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Physics a Profession.

FIFTY years ago, as Sir J. J. Thomson pointed out in his address at the inauguration of the Institute of Physics on April 27, there could be no profession of physics. There were a few laboratories—the oldest at the Royal Institution, founded by Count Rumford; the home of Young and Faraday. They could be counted almost on the fingers of the two hands. There were laboratories in Scottish universities. Kelvin was at work at Glasgow, Tait at Edinburgh, Balfour Stewart at Manchester, Carey Foster was teaching at University College, London, Clifton had built the Clarendon Laboratory at Oxford, Maxwell had only recently resigned his professorship at King's College (he went to Cambridge in 1871). The Cavendish Laboratory was being planned; the seventh Duke of Devonshire had written to the Vice-Chancellor:

"I find in the report . . . recommending the establishment of a professor and demonstrator of experimental physics that the building and apparatus required for this department are estimated to cost 6300*l*.[1] I am desirous to assist the University in carrying this recommendation into effect and shall accordingly be prepared to find the funds required for the building and apparatus."

[1] The tender ultimately accepted for the building was 8450*l*. exclusive of gas, water, and heating.

Maxwell, in his inaugural lecture, said:

"Our principal work in the laboratory must be to acquaint ourselves with all kinds of scientific methods, to compare them and estimate their value. It will, I think, be a result worthy of our University, and more likely to be accomplished here than in any private laboratory, if by the free and full discussion of the relative value of different scientific procedures we succeed in forming a school of scientific criticism, and in assisting the development of the doctrine of method."

Physics as a profession by which numbers of men would earn a livelihood and at the same time revolutionise the daily life of the world by bringing into it knowledge acquired in the laboratory and the study never entered Maxwell's thoughts. Contrast this, as Sir Joseph Thomson did, with the position at present—a university or technical school in almost every great town, each with its well-equipped physical laboratory, its keen professor and its enthusiastic students; laboratories in all the larger schools, with a staff of teachers numbering many hundreds. Fifty years ago the army of physicists was small in numbers; its generals were great men, but they had few of the rank and file to command. To-day our leaders in physical science have under their direction a host of willing privates ready to assist in advancing further the boundaries of knowledge and to adapt the discoveries of those leaders to the requirements of modern life. So it has come about that an Institute of Physics was needed; the attendance at the inaugural meeting on April 27 gave evidence of the need; for there is now a profession of physics.

"Up to the present," to quote from the memorandum explaining the objects and methods of the institute, "the physicist has hardly been recognised as a member of one of the professions. His work will become more and more important in the future both in science and industry, and one of the aims of the institute is to accelerate the growth of the recognition of his position and value. The science of chemistry has already secured a belated recognition of its value to the nation, but there has been so far little or no recognition of the equally important claims of physics and the physicist, although the application of physical knowledge and physical methods is no less vital to the country."

Both Mr. A. J. Balfour and Sir Joseph Thomson placed physics on a higher pedestal than this. Mr. Balfour pointed out that to give a physical explanation of a phenomenon was one of the highest aims of scientific inquiry, and Sir Joseph reminded us that at Cambridge not many years ago chemistry was counted one of the "other branches of physics."

Some of us in the early days of the war faced very sadly the difficulty of bringing home to some of our rulers the value of physics and the services physicists could render. Five years of trial have enforced the lesson, and now it is widely realised that in many branches of work the physicist is able to give much-needed help; opportunities are open to him in widely different directions.

It may be useful to consider some of these. Fifty years ago a few ill-paid teaching posts were all to which a physicist could aspire. The love of discovery, the desire to fathom the secrets of Nature, to give a physical explanation, bringing into their due relation facts apparently disjointed and diverse, brought their own reward—a reward sufficient for the few who devoted their lives to science. And this still remains. Much has been learned; but Nature still hides many secrets, and for the man who can unravel these there is still an ample reward. But the task of nearly all professional physicists must be humbler far. They can assist the work of the discoverer by reducing the period of suspense which, as Sir Joseph Thomson pointed out, will always elapse between a great discovery and the full realisation of its meaning; they can check some of its consequences, indicate the directions in which it may be of service, or carry out supplementary investigations under the guidance of the discoverer himself.

Such would be the work of the young student in the university laboratory training for his profession. And the openings in that profession are very numerous; at present it is hard to find men to fill them; the heads of the fighting Services have realised their need of the physicist. At Woolwich there is a well-equipped laboratory employing a number of highly skilled men. Gunnery has its problems which only the trained physicist can solve, and calls to its assistance the help of the meteorologist and the engineer. Sound ranging, the methods of protection against aircraft, signalling, the use of wireless telegraphy, the application of the petrol engine to transport work, and a host of other questions, are examples of the need for physicists in military work.

Nor is the Air Service less dependent on the physicist. Questions which he alone can solve are brought before every meeting of the Aeronautical Research Committee, and it is only lack of funds that prevents a far larger number of physicists from being employed at the National Physical Laboratory, at Farnborough, and at the other experimental stations of the Air Ministry.

In the Naval Service steps have lately been taken to organise more fully the Scientific Services. Mr. F. E. Smith, the recently appointed Admiralty Director of Scientific Research, gave some account of these at the Cardiff meeting of the British Association last August. For certain parts of the work it is hoped to utilise the opportunities afforded by the National Physical Laboratory, and an admirable building has been erected at Teddington in which work of a strictly confidential character can be carried on; the Signal School at Portsmouth has been reorganised; while work on the petrol engine, commenced during the war under Sir Dugald Clerk at the Imperial College, is now being continued in a special Admiralty laboratory.

Other Government Services, as well as private firms and individuals, have access to the National Physical Laboratory, where, according to the last report, well over one hundred scientific assistants are employed. In the Government service alone there is now engaged a large class of professional physicists occupying permanent posts with reasonable opportunities for advancement and, in the majority of cases, superannuation privileges.

Or, again, turning to another class of service, many, possibly most, of the Research Associations established under the Department of Scientific and Industrial Research depend on the physicist for their investigations, while in almost every large industry there is a demand for his work. The need for an Institute of Physics to care for the professional interests of the large number of men who have already embraced the profession, and of the still larger number who will be required so soon as trade revives, and may hope by their work to advance the date of its revival and to accelerate its progress, is amply proved. The object of the institute will be to promote the efficiency and usefulness of its members by setting up a high standard of professional and general education and knowledge, and by compelling the observance of strict rules of personal conduct as a condition of membership; an association of men who, in Mr. Balfour's words, "by the growth of science and invention would give comfort and leisure where at present discomfort and labour were the only means of producing an article," and by their example would teach our people how to use their leisure.

Polar Exploration.

The Lands of Silence: A History of Arctic and Antarctic Exploration. By Sir Clements R. Markham. Pp. xii + 539. (Cambridge: At the University Press, 1921.) 45*s*. net.

IT is impossible to bear in mind, while reading this book, that it is the posthumous work of an octogenarian. To those who knew the author in the great days of Antarctic propaganda twenty-five years ago, these enthusiastic appreciations of old explorers bring back the very tones of the eager living voice. No man ever did more to make the glories of the past live again in the exploits of his own day, and Sir Clements Markham will always be remembered as a potent force in exploration and an inspiring historian. He was a hero-worshipper whose incense has imparted an undying charm to the memory of the Elizabethan adventurers and to the officers of the Franklin search. He was a stimulating guide to the young explorers whom he sent out to the Antarctic, and he supported the men of his choice through thick and thin, rewarding them while living, and honouring them when dead.

If this beautifully named and stately volume on "The Lands of Silence" were intended merely as a popular series of impressions and appreciations, we could only praise it as the most moving of all the romances of discovery. But it claims to be a history; it is written by the one man whose active life embraced sixty years of experience in polar voyages; it is edited by Dr. F. F. H. Guillemard, whose brilliant studies in historical geography are unrivalled for conscientious completeness; and it is published by the Cambridge University Press. Even so, we would hesitate to look critically into the work of a very old man in his last year of life if the book had shown any signs of senile weakness. The remarkable fact is that it does not. The manner is the manner of Sir Clements Markham in his prime; the opinions are those that he always held and gloried in proclaiming, and we feel that readers of a new generation should be warned that in many cases the opinions of the author are not shared by the majority of polar students.

At the outset the polar regions are defined as extending from the Poles to about 70° latitude, and the sub-Arctic and sub-Antarctic from 70° to 60°. This would exclude a large part of Greenland from the Arctic regions, and remove South Georgia and the Sandwich group from the sub-Antarctic zone; but as no subsequent attention is paid to the definitions they do not in any way limit the scope of the book, which practically treats of all explorations into icy seas.

While Sir Clements Markham deprecates mere record-breaking attempts to reach the Poles, and lays some stress on the importance of studying oceanography, meteorology, geology, and natural history in polar areas, he insists strongly that the real use of polar discovery is as a nursery for seamen, and as an opportunity for naval officers to win distinction in time of peace. Hence his sympathies go out most spontaneously to those explorers who face difficult conditions without the aid of animal or mechanical transport. Polar research, as distinct from exploration, makes a less strong appeal, and the account of the great international circumpolar investigations of 1882 is cold and incomplete. No mention is made of the Antarctic series of stations, which was as important a part of the main scheme as the Arctic series. The indifference to scientific work and workers is often apparent, sometimes in curious ways. While copious biographical details are given even of the most junior naval officers in every British expedition, Sir Douglas Mawson is almost the only British man of science so treated. In many cases the Christian names of men of science are not mentioned, and often not even their initials, so that identification is not always easy, even with the aid of the index. The latter does distinguish "Bruce, Mr.," from "Bruce, Commander Wilfrid," but less than justice is done to Dr. W. S. Bruce in the text, which is sadly restrained as to the work of the *Scotia*. The scientific staff of the Scottish expedition is barely referred to, and Mr. R. C. Mossman, who established the most southerly meteorological station in the world, and kept it going for several years, is not mentioned at all. The expeditions of Capt. Scott are allowed to throw a shadow over those of all other Antarctic explorers.

The committee of the Royal Society, which co-operated with that of the Royal Geographical Society in planning the *Discovery* expedition, was not suffered gladly by Sir Clements, who says: "Yet there was long and tedious opposition from joint committees, special committees, and sub-committees, and all the complicated apparatus which our junction with the Royal Society involved, harder to force a way through than the most impenetrable of ice-packs" (p. 448). The description of the circumstances which led to the selection of the leader and other members of the expedition is suggestive reading when coupled with the note on a chief of the scientific staff "who, perhaps fortunately, did not go out" (pp. 447, 453). A useful chronological supplement containing several names not mentioned in the text, and an excellent bibliography by Mr. Edward Heawood, correct some of the false perspectives created by the very irregular treatment of different expeditions.

In dealing with the northern journeys of Admiral Peary, Sir Clements Markham takes a strongly adverse view of the ability of that explorer to fix his latitude near the Pole (not to put the case too high), and in this he differs from the considered judgment of the Royal Geographical Society, which, after testing the observations, presented Peary with its gold medal, the highest possible mark of confidence in his ability and integrity. The statement on p. 229 as to Kane's description of the Arctic Highlanders being the best ignores the exhaustive anthropometric work of Peary and his comrades during their years of residence with the tribe. At the other end of the earth Borchgrevink is also treated with scant sympathy, and no stress is laid on the fact that he was the first to face the unknown conditions of a winter on Antarctic land, nor is the great discovery of his expedition, that the Ice Barrier of Ross had retreated many miles since it was first seen, even mentioned; but that discovery is actually credited to Scott's expedition (*cf.* pp. 433 and 457).

An obvious oversight in reading the second voyage of Captain Cook has led Sir Clements to credit that great navigator with having been the first to see the continental land of Antarctica when at his extreme south position, 71° 10′ S., in the Pacific. Cook, however, distinctly states that he saw no land on that occasion. He believed in the existence of an Antarctic continent on theoretical grounds, and said that "it is probable we have seen part of it," referring undoubtedly to his discovery of Sandwich Land south-east of his Isle of Georgia; but the insularity of that land was shown by Bellingshausen, to whom, or to Wilkes, or to Dumont D'Urville is due such credit as a first glimpse may convey. As Sir Clements left those parts incomplete, Dr. Guillemard gives a fairly proportioned description of the work of Roald Amundsen in the North-west Passage and at the South Pole, and also of Sir Ernest Shackleton's first expedition. The history stops short of Sir Ernest Shackleton's great adventure in the *Endurance,* which, however, is noted in the chronology.

As to future work, Sir Clements Markham indicates that Antarctic advance can be made most easily along coasts which face the east. This is undoubtedly true in the case of Victoria Land, but we cannot agree with the view that it is so in Graham Land, where the western side has always been found more accessible than the eastern. The lead of an east-facing coast is not a sufficient guide for explorers, and we hold to the view that the next Antarctic expedition should be an effort to circumnavigate Antarctica, following the coast westward from Queen Mary Land to Coats Land, and from the west side of Graham Land to King Edward Land.

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HUGH ROBERT MILL.

Marine Deposits.

Geologie des Meeresbodens. By Prof. K. Andrée. Band ii.: *Die Bodenbeschaffenheit und nutzbare Materialien am Meeresboden.* Pp. xx+689+7 Tafeln. (Leipzig: Gebrüder Borntraeger, 1920.) 92 marks.

THE geology of the sea-floor is geology in the making, since the most important and significant sedimentary rocks were laid down in the sea. The study of these deposits received a great impulse on the discovery by the *Challenger* Expedition of the unexpected contrast between the marginal and deep-sea formations; and the monograph by Murray and Renard on the deep-sea deposits ranks as one of the most epoch-making of the *Challenger* reports. Since its appearance the literature on the subject has been voluminous and is unusually scattered, for the processes of marine sedimentation involve large parts of oceanography, physical geography, and geology, and, in addition to the literature of those sciences, essential data are contained in the serials of applied science and in fugitive newspaper reports.

The geology of modern marine deposits has now been resurveyed by Prof. Andrée in a summary of current knowledge of the subject, which this volume completes by a detailed description of marine deposits and by a short account of their economic products. The work is the more convenient for reference as it follows the ordinarily accepted lines of treatment. The first sections deal with marine sedimentation, including the study of wave action and shore deposits, coastal transport, and the mineralogical and organic structure of shore sands, mud, coral reefs, and serpula-atolls. The salt beds thrown down by the evaporation of sea-water are grouped as the Halmyrogene products, adopting Krummel's term. In this section of the book Prof. Andrée discusses, among other problems, those of coral reefs; and he maintains that recent investigations and the borings at Funafuti have brilliantly and firmly established Darwin's theory of the origin of coral islands. Passing to the coastal shelf, he describes its deposits, and summarises modern evidence as to the depth of current action; he accepts it, on the evidence of the exposure of hard rocks, which he explains as swept clear of mud, at depths of more than 5000 ft.

Such bare rock surfaces, however, have also been explained as due to recent subsidence or submarine eruptions, and are not alone conclusive evidence of deep-sea currents. The wide distribution of land material at sea by the wind is illustrated by a map of the tropical Atlantic showing the areas reached by African dust.

The deposits next outside the continental shelf are classified by Prof. Andrée as the Hemipelagic group, a term introduced by Krummel, of which among the most interesting are the glauconites. The Eupelagic, the typical oceanic deposits, include the true oozes, for which the author conveniently accepts the term Schlamm, although it has been used by Walther and Penck as the equivalent of mud. It would be an advantage if German authorities adopted the author's nomenclature. The account of the abyssal oozes is especially full and instructive. Prof. Andrée discusses various attempts to estimate geological time by the accumulation of the deep-sea deposits; but comparison of the rapid rate indicated, according to Murray, by the covering of cables, with the extremely slow rates claimed by Lohmann, justifies the author's conclusion that the materials are still too scanty and contradictory to yield trustworthy conclusions.

The last sections of the book deal with the stratigraphy of the younger marine deposits and with the quantity of radium in the sediments. An account is given of the geographical distribution of the various deposits in the different oceans, which is illustrated by an excellent map. The final chapter on the useful materials found on the sea-floor is the most scanty and least satisfying; marine placers, for example, are dismissed in a short paragraph. In connection with these deposits, the author remarks, regarding the much discussed question of the occurrence of gold in sea-water, that its presence has not yet been proved; he considers that the belief in gold as a constituent of sea-water rests on gold introduced in the reagents. This conclusion is, however, difficult to reconcile with the blank results obtained by Prof. Liversidge in the test analyses of pure water conducted at the same time as those of his samples of sea-waters.

J. W. GREGORY.

Study of Plants in the Field.

The Outdoor Botanist. By A. R. Horwood. Pp. 284+20 plates. (London: T. Fisher Unwin, Ltd., 1920.) 18*s*. net.

THE sub-title of this work, "A Simple Manual for the Study of British Plants in the Field," indicates the main purpose of the author, who dedicates the book to the veteran field-botanist, Dr. G. Claridge Druce. To achieve a knowledge of the living plant, he says, let the botanist take to the field—*i.e.* be an outdoor botanist. As it is necessary "at the outset to make collections," the first chapter is devoted to methods of collecting and preserving plants, and he gives many useful hints to beginners. The several types of collections which may be made to illustrate particular aspects of the subject are also indicated.

Following this introduction is a long chapter—occupying more than a third of the volume—on ecology, "the study of the homes of plants, their mode of occurrence in the field, and the factors of their environment." Certainly here is an opportunity for the British outdoor botanist; but a perusal of the pages shows that the author has forgotten his original purpose, judging from the frequent references to exotic vegetation—*e.g.* mangrove swamps, desert plants in Asia and Africa, palms and wind witches, and others ranging from the Dead Sea and the Alps to the Badlands of North America. The sources of information here are too obvious for this to be the result of "study in the field," but rather what the author calls "armchair work"; no attempt is made to relate it to British ecology. The subject-matter is confused and rendered difficult for a beginner to appreciate by the absence of proper subject classification and sub-headings, and the whole reads like a collection of brief statements on plant habitats and communities. Misleading and contradictory statements are frequent—*e.g.* on p. 84, and again on p. 103, we are told that "the initial stage of a large proportion of the vegetation of the country is woodland." P. 91: "A wood association on a dry soil is a damp oakwood association." On p. 103 it becomes a "dry oakwood," and a "damp oakwood" is the typical woodland on "clay and loam." P. 74: "There is a pressure exerted by the atmosphere which increases with altitude." P. 76: "In a variety of ways temperature affects plants. It does not vary like the water supply"; and on the same page: "In peaty soils the water is inaccessible to plants, so they are xerophytic."

The author is on rather safer ground in the next chapter, on "Field Botany and Survey Work," and in a discursive way gives some sound advice on note-taking and sketching, and on avoiding work on too wide a field, advice which the author himself evidently finds a difficulty in following. Plans are given illustrating his "field to field" work, and he explains the use of squares, grids, and transects. Chapters follow on "Botany and Scenery," "Phenology," and "Nature Diaries," concluding with "Hints to the Teacher." There is also a glossary which, like much of the work, needs revision—*e.g.* "palisade tissue" is defined as the "water-conducting region of plant stems," and "chloroplasts" as "chlorophyll cells." With one of his dicta we heartily agree: "Since ecology and physiology are really complementary, neither can be adequately studied without the other." The volume includes a number of illustrations from photographs, many of which are exceedingly good and very well reproduced.

An Historical Catalogue of Science.

Bibliotheca Chemico-mathematica. Compiled and annotated by H. Z. and H. C. S. Vol. i. Pp. xii+428+plates. Vol. ii. Pp. 535+plates. (London: Henry Sotheran and Co., 1921.) 3*l.* 3*s.* net.

THE mental stimulus to be gained by the study of the historical development of science is of much greater value than is sometimes supposed. He who follows, from the first vague beginnings, the efforts of many workers in various lands, leading at length to some great discovery, whether of practical or of theoretical significance, will be apt to ask himself the question: "Could not I also do something to help forward human knowledge?"

In this sale catalogue of more than 17,000 books on mathematics, astronomy, physics, chemistry, engineering, meteorology, and allied subjects there is ample opportunity for anyone to pick out books relating to his own special department. The search is rendered easy by a subject index.

The volumes comprise two catalogues arranged according to authors' names, together with a supplement, and give the date of publication and present price of each book. The whole work is due to Heinrich Zeitlinger, of Linz, and it is said to contain nearly all the standard works on the subjects catalogued, and most of the earlier works of historical importance.

The most striking features of the catalogue are the fascinating illustrations. They are prepared by a photographic process, and give excellent facsimile representations of title-pages, woodcuts, diagrams, and letterpress taken from more than one hundred books celebrated either for their quaintness or for having announced new discoveries of far-reaching importance. Thus there is a reproduction, on a reduced scale, of Galileo's famous proposition that a body starting from rest under uniform acceleration moves distances proportional to the square of the time. This is photographed from the first edition of his "Discorsi e Dimostrazioni Matematichi," published at Leyden in 1638. Another facsimile is taken from Huygens's "Traité de la Lumière," published in 1690, in which he deduced the equality of the angles of incidence and reflection from the wave theory of light. There are also beautiful reproductions from Kepler's "Dioptrice," published in 1611. The selected pages discuss the refraction of light and the formation of images by convex lenses.

Some pages from "De Beghinselen der Weeghconst," by Simon Stevinus, of Bruges, published in 1586, contain propositions on the inclined plane (triangle of forces), levers, and laws of floating bodies. Among other curious illustrations, we find an early velocipede from a book by Ovenden, dated 1774, and an early railway train, in which stage coaches, complete with driver, guard with coach-horn, and luggage on the roof, are being drawn by a quaint locomotive with a single rope.

Another illustration shows a very early electric telegraph devised in 1816 by Sir Francis Ronalds. The invention was offered to the Admiralty, but Sir Francis was officially answered that, now the French War was over, telegraphs of any kind were totally unnecessary, and that no other method of signalling than the semaphore then in use would be adopted.

From "Mathematicall Magick," by Bishop Wilkins (1648), are given some illustrations of perpetual motion. As it is obvious that the machines could not work, we wonder whether the Bishop, who was the first secretary to the Royal Society, ever tried the experiments!

These few examples will show that the illustrations are mainly selected to show great discoveries in their early stages.

Maps and Map-reading.

(1) *Topographic Maps and Sketch Mapping.* By Prof. J. K. Finch. Pp. xi+175. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) 13*s.* 6*d.* net.

(2) *Ordnance Survey Maps: Their Meaning and Use. With Descriptions of Typical 1-in. Sheets.* By Dr. Marion I. Newbigin. Second edition. Pp. 128. (Edinburgh: W. and A. K. Johnston, Ltd.; London: Macmillan and Co., Ltd., 1920.) 2*s.* net.

(3) *Notes on Geological Map-reading.* By A. Harker. Pp. 64. (Cambridge: W. Heffer and Sons, Ltd., 1920.) 3*s.* 6*d.* net.

(1) AS the author states in his preface, this book was the outcome of the demand for instruction in map-reading and field sketching

brought about by the war, and it is one of many owing their appearance to the same cause.

Part i. deals with map-reading, and the surveys of the United States, France, and Britain are represented in the maps used as illustrations; contours and elevations, direction, scale, sections and profiles, slopes, visibility problems, and grids are successively dealt with. Part ii. is concerned with the methods of making sketch-maps and field sketches. The instructions for both the making and interpretation of maps are clear and concise, and there is a useful appendix giving a descriptive list of the principal topographic maps of the world.

(2) Miss Newbigin has produced a very readable and suggestive little volume. Following a general introduction indicating the difficulties which the uninitiated may encounter when confronted with the problem of eliciting desired information from an Ordnance map, and indicating the many and varied uses to which such a map may be put by those properly instructed in its mysteries, the author devotes a chapter to methods of studying the maps with and without extraneous aids, such as photographs. Curiously enough, no mention is made of the possible use of photographs taken from the air in connection with the study of Ordnance maps, though the fact that such photographs are not, as yet, generally available may account for the omission.

The main part of the book is made up of descriptions of selected sheets of the 1-in. survey of Britain, and these are well worked out and of much interest as showing the very varied deductions which may be made from the study of a detailed map.

Much is said of the geological structure of the country, but it is to be feared that, in the absence of geological training on the part of the student, and in too many cases on the part of the teacher also, any geological deductions made merely from a study of the configuration of the ground as depicted in the Ordnance maps will be of but little value, and, if relied upon, may give rise to erroneous impressions. Even in the case of Pleistocene geology the reviewer knows only too well that deductions with regard to details of glacial geology drawn from a study of contours have frequently to be abandoned when the matter is studied in the field; and though such deductions may be useful in the formation of tentative hypotheses by the investigator, they would seem to be somewhat dangerous tools to place in the hands of the novice.

(3) The methods advocated by Mr. Harker, though not new, are developed to an unusual extent, and many applications of great interest are elaborated. He shows that, by the reduction of both the slope of the ground and the dip of the strata to "gradients," it is possible to gain much information with regard to the thickness of beds or formations and the general structure of an area depicted upon a map without the use of the protractor.

The surface gradient is determined in the usual way by measuring the distances between contour lines, and that of the stratum under consideration by determining the strike by joining points of equal altitude on the outcrop, and then drawing parallel strike lines through points where the outcrop crosses successive contour lines. These strike lines will be separated by the same vertical interval as the contour lines, and the stratum-gradient obtained by measuring the distance between contiguous strike lines.

The methods are illustrated by a number of interesting and varied examples on a scale of 6 in. to a mile, and for maps on this scale with numerous contour lines they are readily applicable; but in the case of smaller scales, such as the 1-in. maps most generally in use in this country, much difficulty would attend their use, while in the absence of contour lines they are, of course, inapplicable.

The diagrams are good and clear, but in some of these, and also in parts of the letterpress, lucidity has been to some extent sacrificed to the exigencies of space. Thus in paragraph 23 and the accompanying Fig. 18, in which the reader is for the first time introduced to an "unconformable sequence," the unconformity is complicated by "overlap."

As an aid to teachers or in the hands of senior students or engineers, the methods advocated should prove highly instructive, but the reviewer feels that they do not form an adequate substitute for those more generally in use, and would not be readily grasped by the average junior student.

Our Bookshelf.

Zoology: An Elementary Text-book. By Sir A. E. Shipley and Prof. E. W. MacBride. Fourth edition. (Cambridge Zoological Series.) Pp. xx+752. (Cambridge: At the University Press, 1920.) 20*s.* net.

FIVE years have passed since the third edition of this now well-known text-book appeared, and the authors have taken advantage of the opportunity offered by the call for a new edition to place at their readers' disposal some facts and inferences due to certain recent researches. Thus, in the account of Amœba, Jennings's view that the creature's movements are due to contractility of the ectoplasm is followed (in one instance, on p. 17, where this matter is discussed, "endoplasm" seems to have been printed by mistake). Turning to the chapters on Vertebrata, it will be found that Ridewood's researches on the development of vertebræ have been utilised; these, as is pointed out in the preface, "have narrowed the gap between the so-called arco-centra and chorda-centra."

It is somewhat surprising to find that the paired serial excretory tubes of the Peripatids are still described as cœlomiducts, in spite of Miss Glen's recent demonstration (carried out under Prof. MacBride's auspices) that they are true nephridia. This discovery renders the retention of the group in a "class Antennata," which includes also Millipedes, Centipedes, and Insects, the more unnatural.

As one turns over again the pages of this volume the clearness of the descriptions and the excellence of most of the 360 illustrations afford renewed pleasure. In a future edition some of the representations of insects might be replaced with advantage; no entomologist would recognise the figure that does duty for a tsetse-fly.

G. H. C.

Marine Engineering. (*A Text-Book.*) By Engineer-Capt. A. E. Tompkins. Fifth edition, entirely revised. Pp. xi+888. (London: Macmillan and Co., Ltd., 1921.) 36*s.* net.

THE fourth edition of this work was published in 1914, a few weeks before the outbreak of the war, and was reviewed in our columns in September of that year. Owing to the great advancement in marine engineering which has since taken place, a large part of the book has been rewritten, and the remainder thoroughly revised. We are specially glad to notice that room has been found for a fuller consideration of mercantile practice, since this will have the effect of bringing the merits of the volume before a greatly enlarged class of readers. The section on turbines now covers three chapters, and includes an adequate discussion of geared turbines and auxiliaries. The latest systems of oil-firing are included, and the section on internal-combustion engines has been enlarged, and embraces both submarine and mercantile engines.

The labour of revising a comprehensive treatise such as the volume before us must have been very great, especially when one remembers that the author was on war service supervising repairs both at home and in Italy; the experience he gained during those years is embodied in the volume, and adds greatly to its value. The book is primarily intended for sea-going engineers, and therefore contains nothing in the way of mathematical fireworks. Sufficient of the theory is included to enable the reader to understand clearly the principles underlying the working of the machinery which the marine engineer is called upon to handle. The book contains a very large number of admirable drawings, and these, together with the clear descriptions, render the volume of value to all connected with marine engineering. There is also a large collection of examination questions at the end of the volume; numerical answers are appended to these. The impression given by the volume, however, is that it is not a cram book for examinations, but a carefully thought out scheme which will add greatly to the knowledge of the engineer.

An Introduction to Technical Electricity. By S. G. Starling. Pp. xii+181. (London: Macmillan and Co., Ltd., 1921.) 3*s.* 6*d.*

THIS little work is one of a series designed for use in continuation classes and central schools to form the first stage in specialisation in the direction of electro-technics, and necessarily treats the subject in an elementary way intermediate between the scientific and the practical. With the exception of a brief mention of the transformer, only continuous currents are dealt with, and only the very simplest mathematics are required. The conception of the electric current is very suitably introduced by simple experiments with dry cells, and commendable features of the method by which the subject is developed include the leading up to the permanent magnet through the electro-magnet, and making the student familiar with the effects of a current before he is bothered about details as to its production. On the whole, however, we should have liked to see a little more continuity of idea in the treatment. Practical applications are kept well in view all through, and, in spite of a few minor inaccuracies of engineering detail, form adequate illustrations of the principles. Lamps and lighting, motors and dynamos, and the telephone are briefly explained, and, as might be expected, electrostatics do not come within the purview of the treatment.

Set of Cards for Teaching Chemical Formulae and Equations. Devised by Mrs. M. Partington. (London: Baird and Tatlock, Ltd., n.d.) 1*s.* 4*d.*

THIS is a set of cardboard pieces printed with the symbols of elements and common radicles, and graduated in size according to predominant valency; positive radicles are blue, negative are pink. The formulæ are made up by placing the appropriate elements or radicles side by side. It is at once evident that ferrous phosphate is $Fe_3(PO_4)_2$, and ferric phosphate $FePO_4$, while such combinations as CaCl or $NaCl_2$ appear wrong at once. The idea, so far as it goes, is ingenious, and a great deal of facility in writing formulæ may be gained by an exercise more like play than work; moreover, the method cannot foster the misconception of rigid bonds. It is suggested that the pieces can be used to make constitutional formulæ—sulphuryl chloride and sulphuric acid are given as examples. It is evident, however, that before pupils get to the stage of considering the relation of these compounds, the device should have served its purpose.

Letters to the Editor.

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

A Comparison of British and German Volumetric Glassware.

THE manufacture of volumetric glassware was practically non-existent in this country prior to the war. During and since the war it has been developed on an extensive scale. Unfortunately, many users of volumetric apparatus believe that the accuracy of British apparatus is inferior to that of German origin. From our experience at the National Physical Laboratory we are in a position to know that apparatus of British manufacture which has passed our tests is at least as good as any similar standard apparatus of German origin. It appeared to be a matter of some interest, however, to ascertain the degree of accuracy of ordinary grade volumetric apparatus. Consequently in November last samples of glassware were obtained from seven different London firms. Ordinary commercial-grade apparatus was asked for and the purchases were made by a third party, the firms being quite unaware that the apparatus was ultimately destined to be tested at the National Physical Laboratory. The results obtained in the tests on this apparatus are given below. The results marked * relate to apparatus bearing the trade-mark of one or other of the British manufacturers who regularly submit apparatus to the National Physical Laboratory for test. The results marked † refer to two flasks which also bore the trade-mark of a British firm. The remaining results for the November purchase relate to apparatus which had no trade-mark. This was probably mainly British, but some of it possibly of German origin.

In March last purchases were made in a similar manner, but it was stipulated that the apparatus must be of German manufacture. Of about half a dozen firms visited only two would undertake to supply apparatus of German origin. The results for the apparatus obtained from these two firms are given below, along with the results for the apparatus purchased previously:

50 *c.c. Pipettes.* N.P.L. limits:—Class A, ±0·035 c.c. Class B, ±0·06 c.c. Delivery time, 20–40 sec.

Nov. purchase, mainly British	Capacity error, c.c.	0·00	+0·02 *	+0·03	+0·03	−0·03	−0·05 *	+0·07	−0·07	+0·09	+0·12	+0·13	+0·15
	Delivery time, secs.	13	34	24	22	14	52	43	14	27	16	26	15
March purchase, German	Capacity error, c.c.	+0·03	−0·07	−0·08	−0·08	−0·20	−0·23	−0·23	−0·23	−0·27	−0·37		
	Delivery time secs.	18	11	18	12	5	5	5	7	6	11		

25 *c.c. Pipettes.* N.P.L. limits:—Class A, ±0·025 c.c. Class B, ±0·045 c.c. Delivery time, 20–40 sec.

Nov. purchase, mainly British	Capacity error, c.c.	−0·01	+0·01	−0·01	+0·02	+0·04 *	+0·05 *	−0·05 *	−0·07	−0·11	−0·17
	Delivery time, secs.	11	9	8	8	21	36	15	25	14	7
March purchase, German	Capacity error, c.c.	−0·01	+0·01	−0·02	−0·04	−0·04	−0·05	−0·13	−0·16	−0·44	
	Delivery time, secs.	10	13	11	8	10	6	7	5	4	

10 *c.c. Pipettes.* N.P.L. limits:—Class A, ±0·015 c.c. Class B, ±0·03 c.c. Delivery time, 15–30 sec.

Nov. purchase, mainly British	Capacity error, c.c.	+0·005 *	−0·010 *	+0·025 *	−0·030 *	+0·065 *	−0·070	−0·115	−0·160	−0·175
	Delivery time, secs.	24	5	7	19	14	2	3	5	5
March purchase, German	Capacity error, c.c.	+0·015	−0·020	−0·020	−0·020	−0·025	−0·045	−0·055	−0·060	+0·070
	Deliver time, secs.	3	6	4	6	5	4	4	4	6

250 *c.c. Flasks.* N.P.L. limits:—Class A, ±0·08 c.c. Class B, ±0·15 c.c.

Capacity error, c.c.	Nov. purchase, mainly British	0·00 *	+0·01 *	+0·03	−0·04 *	−0·05 *	+0·05 *	+0·12	−0·12 *	+0·15 *	+0·20 *	−0·58 †	−0·61 †
	March purchase, German	+0·08	+0·08	+0·10	+0·10	+0·10	+0·12						

50 *c.c. Burettes* (*with tap*). N.P.L. limits:—Maximum error allowed at any point, and also maximum difference allowed between the errors at any two points:—Class A, ±0·04 c.c. Class B, ±0·07 c.c. The delivery times specified depend on the length occupied by the graduations. For lengths between 50 cm. and 55 cm. the times are:—Class A, 110–220 sec.; Class B, 75–220 sec.

November purchase, mainly British.							March purchase, German.						
Capacity errors, c.c.					Difference between smallest and largest error, c.c.	Delivery time, secs.	Capacity errors, c.c.					Difference between largest and smallest errors, c.c.	Delivery time, secs.
10 c.c.	20 c.c.	30 c.c.	40 c.c.	50 c.c.			10 c.c.	20 c.c.	30 c.c.	40 c.c.	50 c.c.		
* −0·01	0·00	−0·02	0·00	0·00	0·02	51	−0·01	−0·07	−0·12	−0·13	−0·12	0·12	14
* −0·05	−0·05	−0·09	−0·10	−0·05	0·05	69	−0·05	−0·09	−0·07	−0·13	−0·20	0·15	78
+0·07	+0·09	+0·08	+0·14	+0·10	0·07	52							
−0·04	−0·01	−0·03	−0·11	−0·13	0·12	24	−0·02	−0·06	−0·10	−0·14	−0·18	0·16	24
−0·04	−0·12	−0·14	−0·14	−0·17	0·13	39	−0·02	−0·10	−0·10	−0·11	−0·20	0·18	43
−0·08	−0·10	−0·14	−0·25	−0·27	0·19	21							
+0·13	−0·09	−0·16	−0·14	−0·10	0·29	58							

The results marked *, *i.e.* those which relate to apparatus bearing well-known British trade-marks, are very satisfactory. Of the twenty pieces of apparatus thus marked only five have capacity errors in excess of the Class B limits, and of these four have errors but slightly in excess of the Class B limits, the only really unsatisfactory piece of apparatus being the 10 c.c. pipette in error by +0·065 c.c.

The results for the German apparatus clearly show that such apparatus cannot be accepted on trust, as many users appear to imagine. For example, the 50 c.c. German pipettes include a number which have excessive errors and delivery times so short as to render them likely to give inconsistent results. The ordinary grade German apparatus has no claim to superior accuracy as compared with ordinary grade British apparatus.

The results obtained indicate that where accuracy is of importance apparatus should be tested before use, and that in cases where untested apparatus is to be used the safest procedure is to obtain apparatus bearing the trade-mark of British firms which make a feature of supplying apparatus marked by the National Physical Laboratory. Their experience in the manufacture of such apparatus is clearly reflected in the increased accuracy of their ordinary output as compared with apparatus not bearing their trade-marks.

J. E. PETAVEL,
Director.

The National Physical Laboratory, April 16.

Young's Interference Experiment.

IN connection with Dr. Houstoun's letter on this subject in NATURE of April 28, I may direct attention to a note by my father "On a Simple Interference Arrangement" (British Association Report, pp. 703–4, 1893; Collected Works, vol. iv., p. 76). The arrangement described is a tube with a single slit at one end and a double slit at the other. The double slit is ruled on silvered glass, and is much closer than Dr. Houstoun describes—about 1/10 mm., as nearly as I can estimate without pulling the apparatus to pieces. The slit at the other end is about 0·35 mm., and the length of the tube about 31 cm. The apparatus as originally described was intended to be used with the double slit placed close to the eye and the tube directed to a source of light such as a gas flame or the sky. Interference bands are then well seen.

About two years before my father's death I remember asking him whether he had ever seen Young's experiment tried. He replied in the negative, and suggested trying it. It was during a vacation, and I had leisure to do so. In looking round for the necessary appliances it occurred to me that the "simple interference arrangement" was just what was wanted. I placed it in a hole in the shutter of a dark room, with a heliostat outside, so that the single slit was backed by the reflected image of the sun. No lenses were used. The interference bands were then admirably seen on a card held, so far as I remember, 2 ft. or 3 ft. away from the double slit. My father remarked that he did not remember to have seen interference bands projected so well before with any arrangement.

It will be noticed that this use of the apparatus is not materially different in principle from the original subjective use. To pass from the one arrangement to the other we have only to substitute the card screen for the retina and to increase the focal length of the lens of the eye without limit, at the same time removing the screen to a great distance.

RAYLEIGH.

Terling Place, Witham, Essex, April 29.

An Addition to the British Fauna (*Rhynchodemus Scharffi*).

ONE of my students, Mr. G. D. Morison, has brought me a very interesting Planarian worm which he found this morning under rotten wood in a coal-shed in a garden at Chiswick. This is the fourth specimen which he has found in the same place, where they were associated with slugs, upon which they may have been feeding. The other three specimens were found a week ago. A living specimen was measured up to 6 cm. in length when crawling. In this condition the worm is very slender; when contracted it is naturally a good deal thicker and exhibits a transverse wrinkling. The colour in life is usually bright yellow, without pattern, but with a dusky anterior tip bearing the two small eyes close to the extremity. Mr. Morison tells me, however, that one specimen was salmon-pink.

The specimen submitted to me (alive) agrees very closely with von Graff's description and figures of his *Rhynchodemus Scharffi*, and I have no hesitation in identifying it with that species, which was first discovered in 1894 in a Dublin garden, and has not, so far as I am aware, been recorded since. Von Graff at first supposed that the species had been introduced from the tropics, but afterwards adopted Dr. Scharff's view that it is indigenous to Ireland. It is hard to say which of the two views is supported by the discovery of the same species in London. Mr. Morison assures me that no plants have been introduced into his garden for at least three years. Probably the worm will be found in other parts of London, and it would be worth while to search carefully for it at Kew.

It will be remembered that another land Planarian, *Placocephalus* (*Bipalium*) *kewense*, was first found at Kew and is admittedly exotic, having since been found in many parts of the world, especially in the neighbourhood of botanic gardens, being distributed, doubtless, with plants. There is, however, one undoubtedly indigenous British land Planarian, *Rhynchodemus terrestris,* which differs from *R. Scharffi* in its grey colour and much smaller size. This worm is rarely met with unless carefully searched for, and it is quite possible that *R. Scharffi* also will yet be found in situations less open to suspicion than Dublin and London gardens. I hope that the publication of this letter may lead to such a discovery.

ARTHUR DENDY.
Zoological Department, University of London
(King's College), April 28.

Method of Cutting Sections of Cotton Hairs.

No satisfactory method of cutting sections of cotton hairs and similar material appears to have been published; the technique recommended by Balls ("Development and Properties of Raw Cotton," p. 176) is open to the objection that the hairs pull away from the wax at the cutting surface, thus losing the rigidity which is essential for good sections, and attempts made to remedy this by coating the hairs with a paraffin-wax different from that of the main embedding mass did not produce any marked increase in adhesion; while embedding in celloidin or cellulose acetate gave very unsatisfactory results by reason of the contraction and distortion of the hairs.

The method finally evolved was modified from that of Breckner (*Z. f. Wiss. Mikr.*, vol. xxv., p. 29, 1909), and is dependent on the use of a coating of celloidin to procure greater adhesion to the wax embedding mass. The cotton, fixed in a small wire frame for greater convenience, is "wetted out" with absolute alcohol and placed in a dilute syrupy solution of celloidin in alcohol-ether, which is allowed to evaporate to half or a third of its volume. The material is then taken out, squeezed between the fingers to remove excess of fluid, and placed in a chloroform solution of paraffin-wax for two hours, after which the cotton is cut from the frame, transferred to paraffin, and quickly embedded. Sections should be cut without delay, as the material appreciably toughens within twenty-four hours, but blocks can be stored in water for an indefinite time if a trace of antiseptic be added.

Cutting should preferably be done on a sliding microtome, but 5μ sections have been made without difficulty on a Leitz "Minot," with the knife oblique. A useful way of dealing with the sections when cut is to dissolve away the wax and celloidin in alcohol-ether and centrifuge. If the sections are thin enough a very large proportion will be the right way up when spread upon the slide.

Since this letter was written a description of a method for embedding cotton yarns and fabrics has been published in the Journal of the Textile Institute (April, 1921) by Willows and Alexander. Opportunity has not so far arisen for comparative tests of the two techniques.

H. J. DENHAM.
Botanical Laboratory, British Cotton Industry
Research Association, Shirley Institute,
Didsbury, April 20.

An Unknown Organism in Flint.

A PIT dug in my garden here exposed about 12 ft. of the usual Thames Valley gravels and sands, at which depth (approximately) what local excavators call "shingle" was reached. This is composed chiefly of flint-stones mixed with sand, and lacks the binding properties of the gravel above. The rule is to stop digging for gravel when the "shingle" appears.

Pending a detailed description which will be given elsewhere, I may say that the gravels consist of various types of flint and different kinds of sandstones, together with quartzites, vein quartz, Lydian stone, chert with spicules, fragments of sarsen, etc., some of these being of sufficient interest to warrant the cutting of micro-sections. During the last few years some hundreds of these stones have been washed and examined by the platyscopic lens and microscope for surface features.

On one of the flint fragments I discovered a minute fossil organism resembling some form of insect, the like of which, so far as I can ascertain, has not been seen in flint before. There is a head with curious projections on either side, club-shaped antennæ which

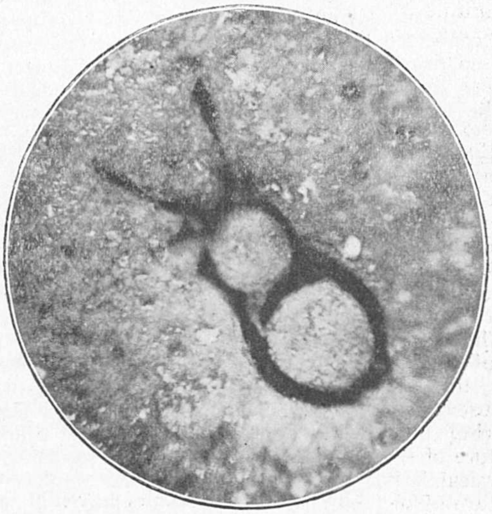

FIG. 1.—Photomicrograph of an apparent organism in flint. Magnification, about 30 diameters.

are segmented, a thorax, and an abdomen, but no legs are visible.

The chitinous parts appear to be silicified, and show up well when moistened under a low power, but there are reasons why it is a very difficult object to photograph satisfactorily in the ordinary way. The one I enclose was kindly taken for me by Mr. A. Cornell with a super-microscope, the magnification being about 30 diameters (Fig. 1).

It is difficult to understand how an organism of such delicate structure could have been preserved in flint unless its entombment occurred while the flint was in a colloid condition. If any reader of NATURE can say what the organism is, I shall feel grateful.

C. CARUS-WILSON.
Strawberry Hill, Middlesex

Ocean Tides.

WHILE not considering myself qualified to question the gain to scientific knowledge on the theoretical side which might accrue from the investigation of ocean tides, such as Prof. Proudman suggested in his article in NATURE of April 7, p. 176, I yet venture the opinion that for practical, utilitarian purposes co-ordinated study of the tidal phenomena at coastal observatories would be of greater value. The official predictions, based on extended local observations, attain such a remarkable degree of accuracy that the error is, in what we may term by courtesy normal weather, negligible. The trouble is that it is the unexpected, in the form of wind and barometrical change at critical times, that happens, and we have no formulæ at hand with which to apply corrections to predictions.

The question is: If, by study and observation, it should prove possible to discover such formulæ, could we communicate the results to those concerned on incoming ships and in harbour in time to be of service? So far as the effect of barometer gradients is concerned the answer will probably be "Yes, with wireless telegraphy at our command." But the wind factor is a different matter, its influence being dependent upon the change in direction and velocity *relative* to the time of high water within the area of influence.

While barometric pressure will be effective to the same extent at any point of the water surface of the globe, I think it may safely be asserted that the influence of the wind on the primary ocean tides will be negligible as compared with its effect on coastal tides, enormously as they are increased by comparison, and converted into currents by land resistance and by the opposing head of outflowing rivers, often enhanced by rainfall—another factor to be considered.

The lack of encouragement of scientific investigation in this particular department of science is most striking.

A. C. TENNANT.

I AM indebted to the Editor for permission to comment on Mr. Tennant's letter. It does not call into question any of the statements of my article, for I did not deny the great importance at the present time of a study of the tidal phenomena at coastal observatories. As a matter of fact, practically all the resources of this institute are at present devoted to this kind of study.

As regards the prediction of coastal tides, I may say, by way of example, that for Liverpool the discrepancies between observation and official prediction of high water possess an oscillation which reaches a foot in range. The prediction-error of any high water differs, as a rule, much more from that of the next high water than it does from that of the next but one. Further, when the complete tide is predicted from the results of all the analyses that have been made, there is a discrepancy with observation which possesses semi-diurnal and quarter-diurnal oscillations often exceeding a foot in range. The periodicity of these discrepancies indicates an astronomical origin, but as they are of a very complicated nature and are superposed on the irregular weather-effects, it is often impossible at present to say exactly how much of any discrepancy is due to departure from "normal weather." Herein lies one of the difficulties of studying the weather-effects.

J. PROUDMAN.

Tidal Institute, Liverpool.

The Physical Continuity of "Space."

THE turn which the letter of Dr. Jeffreys (NATURE, April 28) has given to the "'space' or 'æther'?" controversy may easily obscure the real point at issue. The clear import of my letters of April 7 and 21, and, I think also, of Prof. Eddington's forceful appreciation of the questions involved (April 14), is that the physical universe—at bottom a universe of energy—must in some form or other be continuously extensive, and cannot be discrete. The metaphysical necessity is that something physical must *constitute* interstellar "space." The contention is not primarily one of defending the electro-magnetic æther, or any other specific æther, but of providing for extension throughout the universe. If those who doubt or deny the existence of a connecting medium in any sense hitherto understood, can show that light, electricity, gravitation, or any other manifestation of energy themselves constitute the regions of interstellar, or interplanetary, "space" in such a way that extension is always preserved, then I, for one, am perfectly satisfied. But let them not be responsible for language, or omissions of language, that inevitably lead to the implication of "emptiness" in a universe of transferable energy. It is when the outstanding question of paramount interest from the points of view of both physics and metaphysics, namely, "Of what does interstellar 'space' consist?" is ignored that the situation becomes intolerable.

Dr. Jeffreys will agree that if relativity has indicated anything clearly it is that no rigid line of demarcation can be drawn between the provinces of physics and metaphysics. As Prof. Eddington indicated very clearly in his letter of April 14, in the last resort we are driven back on a theory of extension; and it is surely incumbent upon those who say that the mechanics of the universe can be explained without a physical æther to show how the conception of "empty space" as an entity in Nature, which not only amounts to a contradiction in terms, but is also entirely discountenanced by the theory of relativity itself, can be avoided.

It should be observed that I assume the ultimate entity in the universe to be energy—that physical power which, in effecting changes on a background of extension, introduces the idea of motion, and hence of velocity and time. And since inertia is now known to be a property of energy, the ground is actually prepared for those who shout "Away with the æther!" to save an awkward situation by representing the whole of this universe of energy in a theory of extension.

L. C. W. BONACINA.

May 1.

Logs and Antilogs.

ON p. 7 of NATURE of March 3 a recommendation is mentioned that when taking out the number corresponding to a logarithm a table of antilogs should be used. Assuming the usual seven-figure work, the opposite course should be followed, because the computer can then write down five figures at once and add the remaining two by means of the difference table; no addition or crossing out is required. Thus for the logarithm 0·1234567 the log table gives 1·3287 for 1234269, and 298 in the 327 difference table gives 91, so we write 1328791. *Vice versa,* having 1·328791, what is the logarithm? The anti-table gives 12345 at once, whilst the difference 20 gives 67, so that we write 1234567. No figure requires alteration and the work is done with a minimum of mental strain.

As one who does a great deal of computation, let me state that my order of preference for usual work is Cotsworth's multiplication table (which is better than Crelle's), then the Triumphator or Brunsviga calculating machine, then Shortrede's table, which in one volume gives both logs and antilogs; but special tables can also be usefully employed. Thus Bottomley for all four-figure work is still the best; for multiplying two figures by four, Peters's table; and for two figures by three, Zimmermann's.

Amongst the indispensable tables should be included Zech's addition and subtraction log table, which is easy to use and accurate. For eight-figure work the best, if not the only, tables are Bauschinger's and Peters's. R. T. A. I.

Johannesburg, April 4.

The Colour of Primrose Flowers.

NATURE of April 1, 1920, p. 139, published an interesting article on the colouring matters of plants. From this article it would appear that the normal pale yellow colour of the primrose is due to a yellow sap pigment, a derivative of flavone. Primroses, however, are found with a range in colour from deep red to almost white. Can any of your readers say to what this variation from the normal is due, and whether the colours are anthocyans?

Much attention has recently been directed in the local Press to this variation in colour, and many attempts made to account for it. It is common in parts of Pembrokeshire, but is usually confined to a particular bank or field in the district.

It is said to occur only in the Coal Measures, and is probably due to the presence of iron in the soil or to insect action causing a cross with polyanthus. It is even stated that to plant a normal primrose upside down causes a red coloration.

A possible theory may be the cross from polyanthus, but it is generally agreed that but one insect affects primroses, called sometimes a "primrose sprite," resembling a bumble-bee, but with a long, characteristic proboscis. The late Lord Avebury in "British Flowering Plants" suggests a moth.

These variations are, however, found remote from cultivation, and I have not been able to ascertain a single instance of a red primrose in a cultivated garden unless planted there from a hedgebank, when it attains an even deeper red, and often develops the umbel of the polyanthus.

R. O. LATHAM.

Pembrokeshire, April 12.

IN reply to Major Latham's inquiry, I may say that in the red primroses which I have examined the colour is undoubtedly due to an anthocyan pigment. Pale yellow or white primroses contain no anthocyan. Flavonols rarely give rise to much colour, and do so only when present as salts (phenolates) of metals. Even in primroses there is often a very small amount of a yellow plastid pigment present which produces proportionately far greater colour effect than the flavonol derivatives that exist in the sap. The conversion of the yellow sap pigments (flavonols) to anthocyans is a process of reduction. Exactly what causes such a change to take place in plant-life is not yet fully determined, but the work of Prof. Keeble and of Miss Wheldale has done much towards elucidating this matter. When, as I boy, I tried the method of planting primroses upside down to get red or variegated varieties (the country folk in the district believed that this method was effective), it was never a success. In general, it would appear that new colour varieties in flowers are most frequently produced as a result of crossing. Seeds of red or white varieties of primrose are offered by some seedsmen.

THE WRITER OF THE ARTICLE.

The Resonance Theory of Hearing.

IN the absence of a reply to Dr. Hartridge (NATURE, April 14, p. 204) from a more authoritative quarter, I venture to suggest that his expression "a continuous musical note" is not appropriate to the phenomenon discussed. By changing the time-interval between successive siren-puffs from τ to $\frac{3}{2}\tau$, the experimenter interrupts the periodicity of the vibrations producing the fundamental tone of his note, and the consequent *discontinuity* in the note is perceived by his ear as something indistinguishable from a beat (which, physically, it is not). According to the "dead beat" view, this effect in the sensorium is due to the last vibration of the interrupted series, because there is no resonator in the cochlea which by continuing to vibrate would make the temporary interruption imperceptible. If the interruption-effect were lacking when the resumed vibrations are not of precisely opposite phase, there would be something in Dr. Hartridge's argument.

Though at present reluctant to contribute further to what Prof. McKendrick has called an interminable discussion, I hope that the *lioretgraphe* which Mr. Daniel Jones is shortly to install in the phonetics laboratory in this college will bring a termination within view. W. PERRETT.

University College, Gower Street,
London, W.C.1, April 28.

Biological Terminology.

I DO not wish to be drawn into the whirlwind of controversy raised by Sir Archdall Reid; only from a respectful distance would I protest against his *obiter dictum* that "systematic zoology and botany are purely descriptive" as opposed to "interpretative science." Every specific name is of itself an interpretation; "*Equus asinus*" is a statement that the creature is closely akin to "*Equus caballus*." The classification of any group, and still more the classification of a whole kingdom, contains a long chain of interpretations. Modern systematic work—with which Sir Archdall Reid must surely be ill acquainted—deals at every step with "problems of heredity, evolution, development, and the like." There may still be a few people who confine their energies to pure description of the objects in front of them; but why call them systematic zoologists or botanists? F. A. BATHER.

Experimental Geometry.

DR. JEFFREYS (NATURE, April 28, p. 267) claims that "experimental geometry" is a contradiction in terms. I protest vehemently. "Geometry" means the measurement of the earth. How can you measure the earth without experiment? It is "logical geometry" that is the contradiction in terms; it is that expression which has introduced all this confusion between logic and experiment; and it is the mathematicians, not the experimenters, who have stolen the word and perverted it from its proper meaning.

NORMAN R. CAMPBELL.

19 Holland Park, W.11.

Italian Meteorites.

As reference was made in NATURE of March 31 (p. 149) to records of Italian aerolites, it may be noted that there were fourteen falls of stones or earth in central Italy recorded in forty years from 208–168 B.C. It appears that the earth was then passing through a region of aerolites. The references in Livy are under the years A.U.C. 545, 548, 550, 558, 559, 561, 564, 567, 575, 579, 580, 583, 584, and 585.

W. M. F. PETRIE.

5 Cannon Place, N.W.3.

The Centenary of Napoleon.

By ENG.-COMDR. EDGAR C. SMITH, O.B.E., R.N.

THE death of Napoleon occurred one hundred years ago to-day, and the celebration of his centenary now taking place in France will doubtless include some recognition of the encouragement and patronage given by Napoleon to scientific discovery and mechanical invention. Many rulers have availed themselves of the services of mathematicians at their courts, and not a few learned societies owe their existence to the support of kings and princes. An Academy of Sciences at St. Petersburg was the dream of Peter the Great; the golden era of the Prussian Academy was the reign of Frederick the Great. Napoleon, as keen in his appreciation of the value of science as either Peter or Frederick, had not, like them, to seek abroad for men of talent. More than fortunate in this respect, his accession to power coincided with the rise of such institutions as the Ecole Polytechnique, the Ecole Normale, and the Institut de France, and he found among his contemporaries astronomers, physicists, chemists, and naturalists of the highest rank. Distinguished at school for his mathematical ability, he became a member of the Institute, attended altogether thirty-eight of its sittings, rearranged the various classes, and designed the uniform of its members. It was he who housed the Institute in the Palais des Quatre Nations. During the Egyptian campaign he was wont to sign his proclamations "Member of the Institute, General-in-Chief of the Army of the East."

Among the favourite associates of Napoleon at this time were the savants Monge and Berthollet. It was Monge who carried the Treaty of Campo Formio back to France, and he and Berthollet were among the spoilers detailed to rob the Italian museums and galleries. During the winter of 1797–98 Napoleon attended Berthollet's lectures on chemistry, and it was probably Berthollet's suggestion that a body of savants should accompany the Egyptian expedition. When the fleet left Toulon in May, 1798, besides his generals and secretaries, Napoleon had in his suite two astronomers, four geometers, a geologist, a chemist, three naturalists, and six civil engineers. On the voyage, tired of discussions on religion, government, and strategy, he would raise such questions as whether the planets were inhabited; how old was the earth; would the earth be destroyed by fire or water?

Upon arriving in Egypt Napoleon at once set his corps of savants to work. Undaunted by the destruction of the French fleet by Nelson on August 1, 1798, three weeks later, at Cairo, he inaugurated, with considerable ceremony, the short-lived Institute of Egypt. Monge was president, Fourier, the mathematician, secretary, and Napoleon vice-president. The members were employed on geodetic operations, astronomical work, the study of the Nile, the improvement of crops, and the manufacture of munitions. When the victories of Desaix threw open the middle reaches of the Nile, the artists and engineers of the Western world gazed for the first time upon the wonders of Memphis. Many of the portable relics transferred first to Cairo and then to Alexandria now rest in the British Museum. Our possession of the Rosetta stone dates from about this time. The story of the geologist Dolomieu rightly belongs to the Egyptian campaign. Having suffered the hardships of war, he sailed for home, only to be shipwrecked, and then imprisoned by the King of Naples. Bearing his confinement with philosophic resignation, he continued to write his memoirs on the margins of books. Sir Joseph Banks was foremost among those who tried to secure his release, but it was Napoleon's insertion of a special clause in the treaty after Marengo that gained Dolomieu his liberty.

During the Consulate and Empire Napoleon gave many proofs of his interest in the progress of science, but no discovery raised his enthusiasm higher than did Volta's. The invention of the pile had been made known by Volta's letters to Banks. No sooner did Napoleon hear of it than he called the famous physicist to Paris, attended a special sitting of the Institute, and caused a gold medal to be struck bearing the inscription "A Volta, séance du 11. Frimaire, An IX." He afterwards made Volta a senator and a count, gave him a sum of money, and presented him with a sword of honour. The sword and a picture of Volta explaining his battery to Napoleon were among the relics saved from the disastrous fire at the Volta Centenary Exhibition at Como in 1899. The First Consul further showed his interest by founding a prize of 3000 francs "for the best experiment which shall be made in the course of each year on the galvanic fluid." The acceptance of this prize by Davy in 1808 for his discovery of sodium and potassium roused a good deal of feeling in this country, some folk going so far as to consider Davy almost a traitor. Much the same experience had befallen Banks, when, with Sir W. Herschel, Cavendish, Maskelyne, and Priestley, he had been elected one of the first foreign associates of the Institute.

Another scientific investigator who gained the ear of Napoleon was Chladni, the founder of the science of acoustics. Chladni, who had spent some years travelling and lecturing, arrived in Paris in 1808. The Emperor, struck with the importance of his discoveries, called for a report from his French savants, and afterwards gave 6000 francs for the translation of Chladni's treatise. Whether it was in the domain of astronomy, of chemistry, or of physiology, Napoleon seldom failed to show his respect for work of more than usual merit. His interest in the anatomical models of Fontana, in the mathematical work of Mascheroni, and in the discoveries of Spallanzani, and his encouragement of researches on indigo and beetroot, are a few instances which illustrate this point. To them might be added his admiration for Jenner. It was Napoleon who placed a memorial in one of the wards of the Hôtel-Dieu to the memory of Dessault and Bichat.

Industrial progress and efficiency no less than scientific discovery appealed to Napoleon. Jacquard's loom of 1801 at first brought little but opposition and trouble to the inventor, the Industrial Council of Lyons even passing a formal condemnation of the loom. His ingenuity being remarked by Carnot and then by Napoleon, Jacquard was for a time employed in the Conservatoire des Arts et Métiers, and by a decree dated at Berlin, October 27, 1806, Napoleon gave him a pension of 6000 francs and a premium of 50 francs for each loom erected. In 1810 the Emperor offered a reward of a million francs to the inventor who should first bring into successful operation a method of spinning flax by machinery. The problem was solved by the distinguished mechanician and practical chemist Philippe de Girard, to whom France was indebted for successful work in various directions. Girard, however, died in 1845 without receiving the reward, though his descendants were recompensed.

The great public works initiated by Napoleon were as remarkable as his educational schemes. For the improvement of harbours and rivers, and for the construction of bridges, canals, and roads, he found in the Corps des Ponts et Chaussées, established in 1747, a body of technically trained public servants such as no other country in the world then possessed. The canals connected with the Rhine and Rhône, the Saône, the Seine, the Ourcq, and the Oise; the works at Dunkirk, Havre, Dieppe, Honfleur, and Brest; and the breakwater at Cherbourg, were all carried out by this famous corps, the records of which are enriched with the names of Perronet, Girard, Gauthey, Navier, and Prony. At Malmaison one day Napoleon said to Chaptal: "I intend to make Paris the most beautiful capital in the world. . . . What are your plans for giving water to Paris?" Chaptal gave the alternatives—artesian wells or bringing the water from the River Ourcq. "I adopt the latter plan; go home and order five hundred men to set to work to-morrow at La Villette to dig the canal." "Such," says Dr. Holland Rose, "was the inception of a great public work which cost more than half a million sterling."

The many men of science upon whom Napoleon bestowed honours were scarcely more numerous than those he employed in positions of trust. The story of Laplace as Minister of the Interior is well known. Given the post at his own request, six weeks later he was removed because he carried into the art of government the principles of the infinitesimal calculus. Sixteen years before this Laplace had been young Bonaparte's examiner at his entrance into the army. Guyton de Morveau, Cuvier, Fourcroy, Chaptal, and Lacépède were among those who held public offices. Lacépède was for some time President of the Senate. With Laplace he was not unlike the Vicar of Bray, and found no difficulty in agreeing with any Government—revolutionary, republican, monarchical, or imperial. It may be it was of him Napoleon was thinking when one day he bitterly remarked: "Men deserve the contempt with which they inspire me. I have only to put some gold lace on the coat of my virtuous republicans and they immediately become just what I wish them."

Of a different stamp were Cuvier and Chaptal. Cuvier, whose reputation as a naturalist and organising ability as secretary to the Institute could not fail to attract Napoleon's attention, was appointed one of the six inspectors to establish lycées in the principal towns. He afterwards did valuable work in the reorganisation of some of the European universities. Among all the public men Napoleon drew from the world of science, however, none stood higher in general esteem than Chaptal. Released from prison during the Revolution to superintend the manufacture of gunpowder, the rise of Napoleon opened for him a career of great public usefulness. Succeeding Lucien Bonaparte as Minister of the Interior, he founded trade schools, encouraged arts and manufactures, and assisted the Chambers of Commerce. Though his loyalty to Napoleon led to his being deprived of his peerage at the Restoration, he continued to devote his vast knowledge and great talents to the service of France, showing always that consistency, moderation, and desire for the common good for which he had been conspicuous under the *régime* of Napoleon.

"The true conquests, the only conquests which cost no regrets, are those achieved over ignorance," Napoleon once said. Such are the conquests of science, and no results of Napoleon's life's work are more enduring or beneficent than those due to his encouragement of scientific education and scientific discovery and to his promotion of great public works.

The Annular Eclipse of April 8.

By MAJOR W. J. S. LOCKYER.

THE best positions to observe the annular eclipse of the sun on April 8 were to the extreme north-west of Scotland, and it was the intention of Lt.-Col. F. K. McClean and myself to take up a station somewhere in that part. Owing to the miners' stoppage Col. McClean was unable to take the journey, but in London I succeeded in finding two volunteers in Mr. Patrick Alexander and Mr. Allan Young, and we started off for Durness (Sutherland), near the entrance to Loch Eriboll, on the evening of April 5. Reaching Lairg the following afternoon, we heard that the inn at Durness had been burnt down several years previously, so we proceeded by motor-car along the beautiful side of Loch Shin, and arrived at a place called Rhiconich, at the southernmost end of Loch Inchard. Finding that the hills around were not sufficiently high to obstruct the view of the annular eclipse, we decided to stay at the excellent hotel there for the event.

We took with us two instruments—one a whole-plate camera fitted with a telephoto lens, and the other a small Thorpe grating slit spectroscope fitted up for taking photographs of the spectra of the limbs where they grazed each other. The spectroscopic part consisted of a box to act as a collimator tube, fitted with a 1-in. slit at one end, and a Dallmeyer rapid rectilinear lens at the other. The camera part was also a box arranged to take plate-holders 5 in. by 4 in. at one end, and a Dallmeyer rapid rectilinear lens fitted with a Thorpe grating in front of it. The latter box was placed obliquely with regard to the collimator box, and so adjusted that both the first- and second-order spectra fell on the photographic plate. This spectroscopic arrangement was fitted on a long, stiff plank, made in two sections for the sake of portability, and at the other end were fitted two guides to which was screwed the small framework for carrying a $3\frac{3}{4}$-in. objective.

Arrangements were made for propping up this plank in the direction of the sun so that the solar image fell on the slit of the collimator. A screw adjustment was adapted for raising the plank as the sun increased its altitude. The whole of this outfit can be seen in Fig. 1, as it was in position on the ground outside the Rhiconich Hotel during the first phases of the eclipse. The whole-plate camera can also be seen a little further away.

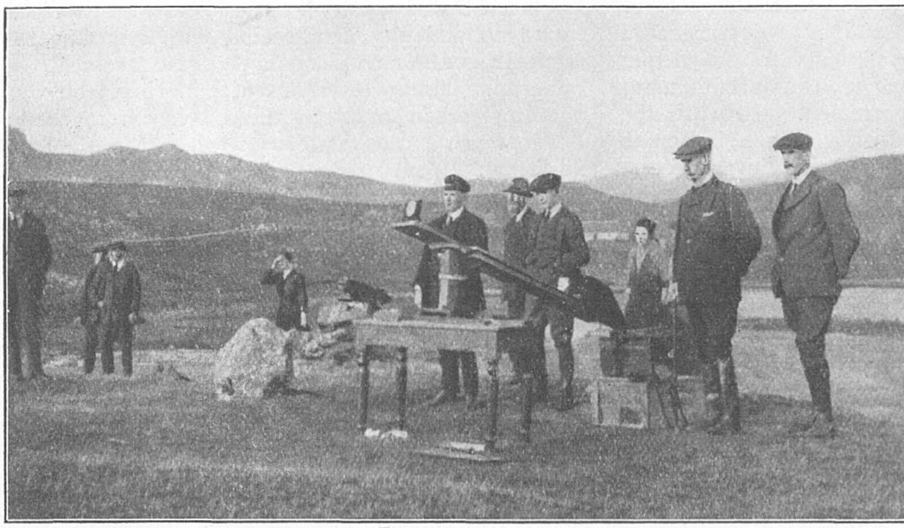

FIG. 1.—Our instruments in the ground adjoining the Rhiconich Hotel. Photograph taken during the first partial phase.

I had to work the instrument completely by myself; but if I had had some skilled assistance I should have obtained more spectra of the chromosphere. The difficulty was to get the right portions of the crescent exactly on the slit, and then to draw the dark slide and make the exposure, the sun moving all the time across the slit.

The only photograph of the chromosphere is that shown in Fig. 2. This is an enlargement from the first order of one of the spectra, and shows amongst others the bright hydrogen and calcium lines. Each plate exposed gave four spectra—two in each order and two at each limb (upper and lower) of the sun.

Fig. 3 shows one of the numerous photographs taken with the whole-plate camera by Mr. Allan Young. It was exposed a little before the time of mid-annularity. The eclipse took place under nearly perfect conditions, but there must have been some very high cirrus haze, because during the first partial phases a halo became visible round the sun. This became brighter as the eclipse progressed, and showed the spectrum colours distinctly. At two points of this halo, about east and west, mock suns were seen, and these extended right and left and formed practically two spectra lying horizontally, the colours being very distinct. These phenomena were observed by all those who gathered round our camp.

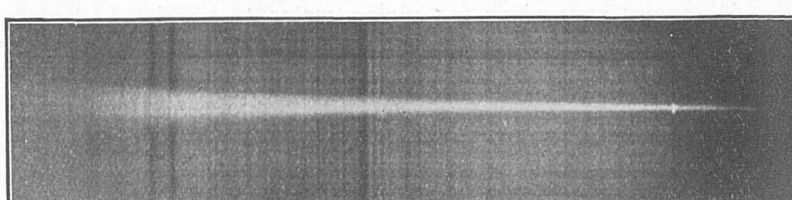

FIG. 2.—The spectrum of the chromosphere, showing, amongst other bright lines, the lines of hydrogen and calcium.

With regard to the visibility of the planets and stars, though I showed everyone a map of the positions of possible visible objects, no one re-

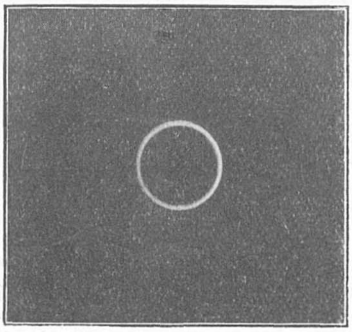

FIG. 3—The eclipse just before the mid-phase of annularity.

corded the appearance of any. At Sidmouth I have been able to see Venus easily in the day-time by looking along a telescope which was pointing to its position in the sky, but I could not pick it up without such help. During the eclipse I looked specially for it, but failed to see it; this may have been due to the haze referred to above. While we had no thermometer to record the temperature, the chilliness was so pronounced that everyone noticed it; further, there was no wind during the first phases, but before annularity was reached there was a distinct breeze blowing, which died away before the later phases ended.

It may be added in conclusion that this annular eclipse was not nearly so striking as that which I observed from the outskirts of Paris in April, 1912, when the moon at the greatest phase of annularity almost, but not completely, covered the sun, making the bright ring appear like a circle of irregularly placed pearls.

The Royal Academy.

SCIENCE and engineering have become closely allied, and it is therefore of interest to note the prominence given in this year's Academy to engineering subjects; in many cases, not merely engineering features as an incident in a landscape or in a pictorial setting, but the work of the engineer shown for its own sake. Thus amongst unexpected subjects we find the interior of a garage with parts of a dissected motor-car in the foreground (262), and a bridge under construction (84). Of the same type is 654, showing railway sidings and factory chimneys with, it is true, cathedral towers in the background scarcely discernible through the smoke. The scientific basis of engineering is not far from the surface in "The Ages Meet" (156), where Mr. Stanhope Forbes shows the welding together of tramway rails by the oxy-acetylene process. The setting of the picture is the Embankment at the foot of Cleopatra's Needle. It was a happy idea of the artist to bring into juxtaposition the two human achievements—the modern welding of the steel rails in the tramway track, and the great stone column of antiquity. The task of raising this to a vertical position with the primitive devices available in those days must have been a feat in comparison with which our modern building operations, with their electric cranes and other labour-saving devices, appear but child's-play. As industrial engineering is given such prominence in this year's exhibition, it will be but one further step forward, one is tempted to think, for the laboratories of scientific workers and their cherished apparatus to be accepted as fit subjects for the work of future exhibitors at Burlington House.

This day has not yet come, and the scientific critic has for the present to confine his attention to the many aspects of Nature which are set forth from year to year in such countless profusion. The proportion of landscape scenes and Nature-studies which are really true to life seems ever to remain a small one, and leads to speculation as to whether the cause lies in a lack of desire or a lack of power on the part of artists to give expression to the truth. There is, and probably always will be, a school which frankly cares not for the accurate representation of Nature; but there are other artists who seem to aim at reality without achieving their object, and the failure is more marked in some directions than in others. Thus the post-impressionist dog and the post-impressionist cloud may be equally obviously unreal; but in the other school the artist who sets out to paint a dog is apparently more likely to succeed than the artist who takes clouds for his theme. Such is the conclusion reached from an inspection of the exhibits at the Academy. Miss Hordern's miniature of a terrier (Bailey, 741) is excellent; so is the more ambitious painting by Edmond Brock (259); but "Rolling Clouds" (616) as an attempt at a cloud study is a failure, both in the colouring and in the form of the clouds. J. Farquharson, who is always at home in snow scenes, gives in 93 a delightful picture with snow on the ground and slanting sunshine among the pines which leaves open only one point for criticism. The moon, though apparently full, is above the horizon at the same time as the sun. The eye is not very sensitive to determining the fullness of the moon, and perhaps this would be the author's explanation, though it seems unnecessary so carefully to direct attention to the point by means of the title, "The Moon is up and yet it is not Night."

If Julius Olsson could refrain from such a free use of brilliant colours in strong contrast with one another his seascapes would be immensely improved. Several examples of these glaring colours are shown this year. There is one exception, "Silver Glitter" (458), where the artist has used more restraint with a marked improvement in effect. Mr. Mark Fisher, in his two small works, shows something of the same defect, the skies containing a mosaic of colours; but, viewed at a distance, these blend, and the effect becomes much improved, particularly in the evening sky of 440. "The Ever Blue Pool" (276) is well named. The reflections of yellow sand dunes and of the curious red scrub growing upon them alike appear in its waters to be blue. Sand dunes are shown in several pictures, in most cases without much success, but a notable exception is found in "The Bay of Aberdovey" (309, Leader). In "Third Year Pollards" (269) Mr. Bertram Priestman has missed an opportunity of indicating the really remarkably rapid growth which occurs in the first year after a pollard willow has been cut. The trees in the picture show no great growth for three years, and have a somewhat hard and unnatural look.

It is not to be expected that men of science will be numerously represented among the portraits in the Academy when there is so wide a choice open among civic authorities, well-known soldiers, and other men high in public esteem. Scientific visitors may this year take pleasure in noting that two fellows of the Royal Society are included amongst the portraits—that veteran man of science and professor of engineering, Dr. Unwin (242), and Sir Napier Shaw (348). Meteorologists may feel proud that their science is represented by the president of the International Meteorological Committee, than whom assuredly no better representative could be found. J. S. D.

Obituary.

Mr. Bertram Blount.

On April 9 chemistry suffered a loss in the death of Mr. Bertram Blount at the comparatively early age of fifty-four. Never robust, his health had been poor for the past few years; he appeared to be exhausted by his successful struggle in 1915 to bring cotton within the list of contraband goods; for, wonderful as it may seem, it was no light task to convince the Government of the necessity for the step, even with such weighty aid as that of Sir William Ramsay. But of nervous energy Blount had a remarkable store; his staying-power was the admiration of those who knew him as an early cyclist, and later as a pioneer automobilist.

After a few years at King's College School, Blount entered the chemical laboratory of the college, where the foundation of his skill as an analyst was laid by the then professor, C. L. Bloxam. At the age of nineteen he accepted service as an assistant to W. H. Stanger, a consulting engineer to the Crown Agents for the Colonies. His talent did not allow him to remain a subordinate for long; Stanger's practice soon developed to include that of consulting chemist, with Blount as partner. On Stanger's death a few years later Blount continued practice on his own account, and rapidly became a prosperous consultant, the chemistry of cement being his chief subject. His quickness in grasping the meaning of a problem and his undaunted perseverance in attacking it fitted him to be a researcher. His clients' interests, however, left him little time for investigation, so that his contributions to purely scientific literature are limited to a few papers on cement and on minor analytical problems; recently, in conjunction with J. H. Sequeira, he investigated the origin of the colour of Blue John.

Blount was an excellent writer and talker, his style being clear and incisive in both cases. His more permanent writings are "Chemistry for Engineers and Manufacturers," in conjunction with A. G. Bloxam; a "Practical Electrochemistry"; and a recent monograph on "Cement," in conjunction with W. H. Woodcock and H. J. Gillett. He also contributed the articles on cement in the "Encyclopædia Britannica" and in Thorpe's "Dictionary of Applied Chemistry."

We regret to record the death, on April 21, at seventy-nine years of age, of Dr. E. J. Mills, F.R.S., emeritus professor of technical chemistry in the Royal Technical College, Glasgow.

Notes.

The observatory founded in 1913 by Sir Norman Lockyer and Lt.-Col. F. K. McClean on Salcombe Hill, above Sidmouth, is henceforth to be called "The Norman Lockyer Observatory." It will thus form a memorial to the scientific pioneer who was described by Dr. Deslandres, past-president of the Paris Academy of Sciences, in our columns as "one of the greatest astronomers of all time." It is proposed to render the memorial more complete by placing in the observatory a portrait of Sir Norman Lockyer, in the shape of a medallion, to be executed by Sir Hamo Thornycroft, R.A. As there are, no doubt, many persons who will value the opportunity of joining in this tribute, the council of the Observatory Corporation has decided not to restrict to a few friends participation in defraying the cost of the medallion, but to invite contributions of any amount from all who may wish to express appreciation of Sir Norman's astronomical work. Names of donors will be recorded in a suitable manner in the observatory. Contributions towards the cost of the medallion should be sent to the hon. secretary of the Observatory Corporation, Capt. W. N. McClean, 1 Onslow Gardens, London, S.W.7.

The Institute of Chemistry has just issued by order of the council a memorandum prepared by the Special Purposes Committee on Fine Chemicals, Laboratory

Glass and Porcelain. With regard to the production of chemical reagents the council states that a great advance has been made during the war and since by our manufacturers, and this has already enabled professional chemists to obtain practically the whole of the reagent chemicals necessary for their work. Many instances have proved that British manufacturers are capable of producing chemicals in a state of purity fully comparable with that of pre-war supplies from abroad, and the council emphasises the importance of encouraging home production. It is not suggested that chemists should be hampered for lack of chemicals if they cannot be obtained in this country in sufficient quantity and of the right degree of purity, but the council urges that users of chemicals should make themselves acquainted with what is available as the result of the very substantial progress made by British manufacturers, and consider the ultimate effect of failing now to aid in building up a stable chemical industry in this country. In respect of glass apparatus, members of the council are aware that many complaints are made with respect to the quality and quantity of laboratory glass sold as of British origin, "but, so far as they have been able to obtain evidence at present, the complaints regarding glass of recent manufacture marked with the names of known makers have been few in number." The council repeats and emphasises the appeal recently issued by the institute to users, urging them to purchase only laboratory glassware which bears the manufacturer's distinctive marks, and it adds that "if *bona-fide* British manufacturers who are prepared to guarantee their productions by their own marks do not receive proper encouragement, the opportunity of establishing firmly the British scientific glassware industry will be lost, and this at a time when through enterprise and research success in respect of manufacture and technique has been attained."

THE *Times* announces that Sir Ernest Cassel has devoted the munificent sum of 225,000*l.* to the object of founding and endowing a hospital or sanatorium for the treatment of functional nervous disorders, and has purchased a fine mansion and park at Penshurst, Kent, for the purpose. The King and Queen have consented to become patrons of the new institution.

A NUMBER of distinguished civil, mining, metallurgical, mechanical, and electrical engineers of the United States will arrive in England near the end of next month, and will hold a joint meeting with British engineers in July. The American engineers will present Sir Robert Hadfield on June 29 with the John Fritz medal, which was awarded to him recently in recognition of his invention of manganese steel. Previous recipients of the medal have been Lord Kelvin, Mr. Edison, and Dr. Graham Bell.

A DISCUSSION on "The Structure of the Atmosphere up to Twenty Kilometres" will take place in the rooms of the Royal Astronomical Society, Burlington House, London, on Friday, May 6, at 5 p.m. The chair will be taken by Dr. G. C. Simpson. Sir Napier Shaw will open the discussion, which will be continued by Col. E. Gold, Mr. W. H. Dines, and Mr. F. J. W. Whipple.

THE President of the Board of Trade, by arrangement with the Lord President of the Council, has appointed Mr. J. E. Sears, jun., to be Deputy Warden of the Standards in succession to Major P. A. MacMahon, who has retired under the age-limit. Mr. Sears is superintendent of the metrology department at the National Physical Laboratory, and will continue to hold this post in addition to that at the Standards Department of the Board of Trade.

THE award of a Moseley studentship for research in molecular physics or some allied branch of science will shortly be made by the council of the Royal Society. The studentship is of the value of 300*l.* a year and tenable in the first instance for one year only. It may, however, be renewed for a further year if the student's work be considered satisfactory. Applications must be made to the Secretaries of the Royal Society, Burlington House, W.1, before June 1.

APPLICATIONS for two Mackinnon research studentships, each of the annual value of 150*l.*, are invited by the Royal Society. One of the studentships is for research in physical science and the other for research in biological science. The appointments are for one year, but are renewable for a further like period. In exceptional circumstances they may be extended to a third year. Full particulars and forms of application are obtainable from the Assistant Secretary of the Royal Society. The latest date for the receipt of applications is June 1.

THE Council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1920–21:—A Telford gold medal and a Telford premium to Mr. George Ellson (London); Telford gold medals to Sir Murdoch MacDonald (Cairo) and Dr. T. E. Stanton (Teddington); a George Stephenson gold medal to Mr. R. G. C. Batson (Teddington); a Watt gold medal to Mr. S. A. Main (Sheffield); and Telford premiums to Mr. Algernon Peake (Sydney, N.S.W.), Mr. L. H. Larmuth (London), Mr. H. E. Hurst (Cairo), Prof. T. B. Abell (Liverpool), and Mr. Percy Allan (Sydney, N.S.W.). The council further records its appreciation of the paper contributed (jointly with Mr. Main) by Sir Robert A. Hadfield, a member of the council.

IT is announced that the annual meeting of the British Medical Association will be held at Newcastle-upon-Tyne on July 15–23, under the presidency of Prof. David Drummond. On the occasion of the president's address on July 19 the gold medal of the association will be presented to Sir Dawson Williams, editor of the *British Medical Journal* since 1898, in recognition of his distinguished services to the association and the medical profession. In connection with the annual meeting in 1922 to be held at Glasgow, Sir William Macewen, Regius professor of surgery in the University of Glasgow, is announced as president-elect. The council of the association has recommended that the annual meeting in 1923 be held at Portsmouth.

FROM a recent copy of the *North China Herald* we learn with pleasure of the award by the French Government of the Cross of the Legion of Honour to Father Froc, S.J., who for more than a quarter of a century has been connected with the meteorological work at Siccawei Observatory. It was at the Jesuit observatory in Manila that Father Faura in 1879 for the first time predicted the existence, duration, and course of a typhoon in the Far East, and the work at both Manila and Siccawei has been of the greatest importance to those who sail the China seas. Siccawei, which stands about four miles from the international settlement of Shanghai, derives its name from a distinguished Chinese who was converted to the Christian faith by Matthew Ricci three hundred years ago, and whose grave lies close to the observatory. Besides the observatory the Jesuit Mission has here a fine cathedral, a college, an orphanage, a convent, and a natural history museum. The work of Father Froc and of his colleagues, Fathers Chevalier and Gauthier, has the support of the community at Shanghai, and the observatory at Siccawei and those at Zosé and Liu-ka-pong connected with it are an object-lesson to the Chinese Government.

THE Danish explorer Mr. Knud Rasmussen is planning to leave Copenhagen on May 25 in his motor schooner *Sea King* for the Canadian Arctic Archipelago in order to continue his researches in Eskimo ethnography and migrations. Mr. Rasmussen recently laid his plans before the Royal Geographical Society of Denmark. According to the *Times*, he proposes to sail for the station of Thule, in north-western Greenland, where several Eskimo and a number of dogs will be embarked. From there he will go to Hudson Bay and establish his base at Lyon Inlet, in Melville Peninsula. During autumn and winter the tribes around Fury and Hecla Straits will be visited. In the spring of 1922 the expedition will go south to Chesterfield Inlet, where arrangements have been made with the Hudson Bay Co. to form a food depôt. The winter of 1922–23 will be spent among the Kinipetu tribes in the Barren Lands, and other tribes along Maud Sea and Dease Strait. The *Sea King* will take the collections back to Denmark in 1923, while Mr. Rasmussen with a sledge party hopes to reach Thule, travelling *via* Baffin Land, Lancaster Sound, Jones Sound, Ellesmere Sound, and Smith Sound. This journey is expected to throw light on the ancient Eskimo migrations from Bering Strait *via* Coronation Gulf and Baffin Land to Greenland. Mr. Rasmussen's companions will be Messrs. P. Freuchen, Mathiessen, and Birket-Smith.

THE Research Defence Society has issued a pamphlet entitled "The Fight against Disease" (Macmillan and Co., 6*d*.). The pamphlet gives a summary of important current researches on the prevention of human diseases, such as those of Nathan Raw and Calmette on immunisation against tuberculosis, an abstract of Bassett-Smith's lecture on Malta fever at the Middlesex Hospital and quotations from Sir Charters Symond's Hunterian oration on the importance and value of experiments upon animals. The advantages gained by animals from experiments on animals are also emphasised, notably in the case of glanders. Prof. Hobday points out that in 1901 some 2370 horses were destroyed for glanders in Great Britain, whereas during 1920 only 22 animals were destroyed, and this after the sale and distribution of 150,000 Army horses and mules. This result is due to the use of mallein, a sure test for the presence of the disease. The extraordinary mistakes and misstatements of anti-vivisection publications are also referred to and exposed.

THE Report of the Director-General of Public Health, New South Wales, for the year ending December 31, 1919, contains a useful summary of the influenza epidemic which raged in the State during that year. In Sydney itself it is estimated that 290,000 persons were attacked, or 36 per cent. of the population, and from January–September 6244 deaths due to influenza were recorded in the State. As in this country, males of working age had the highest death-rates, and the disease was frequently accompanied with hæmorrhages. The precautionary measures taken included restrictions upon travelling, the provision of hospital accommodation and of medical and nursing assistance in the homes of the sick, notification, isolation of patients and contacts, restriction of public assemblies and closure of schools, and the wearing of masks in certain circumstances. These measures, however, did not appear to limit the spread of infection. Inoculation was also applied to a limited extent, and the death-rate among the inoculated seemed to be decidedly reduced. Extensive bacteriological and pathological investigations were carried out by Dr. Cleland, who thinks that the balance of evidence is in favour of the disease being caused by a filter-passing organism, although no definite experimental evidence in favour of this view was obtained.

THE Natural History Society of Rugby School has recently issued its annual report for 1920, which we note is the fifty-fourth issue of this record. In all, nine general lectures were given during the year on a variety of subjects; brief abstracts of each are printed, and if we are to judge by the attendances recorded, that by Dr. Fournier d'Albe on the optophone was by far the most popular. The report also contains a list of birds of Rugby by Mr. J. F. Madden, compiled chiefly from the society's reports of the last six years; one hundred birds are mentioned, and remarks are added indicating where and how often each has been seen. The botanical section has contributed a list of some three hundred plants which have been found locally, and their dates of flowering are given. The entomological and the ornithological sections also supply lists which will be useful to students of local natural history, while the contribution of the latter is illustrated by some good reproductions from photographs of birds' nests and young sparrowhawks. Other groups, such as the geological, meteorological, photographic, and agricultural sections, have also provided brief reports of their activities, making altogether an attractive record of a year's endeavour in the field of natural history. A new feature upon which the society is to be congratulated is the opening of a laboratory in which members can carry out a certain amount of independent work.

MRS. MABEL C. WRIGHT describes a new conchostracan genus under the name Limnestheria from the Coal Measures of Kilkenny, which have been fertile in interesting fossil forms, ranging from limuloids to amphibia (Proc. Roy. Irish Acad., vol. xxxv., sect. B, p. 187, 1920). The specimens, including antennæ and limbs, are beautifully preserved in pyrite in Carboniferous shale, and were received by the Geological Survey of Ireland from a depth of 830 ft. in the cores of a recent boring. The author concisely reviews the eight known living genera of Conchostraca, and shows how Limnestheria, on the analogy of the highly fertile Limnadia, illustrates the geographic and climatic conditions of the epoch in the Leinster coalfield.

ENTOMOLOGICAL Bulletin No. 872 of the U.S. Department of Agriculture deals with "Insect Control in Flour Mills." Mr. E. A. Back, the author of the publication, confines his attention to the Mediterranean flour-moth, which is by far the most serious pest. He divides control measures into three classes: Preventive, including attention to cleanliness; natural control by means of parasites; and artificial control. A large proportion of insect infestation in flour-mills is directly due to lack of cleanliness, and much may be achieved by thorough cleaning once every five weeks throughout the summer months. The utilisation of parasites cannot be depended upon in any part of the United States. Artificial control has been advocated along various lines, and there have finally emerged two measures that have now proved their value, viz. fumigation by hydrocyanic acid gas and control by heat. The former method is disagreeable and dangerous, and elaborate precautions have to be taken. There are also certain beetle pests which are more resistant to the effects of the gas, and the most satisfactory method for controlling *all* classes of mill-infesting insects is the application of a temperature of 118° to 125° F. To carry out this process effectually the installation of radiators or radiation surfaces is necessary. It has been estimated that this can be fitted up sufficiently economically in an average-sized mill to pay in five years for the cost of its introduction; the heat does not affect the baking qualities of the flour.

THE United States Geological Survey has published a preliminary summary of the mineral resources of the United States in 1919. The value of such statistics of production, etc., at an early date is very obvious, although it is to be hoped that in future years their compilation may be completed in less than nine months. The importance of the present set of statistics lies in the fact that they include 1913, the last pre-war year; 1918, the year of the maximum intensity of production for war purposes; and 1919, the first year of the return towards more normal industrial conditions. Thus, to take the most important of all, namely, coal, it is shown that the production in 1913 was 569,960,219 (short) tons; in 1918, 678,211,904 tons; and in 1919, about 544,263,000 tons. The position is similar in most other important minerals, the output in 1919 being considerably less than the intensive figures reached in 1918, but in most cases not far behind those of 1913. The importance of having such statistics as these available at an early date, even though they may not be absolutely accurate and may need some little later revision, cannot be too strongly emphasised.

THE weather was so persistently mild and dry during the past winter that a comparison with previous winters may be of interest. The Greenwich mean temperature for each of the six months October, 1920–March, 1921 was above the average. The mean for the whole period was 45·0° F., the excess for the six months amounting to 2·6°. The greatest excess was 7° for January, while for March the excess was 4°. There have been two milder winters since 1841, that of 1898–99 having a mean of 45·4°, while for 1913–14 the mean was 45·2°. For each of the winters 1911–12 and 1876–77 the mean was 45·0° F., in absolute agreement with the past winter. Frost occurred in the shade on thirty nights during the past six winter months, the greatest number of frosty nights, ten in number, having occurred in November. There have been eight winters since 1841 with fewer frosts, the least number being nineteen recorded in 1883–84. Rainfall was below the average in each month except perhaps December, which, however, was dry compared with the Greenwich average for a hundred years. The total fall for the winter was 6·87 in., which is about 5 in. less than the normal. There have been only three drier winters since 1841; the driest was 1879–80 with 5·54 in. of rainfall, followed by 1858–59 with 6·65 in. and by 1897–98 with 6·85 in.

THE equation $UV=-f^2$, where U and V denote respectively the distance of object and image from the focal planes of a thin lens, is not so well known as the equation $1/v-1/u=1/f$, which gives the distances from the lens itself. We have received a booklet from Prof. Mohd. A. R. Khan, Nizam College, Hyderabad, in which the former equation is graphed and applied in detail to different elementary cases with the view of encouraging its use by students of elementary optics.

WE have received from Messrs. R. and J. Beck, 68 Cornhill, E.C.3, a catalogue of microscopes and microscopical apparatus. The standard London microscope, Model I., has been designed to fulfil the specification prepared by the British Science Guild for a standard microscope, and is supplied in four types. Stand No. 3211, which is suitable for ordinary bacteriological work, includes condenser, three eyepieces, $\frac{2}{3}$ in., $\frac{1}{6}$ in., and $\frac{1}{12}$ in. o.i. objectives, darkground illuminator and stop for the oil-immersion objective, and a set of Sloan objective changers, and is listed at 33*l*. 11*s*. (December, 1920). A detachable form of mechanical stage costs an additional 6*l*. A new electric lamp for the microscope has also been designed for use with a "Pointolite," a half-watt, or a metal filament lamp. Another piece of apparatus at a moderate price is the Beck photomicrographic camera.

IN *Science* of March 25 Dr. I. Langmuir attempts to modify the "cubical" model of the atom, in which the outer electrons are supposed to be practically at rest, so as to obtain the well-known results in connection with spectra which were achieved by the entirely different atomic model due to Bohr. It is shown that on the assumption of a repulsive force $F_q = 1/mr^3(nh/2\pi)^2$ between the positive nucleus and an electron, in addition to the Coulomb attractive force $F_c = Ze^2/r^2$, the equations for the radius of the electronic orbit, the total energy in any stationary state, and the frequency of revolution of the electron in the Bohr atom are obtained. The symbols denote: m = mass of nucleus, Ze = charge on nucleus, r = distance between electron and nucleus, h = Planck's constant, and n is an integer denoting the quantum state of the electron. The assumption of the particular law of force for F_q is, however, entirely arbitrary, and was chosen to give the results obtained.

AT a meeting of the Institution of Civil Engineers on April 19 a paper on "The Measurement of the Discharge of the Nile through the Sluices of the Assuan Dam" was jointly presented by Sir Murdoch MacDonald and Mr. H. E. Hurst. The paper describes a series of observations taken to determine accurately the discharge by means of the volumes of water passed into a masonry tank having a capacity of 22,000 cubic metres, which was constructed for the purpose of forming a water-cushion to protect the rock surface on the down-stream side of the dam. The results of the measurements, which are believed to be correct within 1 per cent., showed that (*a*) for a given opening the coefficient of discharge increases as the head increases until, in the neighbourhood of 10 metres head, it becomes constant; (*b*) for the small openings, 1·5 and 2·0 metres, there is not much difference between the coefficients for the same head, and the coefficients for both openings attain practically the same maximum value; and (*c*) for the small heads there is a progressive decrease of coefficient as the size of the opening increases. For heads greater than 3 metres this effect is reversed, and the coefficient increases with increase of sluice-opening. Experiments were also made to determine the coefficients of discharge of other types of sluices of the dam which differ in dimensions and in the levels of their sills. The results of these experiments are stated and discussed. Some observations are added on the accuracy of Gurley current-meters.

THE lighting of ships at sea, which was the subject of discussion at the last meeting of the Illuminating Engineering Society, offers a number of interesting problems. The society was fortunate in receiving the co-operation of representatives of the Admiralty and of the Mercantile Marine Service Association, some of whom gave interesting accounts of their difficulties when oil-lanterns were the only illuminants available. One gathers from the discussion that in many cases the degree of light provided is much less than that usual on land, and this must affect the safety and efficiency of work in the hold of the ship. Among special problems mentioned the lighting of the chart-house and compass-dials deserves attention. Naturally, concealed lighting is recommended in this case, one approved method being the lighting of charts mounted between sheets of glass by diffused light transmitted from below. Another interesting question raised in the discussion was the amount of light desirable on the deck of a ship. Shipmasters were inclined to view with disfavour the use of lights on deck, on the ground that, in contrast with the dense surrounding darkness, they would dazzle the eyes and interfere with operations on deck in sailing-ships, as well as affect the "look-out." It may be presumed, however, that this depends much on the nature of the lighting, and that these objections would be less if the actual sources could be effectually screened from view. To a landsman the idea of working constantly on a violently moving ship in complete darkness seems inevitably accompanied by risk and inconvenience such as moderate diffused lighting might diminish.

WE have received a copy of the first of a new series of catalogues issued by the Science Museum at South Kensington. It is intended that each catalogue shall treat of a single group of the collections and contain illustrations of a few important objects; by these means the price can be kept within reasonable limits, and the visitor need purchase no more than he actually requires. Eventually the new series will cover the whole of the collections in the museum and take the place of the existing catalogues. The present part (1*s*.) deals with machine-tools and metal-working and wood-working machines; descriptive and historical notes are included. The compilers of the catalogue clearly have in view the meeting of the requirements of the visitor or purchaser who is interested in one particular class of exhibits, and such will find that the arrangement of the catalogue is good and that the notes appended to each exhibit have been admirably written. The value of the illustrations given may be questioned; these comprise twenty-two photographic representations of selected machines. If the purchaser is also a visitor he will certainly not require these illustrations, having the actual model or machine before him. If he is not a visitor photographs will help him in a minor degree only, and we should like to suggest that a few line-drawings showing the mechanism or the principle of the mechanism would constitute a very valuable addition to the catalogue. The idea of section catalogues is a sound one, and we hope that the authorities will develop it in such a manner as to meet the need which all students have experienced in visiting the Science Museum, viz. to provide a record to which reference may be made at any future time, confident that the method of working and arrangement of any of the exhibits will be understood.

MESSRS. A. GALLENKAMP AND CO., LTD., of Sun Street, Finsbury Square, E.C.2, have issued a list (No. 71) of students' balances and weights of British manufacture. The prices seem very moderate, and the construction and sensibility of the instruments are such as will make them suitable for teaching purposes in schools.

BEGINNING with the number to be published on July 15 next, the *Psychic Research Quarterly* will be incorporated in a new quarterly review entitled *Psyche*, which will deal with applied and general psychology in relation to education, psycho-analysis, industry, religion, social and personal relationships, psychical research, etc. A special feature of the periodical will be the literary section. The publishers will be Messrs. Kegan Paul and Co., Ltd.

THE first number of a new publication, *State Technology*, has been received. The journal is to be the official organ of the Institution of Professional Civil Servants, which was founded in 1918. A novel feature of the first issue is the inclusion of short abstracts of the proceedings of technical institutions and a paper on a technical subject. The journal will thus assist in providing a means of communication between the technical, scientific, and professional workers in the service of the State, and may also serve to acquaint men of science generally with some of the activities of our numerous Departments of State.

MESSRS. BOWES AND BOWES, 1 Trinity Street, Cambridge, have just issued a handy classified catalogue (No. 404) of second-hand books, journals, and monographs dealing with many departments of science. The scope of the catalogue will be seen from the following sections into which it is divided:—Journals, Transactions, and Proceedings of Learned Societies; Travels, Expeditions, etc.; Biographies of Scientific Men; General Science, including Evolution, Microscopy, etc.; Biology; Botany; Zoology; Geology, including Mineralogy; Anthropology, Ethnology, etc.; Chemistry and Physics; and Portraits of Scientific Men. Upwards of 900 works are listed, and the prices asked are very moderate. The catalogue is obtainable upon application.

Our Astronomical Column.

REID'S COMET.—This comet has been readily visible with the naked eye provided its position was known. In the telescope it has been most conspicuous with a large coma, a stump of a tail, and a nucleus which, as Mr. G. Merton expresses it, is planetary rather than stellar in character. It will be nearest to the pole (distance 4½°) on May 9. The following is a continuation of the ephemeris from M. Ebell's latest elements. A little sweeping may be necessary to locate the comet (this remark applies also to the comet Pons-Winnecke, which was readily visible with 6-in. aperture on April 28, and was glimpsed by Dr. W. H. Steavenson with 2-in.):

Ephemeris of Reid's Comet for Greenwich Midnight.

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
May 12	6 21 6	81 36	0·0044	9·9128
14	7 3 17	77 59		
16	7 23 48	74 35	0·0066	9·9636
18	7 35 47	71 29		
20	7 43 37	68 42	0·0108	0·0129
22	7 49 10	66 11		
24	7 53 18	63 55	0·0167	0·0590
28	7 59 9	60 1	0·0243	0·1011
June 1	8 3 9	56 45	0·0333	0·1396
5	8 6 7	54 0	0·0434	0·1745

PHOTOGRAPHIC CATALOGUE OF THE GLOBULAR CLUSTER MESSIER 15.—This bright globular cluster is situated near the western edge of Pegasus. Two exposures on it were made with the Bonn astrographic equatorial (aperture 280 mm.) on 1916 November 16 and 1917 September 24 (exposures 150m. and 90m. respectively) by Prof. Küstner. The positions and proper motions of eight reference stars (re-observed at Bonn by Mönnichmeyer) are discussed in *Veröff. der Univ. Sternwarte zu Bonn*, No. 15, and a catalogue is deduced giving magnitudes and rectangular co-ordinates of 1137 stars in the cluster. Their magnitudes (excluding one star, mag. 8·07, probably superimposed on the cluster) range from 13 to 16½, their X co-ordinates from $-541''$ to $+495''$, and their Y co-ordinates from $-531''$ to $+509''$. A similar research in a few decades will render it possible to pick out the stars optically projected on the cluster. No appreciable change in the positions of the cluster stars can be expected until centuries have elapsed.

Photographs with a time-interval of forty-four years are now available for the clusters h and χ Persei. Measurements of these plates were discussed in a paper by the Rev. H. E. Macklin, S.J., presented to the March meeting of the Royal Astronomical Society. He concluded that the few stars showing displacement in the interval were optically projected on the clusters, and further showed that fifteen of them appeared to belong to the moving cluster in Perseus.

A PHOTO-ELECTRIC STUDY OF ALGOL.—Prof. Joel Stebbins, who in 1909 detected the secondary minimum of Algol with his selenium photometer, has recently (*Astrophysical Journal*, March, 1921) published a still more refined research which he has made with the photo-electric cell. He has incidentally detected that δ Persei is variable to the extent of 0·04 magnitude, and in his later work he used l and π Persei as his sole comparison stars, Algol's light being reduced by a neutral shade-glass. On the whole, the new research confirms the old very closely, but there is evidence that the components are ellipsoidal, with a flattening of about 1 in 50. The secondary star appears two-thirds as bright with the new cell as with the selenium one; it is inferred that it is yellower than the primary, perhaps of spectral type G_0. Endeavours have been made to determine the light of the third component, with period of 1·9 years, revealed by the spectroscope, but this has not yet been done with certainty. The greater brightness of the side of the secondary turned towards the primary is confirmed, though the range is diminished. Taking the light of the whole system as unity, that of the two faces of the secondary is 0·075 and 0·045 respectively. The values found before were 0·102 and 0·058. The area of the bright body obscured at principal minimum is now given as 0·700, and the cosine of the inclination of the orbits as 0·142. It is satisfactory to note that the greater precision of the new results is accompanied by a reduction in the time of observation. "The new curve represents half the effort of the old one."

The Inauguration of the Institute of Physics.

THE inaugural meeting of the new Institute of Physics was held on Wednesday, April 27, in the rooms of the Institution of Civil Engineers. The creation of a new institute was first suggested about four years ago, and in the interim the scheme has been most carefully deliberated over and developed, and it received the sanction of the Board of Trade in November of last year. The object of the institute is specially to look after the professional interests of physicists, to set up and require from its members a high standard of professional conduct, and in other ways to forward the development of physics. It is thus intended to play the same part for physics that the Institute of Chemistry and various engineering bodies do for the cognate subjects. Its founders look forward to the foundation of a central building in which the various societies that participate with it can be housed and their libraries assembled so as to become more accessible than at present. It is not likely that this part of the scheme can come to fruition at any early date; the possibility may, however, rapidly develop now that the public has been called in to inaugurate the institute.

The chair at the meeting was taken by the president, Sir Richard Glazebrook, who in opening it outlined the aims of the promoters. He then called upon Sir J. J. Thomson to address the assembly. Sir Joseph, speaking on behalf of those interested in physics, pointed out that the institute had become necessary on account of the increased number of men and women who now earn their livelihood in one capacity or another in connection with physics. This necessity is evidenced by the fact that in the first year of its existence it has secured 300 members out of the 800 or 1000 persons that are available even when school-teachers are counted. This support is sufficient to justify the recognition of physics as an independent profession. The institute is intended to act as a bond of union. Chemistry (a branch of physics) has long been recognised professionally. The need for a similar recognition of physics has become urgent owing to the establishment of numerous research institutions, especially in connection with industry.

Sir Joseph Thomson indicated that the connection of physics with its applications was accidental, although there have been great developments on the material side. His recollection went back to fifty years ago; the laboratories in existence then were few and sparsely populated. The Cavendish Laboratory had been decided upon, but had not been started. The estimated cost of it was only 6300*l.*, though this estimate was, in fact, exceeded. It was then a reckless and a dangerous thing to make physics the business of one's life, and, in consequence, this course was confined to enthusiasts whose delight in research more than compensated for the deficiencies in their salaries. There were probably fewer than a hundred physicists in all, but the list included such names as Kelvin, Stokes, Maxwell, Crookes, and Osborne Reynolds. Yet work in a laboratory in those days had some advantages. There were fewer students, even though there was less apparatus; now there are twelve induction coils and twenty students wanting them. In these circumstances the director of a laboratory has to exercise the functions of a league of nations in the maintenance of peace. At that time also committees were sporadic rather than chronic, as at present.

The rapid growth of laboratories connected with various industries and with schools and new universities has created a demand for men which exceeds the supply. In Sir Joseph Thomson's opinion, physics now offers to any competent man a livelihood, though there is small hope of its providing him with a fortune.

There is an increased belief in the use of physics in industry. Sir Joseph Thomson suggested that though it is undoubtedly a good thing to have a physicist in the laboratory, there is a need also for one in the works itself where articles are manufactured in large quantities. This need he illustrated by the case of an article in general use for which the English design is better than the German, and the article itself is superior when it is made in the old-fashioned way by skilled workmen; but when it is manufactured by automatic processes on a large scale (*i.e.* by mass production) the article is very inferior to the German.

Sir Joseph Thomson considers that the scarcity of physicists is likely to continue, for the supply is not adequate to the demand. The number of first- and second-class honours men in 1916 were fewer than five hundred when engineers, chemists, and the higher type of medical men are all included in the estimate. The needs of schools had to be supplied out of this number. It is difficult to see how the insufficiency of eligible men is to be rectified. Each man must undergo at least one year's training in research in order to develop his character, to increase his independence of thought, and to develop his resource, critical power, and enthusiasm—to raise him, in fact, from intellectual adolescence to intellectual manhood. But this means another year at college, involving additional expense that must be faced. This expense is met in part by fellowships and post-graduate studentships, which, however, are insufficient. But lately a Committee of the Department of Scientific and Industrial Research has awarded grants to students in training. Thirty-seven such grants have been awarded by the Committee.

Research is also expensive for the university; the present increase in cost is horrible. Research is as much a part of the work of the university as education. Much more money is now available than formerly, and we should be grateful to a Government for what it does in this direction.

Sir Joseph Thomson directed attention to the vast increase in the amount of work that is now done. The number of papers that were abstracted in the *Beiblätter* in 1873 was 400 for the whole world; in 1913 this was increased to 2700. It may be a question whether pioneer work has increased in the same proportion as routine work, but still it has certainly been accelerated to a very great extent. In examining discoveries the physicist requires, not that truth shall be beauty, but that it shall be in accordance with the laws of Nature. To judge this, a period of suspense is needed; this period is shortened when the number of laboratories and workers is large. It results that even pioneer work has been helped by the appliances which are now available.

In conclusion, Sir Joseph Thomson emphasised that, together with all the developments taking place in response to the stimulus of industry, he saw no disposition to undervalue research undertaken without any thought of industrial applications. Scholarships had been given by the Committee already mentioned for the most abstract researches in pure mathematics. The intellectual harvest is even a higher reward than increased comfort and convenience. He congratulated the Institute of Physics in being formed to aid intellectual development.

Mr. A. J. Balfour, who as Lord President of the Council is concerned with the Department of Scientific and Industrial Research, was then called upon to extend a welcome to the institute. He expressed his deep gratification at being present. He represented the outside public who ought to have a deep interest in what was being done in the development of pure science and in industry. He was profoundly surprised that there was not hitherto an Institute of Physics. Physics is one of the most fundamental of all the sciences. That lacuna is now filled, and he rejoiced that it had begun under such favourable auspices. Reference had been made to the Department of Scientific and Industrial Research. The public knew little about its work—the public very seldom does know about the things which most deeply concern it. He confessed that when he saw great industrial disputes going on about the distribution of the results of industry he could not help thinking, "Why do not you devote half the energy and half the amount of money involved to increasing the power of man over Nature, which would increase the share and increase the total result to be divided among the members of the community, instead of devoting your energies to saying how the relatively insignificant amount we now produce is to be divided among the producers?" Mr. Balfour's memory went back to his Cambridge days and to the great Cambridge physicists who all in their several ways had made advances in physics which have changed our conception of the structure of the universe and increased our power of turning it to practical account. Mr. Balfour did not believe that mere expenditure of money, the mere growth of laboratories, or the mere multiplicity of students was going to produce a larger crop of men of genius. Genius comes of itself; no system of education yet discovered has been able to turn it out. The spirit bloweth where it listeth, and no organisation will increase the number of men at the very summit of the profession. He did not for a moment wish it to be thought that this remark settled the whole question. A large amount of work which does not in itself bring to maturity a great discovery is required if great discoveries are to be made, and this work can be increased by organisation and by the expenditure of money. The work that the Advisory Council has done in providing opportunities for research deserved all the praise which Sir J. J. Thomson had given to it. Unfortunately, the present impoverished state of the country has compelled a reluctant Treasury to cut down the sum at their disposal. No money gives, not only a greater spiritual return, but also a greater pecuniary return than the money devoted to research. It is impossible to carry on without more assistance than an impoverished State can afford or wealthy men seem inclined to contribute. Apparently these men do not realise what they might do.

Mr. Balfour said he was often surprised that the imagination of our great magnates was not stimulated by the idea that they could add to the wealth of the whole world by encouraging industrial research. There was nothing narrow about the results of an increase in physical knowledge. What is discovered in Cambridge or Paris or Japan is a gift to mankind. When he reflected, as he thought political economists were slow to reflect, on the prodigious changes which are made by discovery in the lot of mankind he was surprised at the lack of the spirit of liberality, at the imperfect realisation of the actual facts of the case, and at the fatal desire to see an immediate return. Discovery, however, lurks undeveloped for a generation; but the life of nations is a long life, and anything that adds to a knowledge of the physical world must, either sooner or later, in our own time or in that of our remote descendants, do something material for the life of mankind. The hope he had for the world was that by the growth of science and invention, instead of discomfort, comfort and leisure would be given to the community—at least, if the people learn how to use their leisure. That was the idea based upon the work of men who were engaged, as those present were engaged, in probing the secrets of Nature. If, as he believed, the institute they were inaugurating was going to assist in that great work, they might regard the day of this meeting as a red-letter day in the history of British science.

Votes of thanks were proposed by Sir W. H. Bragg, Sir Robert Hadfield, and Prof. C. H. Lees.

All information concerning the institute can be obtained from the Secretaries, 10 Essex Street, Strand, W.C.2.

The British Science Guild.

SCIENTIFIC DEVELOPMENT AND WORLD-WELFARE.

GREAT success attended the annual dinner of the British Science Guild, which was held at the Hotel Cecil on Tuesday, May 3, Lord Montagu of Beaulieu, president of the Guild, being in the chair. There was eloquent acknowledgment of the great part science has played in the country's progress, and keen insistence on the imperative need of its wider application to the stupendous problems of the future. The president, unfortunately, was suffering from the effects of a severe attack of laryngitis, and, although this affected the wonted vigour of his utterance, it is scarcely necessary to add that it did not lessen the value of his weighty observations.

After the loyal toasts had been duly honoured, the president, in proposing "Science and the Empire," said he thought it was quite clear that in whatever direction we looked, science, moderation, and balance of mind were wanted all over the world to-day more than ever before. We had appeals to reason unheeded by great masses of people, we had attempts in other directions to set scientific laws and economic laws at defiance; and when there was an organisation like the British Science Guild, which could, at any rate, attempt to sum up the balance one side and the other, it seemed to him they would do less than their duty if they did not attempt to bring their case and their teachings before the public. Their thoughts were naturally centred on the great struggle that was going on in reference to one of the vital necessities of life—coal. They could not help realising that all these struggles meant an immense waste of power and wealth to the nation. Of course, if we used coal as we should, as every scientific man in that room knew, we should never burn it, for instance, in that most cheerful thing, the open grate. We knew that the smuts which covered our clothes and our buildings in

London were the result of waste in coal-burning. On many grounds they would like to see the time come when all the bituminous coal of the country was passed through a process of coking, and we used the liquid fuel on one side for all kinds of transport and other purposes, and burnt only smokeless fuel in our grates. They would welcome anything that would improve the lot of the miner underground and help him to raise a greater quantity of coal at less exertion to himself and make his occupation more healthy. As economists they knew that unless we could in the future raise coal at a reasonable price the coal of great countries like America would beat us in the markets of the world. Lord Montagu, quoting the example of Joseph in Egypt in preparing for the lean years, suggested that the Government should store certain articles like coal and certain kinds of food which the community might be deprived of during the progress of industrial disputes. That idea might be misinterpreted by some as an attack on the power of the trade unions, but it was nothing of the kind. We did not wish any portion of the community to starve or suffer hardship; moreover, the community must defend itself when attacked. He thought we must gradually look forward to a time when we must not be dependent upon one kind of fuel only. We must cultivate so far as we could the use of alternatives to coal.

Lord Montagu went on to insist that the need of science in every department of the country was greater to-day that it had ever been. He hoped that some of our leading statesmen would not think of science only as a means of destroying our fellowmen because during the war, no doubt, science, especially towards the end of the conflict, was called upon to invent new means of dealing out death to our adversaries, and the whole ingenuity of large numbers of men of science was concentrated on what, after all, was the horrible business of destroying each other. He was sure Field-Marshal Sir William Robertson would agree with him that they should try to develop all these great energies of science to the benefit of the human race. What they really desired to do was to lead a campaign against ignorance, and he could not help thinking of one of the members of their council, a most energetic and valuable member, Mr. J. J. Robinson, who had done wonderfully good work already in establishing provincial centres and in endeavouring to cultivate the scientific spirit in our great provincial towns. He would like to see that side of their work greatly increased.

Field-Marshal Sir William Robertson, replying to the toast, spoke of the great work of men of science in the war, particularly referring to the development, with astonishing success and rapidity, of submarine warfare, both offensive and defensive, and of sound-ranging and signalling. There was also the tank, which was produced in the face of considerable obstacles—some people said obstructions. We had very little glass for making optical instruments, but during the war men of science came forward and produced sufficient quantities of this glass well up to pre-war standard. The credit due to science was all the greater, because in the pre-war preparations science had been too frequently disregarded, with the result that everything had to be done almost from the very beginning. It was to be hoped that the lessons of the war would not be forgotten by the fighting Services, for we might be sure that science would play an even greater part in the next war than it had in the recent war, more especially when we thought of the air and under the water. In view of the present position of affairs we must not altogether forget about preparations for war. He suggested that what we required was that every State Department and every public service should have with it, and in it, the best scientific advice and assistance that could be furnished. Men who aspired to exercise Ministerial control over the destinies of the country, or in other ways to wield large administrative powers, should attach much greater importance to the value of science as an educative force than they had done in the past. If they neglected to do this they could not hope efficiently to discharge their duties in peace, or usefully assist in guiding their country through the terrible ordeal of war.

Col. Sir Ronald Ross proposed "Science and Literature," and the toast was acknowledged by Dean Inge.

Lord Rayleigh submitted the toast of "The British Science Guild," and made a graceful allusion to the distinguished man to whom the origin of the Guild was primarily due—Sir Norman Lockyer. Sir Norman combined, he thought, in a peculiar sense, the qualities necessary for those who would push and advance the scientific cause in this country. It was no use merely to hold scientific views; they had metaphorically to take people by the throat and shake them before they would realise the national importance of scientific principles in progressive practice.

Lord Bledisloe, in acknowledging the toast, said a question those of them who were not yet sufficiently familiar with the Guild might well ask was: "What is the British Science Guild?" The answer had been suggested to him by a very interesting book which had lately been published, Westaway's "Science and Theology," in which he found the following statement:—"The training in scientific method has brought into being a thinking fraternity whose bond of loyalty is respect for the truth." Now, surely, if there was one body more than another in this country that would answer to that description it was the British Science Guild. He thought there was a great poet who said in substance:—"He is a free man whom the truth makes free, and all are slaves besides." Well, we boasted that our country was the land of the free. He thought it was extremely doubtful whether, at any rate under existing conditions, this was an apt description, but if we were not yet conscious of that extent of freedom which ultra-democracy should bring to us, surely we could best remedy the defect by applying science to all the activities of our human life in the future to a much greater extent than we had done in the past. Perhaps the most important work upon which the Guild was at the moment employed was to endeavour to arrange a conference between representatives of science on one hand, and representatives of organised Labour on the other. They felt there was an opening now for an *entente cordiale* between the great enlightened leaders of Labour and the chief exponents of science with the object of rendering the task of Labour lighter, more effective, more comfortable and happy, and in the long run to obtain a very much larger output from the industries of the country. They had every reason to know that the leaders of Labour were quite in sympathy with their endeavours to bring the conference about. Referring to agriculture, his Lordship said that at the present time—largely as a result of the alarming experiences of the war—there was a livelier interest on the part of the organised farmers of this country in scientific methods than ever there had been during the last generation.

Early Chronology of Sumer and Egypt.

ON Wednesday, April 27, Prof. S. Langdon delivered a lecture on behalf of the Egypt Exploration Society at the Royal Society's rooms at Burlington House on "The Early Chronology of Sumer and Egypt and the Similarities of their Culture." The chair was taken by Lord Carnarvon, who has just returned from Egypt and gave a few interesting details of recent excavation work carried out there.

Prof. Langdon said that the ancient people commonly known as the Egyptians were not the first civilised people on the banks of the Nile, but they were preceded by an Asiatic people who were probably Sumerians or Elamites. These two Asiatic peoples are now known to have belonged to the same race, and they founded the first organised societies known to history on the shores of the Persian Gulf and in Elam in the Stone age. The Sumerians, the most talented branch of a widely spread race, spoke a highly organised agglutinating speech. They are found in prehistoric levels from the head of the Persian Gulf northwards along the banks of the Euphrates and the Tigris as far as Assur, north of the Lower Zab, and in Russian Turkestan. Recently discovered dynastic tablets establish the date of the earliest kingdoms of Mesopotamia as early as 5000 B.C. At that time the Semites had already invaded the Mesopotamian Valley and established themselves in the region of Bagdad. The history of ancient Babylonia consists of two rival kingdoms, Sumer in the south, the principal capital of which was Erech, and Kish in the north, the principal capital of which from 5000–2900 B.C. was at Kish.

The earliest Sumerian culture is strikingly similar to that of prehistoric Egypt; it must be assumed that a branch of this people occupied Upper Egypt in the region of Abydos and Hieraconpolis as early as 5000 B.C. The Sumerian linear pictographic writing is clearly revealed in the Egyptian pottery markings which preceded the Egyptian hieroglyphs. This writing is known to have been well developed in Sumer or ancient Chaldea before 3800 B.C., and the prehistoric Egyptian linear style cannot be much later. The Sumerians and Elamites appear to have reached Egypt by sea routes, trading and adventuring along the coasts of southern Arabia until they reached Punt, Ethiopia, and finally the Nile Valley in the region of Coptos. All their prehistoric remains have been found in Upper Egypt, principally at Abydos and Naghada. They brought with them into Egypt the cylinder seal, the mace head, and a style of decoration in stone which is characteristic of Sumerian art.

The characteristic features of this remarkable people were a long head of large brain capacity, a thin, high nose which joined the cranium without depression, a slightly receding forehead, and eyes the axes of which are not horizontal, but slant slightly outward. The position of the axis of the eye is precisely the reverse of the Mongolian type. It is possible to discern in their prehistoric tomb paintings in Egypt the same physical characteristics. They disappeared in Egypt some time before the first Egyptian dynasty founded by Menes, and were superseded by an African people who amalgamated with Semitic races from Asia. This new race invented their own system of writing, which developed into the classical hieroglyph. The older Sumerian linear style appears to have been used in Egypt without intelligence even by the Sumerian-Egyptians themselves. It was probably never understood in Egypt, and the signs survived only as occult marks on pottery after the older Asiatic peoples had disappeared.

The religion of the Egyptians is obviously related to the Sumerian, and there is no Semitic influence in the fundamental religious concepts of the ancient religions of Babylonia and Egypt. The names of the gods in both pantheons do not reveal a single Semitic name. It is probable that the great cults of Tammuz and Osiris are the creations of two branches of the same people, that of Osiris being inherited by the Egyptians from the older Asiatic people.

Prof. Langdon attempted to fix the beginning of the first Egyptian dynasty by comparing the methods of year-dating of the famous Semitic Emperor Narām-sin (2795–39 B.C.) with those of Egypt. He argued that Narām-sin borrowed his system of year-dating from Egypt, and showed that this could have taken place only after Den, fifth king of the first dynasty. He also argued from archæology to make Narām-sin a contemporary of the last two kings of the second Egyptian dynasty. He arrived by these two methods at a date *circa* 3200 B.C. for Menes.

Imperial Forestry Education.

THE Report of the Interdepartmental Committee on Imperial Forestry Education appointed to prepare a scheme for giving effect to the resolutions of the British Empire Forestry Conference of 1920 with regard to a central institution for training forest officers has just been issued (Cmd. 1166, H.M. Stationery Office, 2*d.*). Keeping in view the decision of the conference that the future higher training in forestry should take place at a single central institution, the Committee recognises that the main object to be aimed at in the training of forest officers is to turn out men fully equipped with theoretical and practical knowledge, with minds broadened by education, and with capacity, strengthened by practical experience in forest work, to direct men and operations. It considers that it would be a retrograde course to interfere with the work already done by universities in establishing and maintaining courses of training in forestry, and seeks rather to co-ordinate all these courses, to bring them up to a common level, and to utilise them as a preliminary to a higher course of training at one centre.

Under this scheme the course of study at a university would extend over three years, leading to a degree in forestry; at this stage men would be selected as probationers for one or other of the forest services, and admitted to the central institution for a period of higher training extending over one year in the case of ordinary forest officers, or longer in the case of those who propose to specialise. In order to widen the field for recruitment and to obtain men with a high scientific training, it is considered desirable that a certain number of probationers should be selected with honours degrees in science; these men should then, after a forestry course covering the second and third years at a university school, spend a final year at the central institution. In the case of men required as specialists honours graduates in science should be selected, given such a course in general forestry as may be considered necessary, and then sent for two years to the central institution.

The Committee directs attention to the great value of maintaining close relations between the central training institution and research work; research into questions affecting forest production as well as entomology, mycology, soil science, and the like should form part of the work of the central institution.

It is proposed that the central institution should be located at Oxford, incorporated with the University, and governed by a board appointed one half by the Departments or Governments concerned and the other half by the University. The director (who should be the professor of forestry) and the staff should be appointed by the University with the approval of the board. The Departments concerned should jointly guarantee to the board an annual sum sufficient to pay the costs of the institution, and should defray any deficit in the annual working in proportion to the number of students trained for the services of each Department. It is estimated that the annual cost of the permanent staff should not at the commencement exceed 4000*l.* per annum. No estimate of the capital cost of the proposed scheme can be made until detailed plans of such buildings as the University are prepared to provide have been obtained and discussed, but pending the erection of permanent buildings it has been ascertained that arrangements can be made with the University for temporary accommodation.

Among other proposals is one that officers of every forest service should at one period of their career return to the institution for a special course.

University and Educational Intelligence.

CAMBRIDGE.—Dr. J. H. D. Scott and Mr. W. W. Harvey, of Christ's College, have been elected to John Lucas Walker studentships in pathology.

Mr. T. C. Wyatt has been elected to a fellowship at Christ's College.

The directors of Messrs. Barclays Bank, Ltd., have given 1000*l.* towards the cost of the new engineering laboratory.

Details of the latest proposals as to women students at Cambridge have now been published. The memorial (which has been signed by nearly two hundred residents, including Sir Clifford Allbutt, Prof. Eddington, Dr. Fenton, Dr. E. H. Griffiths, Prof. Inglis, Sir William Pope, Dr. Rivers, Prof. Seward, Sir Joseph Thomson, and Dr. Whetham) asks that women shall be matriculated as members of women's colleges; shall be eligible for all degrees with all privileges except membership of the Senate and of the Electoral Roll; also that they shall be eligible for scholarships, prizes and studentships, professorships, readerships, lectureships, and examinerships of the University and for membership of boards and syndicates. Women would be present on the council of the Senate as assessors without vote. There would be provision against mixed colleges and against an increase of resident women *in statu pupillari* beyond 500. The council proposes to have this scheme and the alternative scheme, which merely offers the women titular degrees, voted on during the present term. The new scheme is the result of a conference between some of the supporters and some of the opponents of the old Report A, and is backed by the signatures of 115 supporters of Report A and of 50 opponents of this report.

LONDON.—The first of a course of eight advanced lectures in physiology was given in the physiological laboratory, St. Bartholomew's Hospital, West Smithfield, E.C.1, on Tuesday, by Prof. W. D. Halliburton upon the subject of Cerebro-spinal Fluid. The remaining lectures will be as follows:—May 10, Prof. M. S. Pembrey, The Secretion of Milk; May 17, Mr. J. Barcroft, Alpinism; May 24, Prof. W. M. Bayliss, The Reaction of the Blood; May 31, Prof. J. B. Leathes, Tyrosine; June 7, Prof. E. H. Starling, The Heart in Exercise; June 14, Dr. H. H. Dale, Anaphylaxis; and June 21, Dr. Leonard Hill, The Capillary Circulation.

Another course of eight lectures on "Reception of Sensory Stimuli" will be given by Prof. H. E. Roaf in the physiology theatre, London Hospital Medical College, Turner Street, Mile End, E.1, at 4.30 p.m., on Thursdays, May 12, 19, and 26 and June 2, 9, 16, 23, and 30. The lectures in each course are addressed to advanced students of the University and to others interested in the subject. Admission is free, without ticket.

THE Zionist Organisation is prepared to send a lecturer on the Jewish national movement free of all charge to any organisation or society. The lecture can be illustrated by lantern-slides dealing with Palestinian life and scenery. Persons interested should write to the Lecture-Secretary, Zionist Organisation, 77 Great Russell Street, London, W.C.1.

A PROVISIONAL programme has been issued of the summer meeting of the Institution of Electrical Engineers to be held at the Scottish centre (Glasgow) on June 7–10. On the first day of the meeting Mr. R. B. Mitchell will describe the Dalmarnock generating station, which will be followed by a visit to this power station. On the second day Prof. M. Maclean will give a paper entitled "The Hydro-electric Resources of the Scottish Highlands." The last day of the meeting will be spent at Oban, and a visit will be paid to the hydro-electric installation of the British Aluminium Co.

ACTING in co-operation with the Royal Academy of Sciences in Holland, the Anglo-Batavian Society is attempting to foster a fuller understanding between scientific men in Holland and England by arranging for addresses to be given by Dutch lecturers in London and by English men of science in the four universities of the Netherlands. In March last the lectures in Holland were inaugurated at Leyden by Dr. Thomas Lewis, of University College Hospital, who gave an account of his recent work on the heart. On April 14 and 16 Prof. Elliot Smith delivered addresses at Groningen and Utrecht respectively on "Vision and Evolution." In 1912 Prof. Elliot Smith directed attention (NATURE, September 26, 1912) to the far-reaching results in the evolution of the Primates of the substitution of vision for smell as the guiding sense in man's arboreal ancestors. In the Montgomery lecture in Dublin last autumn he developed this theme further by demonstrating the profound influence exerted upon the evolution of the brain by the acquisition of stereoscopic vision. In the lectures given in Holland attention was concentrated on the changes which are brought about in the cerebral cortex of an animal which for the first time acquired powers of true observation and the means of appreciating form, space, and time. The possession of acute vision in conjunction with extreme mobility and co-ordination of the eyes and such delicate tactile instruments as the hands, which under the guidance of vision explore the surrounding world and learn by experiment, gave the animal the curiosity and the incentive to embark upon the voyage of discovery which eventually led to the emergence of man's intelligence and æsthetic appreciation, and as a result the attainment of his distinctive knowledge and powers of discrimination.

Calendar of Scientific Pioneers.

May 5, 1859. Peter Gustav Lejeune Dirichlet died.—The successor of Gauss at Göttingen, Dirichlet did original work on the theory of numbers and Fourier's theorem, and wrote on the discoveries of Gauss and Jacobi.

May 5, 1892. August Wilhelm von Hofmann died.—A great leader in the chemical world, Hofmann in 1845, at the age of twenty-seven, through Liebig, became head of the Royal College of Chemistry, London, where many prominent chemists were trained. His work related to many problems in organic chemistry, and especially to the coal-tar industry. Returning to Germany in 1864, the following year he succeeded Mitscherlich in the University of Berlin.

May 6, 1859. Friedrich Heinrich Alexander, Baron von Humboldt died.—Possessing a passion for travel and science, Humboldt during 1799–1804 made a memorable journey with Bonpland in South America. His great scientific work, "Cosmos," was published during 1845–58.

May 6, 1904. Alexander William Williamson died.—Williamson in 1855 succeeded Graham in the chair of chemistry in University College, London. For his work on etherification he was awarded one of the Royal medals of the Royal Society.

May 8, 1794. Antoine Laurent Lavoisier died.—The founder of modern chemistry and one of the most distinguished victims of the French Revolution, Lavoisier perished beneath the guillotine at the age of fifty. In prison he refused poison, saying, "I set no more value on life than you do; and why seek death before its time? It will have no shame for us. Our true judges are neither the tribunal that will condemn us nor the populace that will insult us. We are stricken down by the plague that is ravaging France." One hundred and six years after his death Paris, as the result of an international subscription, erected the monument to Lavoisier which stands behind the Madeleine Church, close to where he once lived.

May 8, 1892. James Thomson died.—The elder brother of Lord Kelvin, Thomson was a distinguished physicist and engineer, and in 1873 succeeded Rankine in the chair of engineering at Glasgow.

May 9, 1850. Joseph Louis Gay-Lussac died.—A professor of chemistry at the Ecole Polytechnique, Gay-Lussac was known principally for his researches into the chemical and physical properties of gases and vapours. In 1815 he isolated cyanogen.

May 10, 1566. Leonhard Fuchs died.—Fuchs is regarded as one of the founders of German botany. His name is perpetuated by the word "fuchsia," first applied to the plant in 1703 by Plumier.

May 10, 1829. Thomas Young died.—A pioneer in physiological optics, the advocate of the undulatory theory, the first to use the term "energy" for the product of mass into the square of velocity, and the introducer of "Young's modulus," Young has been referred to as the most clear-thinking and far-seeing natural philosopher of his age.

May 10, 1910. Stanislao Cannizzaro died.—The greatest of Italian chemists, Cannizzaro held posts at Pisa, Alessandria, Genoa, and Palermo, took part in the liberation of Sicily, and from 1871 was professor of chemistry at Rome. His greatest work was the extension and application of the hypothesis of Avogadro.

May 12, 1871. Sir John Frederick William Herschel died.—By his work in physics and astronomy and by his writings Herschel exerted a great influence on his fellows. His fame was largely enhanced by his astronomical work at the Cape of Good Hope during 1834–38.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, April 21.—Prof. C. S. Sherrington, president, in the chair.—Prof. J. **Joly**: A quantum theory of colour vision. In accordance with the physiological law of nerve impulses, known as the "all-or-none" law, the cone is connected with the optic nerve through a plurality of nerve-fibres, the rod being connected through one fibre only. This is supported by histological evidence. The fundamental colour-sensations may be taken as corresponding to frequencies in the ratio 2 : 3 : 4, and this is the ratio of the energies of the corresponding quanta and of the kinetic energies of the electrons liberated. It is supposed that this is also the ratio of the numbers of fibres activated in the cone. In the case of the rod, quanta can activate but one fibre; hence its achromatic functions. In the case of the cone the activation of two, three, or four fibres evokes the fundamental sensations. White sensation arises when all nine fibres are activated. Colour-sensation curves, colour blindness, and the energy relations of colour sensation and luminous sensation are discussed.—Prof. A. V. **Hill**: The energy involved in the electric change in muscle and nerve. An expression is given for the heating effect in a muscle or nerve of the currents produced by the electric response accompanying the propagated impulse. In a muscle the heat produced is not more than one-hundred-thousandth part of the energy liberated in a twitch; in a nerve it is of the order of size of $3 \cdot 5 \times 10^{-10}$ calorie. It is concluded from the smallness of these quantities that no appreciable provision of energy is required in the propagation of the electric response, and that the physico-chemical change producing the response is the only factor involved in the propagated nervous impulse.—H. M. **Kyle**: Asymmetry, metamorphosis, and origin of flat-fishes. The flat-fishes owe their change of form in the beginning to an inherent asymmetry of the abdominal organs, the coil of the gut; other organs develop asymmetrically according to the balance, and persistent flexures convey the asymmetry to the skull. Many normal teleosts form a coil and display the same initial disturbances, but their balance is less defective and the skull escapes deformity in various ways. The metamorphosis of flat-fishes takes place during the pelagic stages; the fish swims and lies on one side because that side becomes the heavier. After the demersal habitat has been attained, changes in fundamental structure are improbable, so essential differences indicate separate origins. The flat-fishes have appeared in phylogeny—that is, the skull became affected by the asymmetry of the body when the coil of the gut was forming and when the caudal region came to occupy more than half the total length. Confirmation of this view is found in the affinity of each group to separate types of normal teleosts ranging from the Macrurids to the Percoids.—T. L. **Prankerd**: Studies in the cytology of the statolith apparatus in plants, viewed in relation to their habit and biological requirements. (1) The reaction to external stimuli of some liverworts. The degree of geotropic irritability corresponds in general with the biological requirements of the plant. The statolith apparatus is usually absent in vegetative thalli where position is of no importance, while it is most strikingly developed in the strongly geotropic gametophores and sporogonia. (2) The movements executed by fern-fronds in response to internal and external stimuli. In fifteen species representative of the Filicales geotropic irritability was always present, though both latent and reaction times are greater than the corresponding periods for Angiosperms, implying physiological evolution. A cylinder of statocyte tissue is always developed in the ground tissue of the young rachis, which disappears at about the time of unfolding of the leaflets, when response to gravity also ceases. In *Asplenium bulbiferum* a curve showing the amount of statocyte tissue present corresponds more closely with the curve of geotropism. Growth continues some time after the simultaneous loss of the statolith apparatus and the power of gravitational response.

April 28.—Prof. C. S. Sherrington, president, in the chair.—Prof. H. **Lamb** and R. V. **Southwell**: The vibrations of a spinning disc. This investigation was suggested by the occasional failure of the blades of steam turbines, apparently resulting from flexural vibrations of the turbine disc. Expressions have been obtained for the gravest natural frequencies of vibration (1) by exact methods, on the assumption that the disc is so thin or rotates so fast that the restoring effects of centrifugal force are predominant and the effects of flexural rigidity negligible; (2) from Kirchhoff's theory for flat circular plates, in cases for which the opposite assumption can be made; and (3) by Rayleigh's approximate method, employing an *assumed* curve of deflection, for cases in which both centrifugal and flexural effects require to be taken into account. Employing method (3), the gravest natural frequency of vibration must be over-estimated. It is shown that a corresponding lower limit can be obtained by considering each restoring system separately.—Dr. W. **Rosenhain**: The hardness of solid solutions. It is suggested that crystals of a solid solution of metal B in metal A are built up on a single space-lattice system similar to that of crystals of pure A, but that certain atoms of A are replaced by atoms of B. As the atoms of B are necessarily dissimilar from atoms of A, this involves a certain amount of distortion of the space-lattice, the amount of which will depend upon the degree of dissimilarity between the two kinds of atoms. The mechanical properties of the crystals will be affected by the distortion, surfaces which were plane gliding surfaces in the crystals of pure A being no longer perfectly plane in the solid solution crystals, and consequently offering an increased resistance to slip within the crystal. The greater the distortion produced by the introduction of an atom of B, the greater will be the hardening effect of the introduction of B into A in the form of solid solution. As a first approximation, the hardening effect of one metal upon another in solid solution is inversely proportional to the solubility of that metal in the first. This is shown to be in accordance with fact in regard to the alloys of many metals.—W. **Hartree** and Prof. A. V. **Hill**: A method of analysing galvanometer records. The motion of a galvanometer connected to a thermopile in contact with a body producing or absorbing heat is governed by linear differential equations with constant coefficients. From the relation between galvanometer deflection and time the relation between heat-production and time can be determined. It is necessary to construct a "control curve," *i.e.* the relation between galvanometer deflection and time for an instantaneous liberation of heat in the body on the thermopile. The observed curve is reconstructed in terms of the control curve, and, employing a numerical method described, a fair analysis of the course of the production or absorption of heat can be made.—F. H. **Newman**: A new form of Wehnelt interrupter. The new interrupter consists of a platinum wire immersed in a saturated solution of ammonium phosphate. The whole is contained in an aluminium vessel, which acts as the cathode. The current density at the anode is one-quarter of the value in the old form of Wehnelt interrupter; consequently there is less heating of the electrolyte and less disintegration of the platinum wire. The interrupter can be used with alternating currents, which it rectifies. The secondary discharge, obtained from the new type of interrupter, is very disruptive, and has a large peak value. There is no self-induction in the circuit when used with alternating currents. The primary current wave-form has been investigated with direct and alternating currents.—T. L. **Ibbs**: Some experiments on thermal diffusion. The method depends on the use of the katharometer as an instrument for accurate gas analysis. A temperature gradient was applied to a number of mixtures of hydrogen and carbon dioxide by passing them through a cylindrical glass tube down the middle of which was a platinum helix heated by an electric current. A steady flow of the gas mixture was maintained, and the gases were drawn off from the hot and cold regions of the tube, afterwards passing through a differential katharometer for analysis. There was a general tendency for the hydrogen to diffuse towards the hotter region and the carbon dioxide towards the cooler region, confirming the results of Chapman and Dootson. Curves are drawn showing that the amount of separation is proportional to $\log T_1/T_2$, where T_1 and T_2 are the absolute temperatures of the hot and cold regions. The maximum separation for a given temperature gradient is obtained in mixtures containing from 50–60 per cent. by volume of hydrogen. The results give strong support to the theory worked out by Chapman in his kinetic theory of gases. The amount of separation is less than would be expected if gas molecules behaved like rigid elastic spheres.—B. N. **Chakravarty**: The diffraction of light incident at nearly the critical angle on the boundary between two media.

Association of Economic Biologists, April 22.—Sir David Prain in the chair.—W. A. **Millard**: Green-plant matter as a "decoy" for Actinomyces scabies in the soil. The work of Gillespie, Hurst, and Martin was criticised and the obligate relation of potato-scab to a certain range of hydrogen-ion values disproved. Experiments carried out during several years at Leeds were described and interpreted in terms of the author's "decoy" theory.—E. H. **Richards**: The action of bacteria and protozoa in conserving the nitrogen in sewage. A brief account was given of the activated-sludge process by which intense aerobic treatment increases the nitrogen content from 2 per cent. to from 5 to $7\frac{1}{2}$ per cent., the whole of this being derived from the urea in the initial sewage. Estimating the weight of dry matter in protozoa and bacteria at 25 per cent., the author's experiments at the Rothamsted Experimental Station showed that the nitrogen contained in these organisms gave 8 per cent., a remarkably close approximation to the increased nitrogen after activating sewage. Rothamsted experiments were described which illustrated the valuable manurial properties of activated sludge.—G. P. **Wiltshire**: The methods of infection of the apple canker fungus. The parasite enters apple-trees through wounds caused by various natural and artificial agents, but the primary channel of invasion is through small cracks in the leaf-scars. The course of such infection was described in relation to the relative susceptibilities of different varieties of apple. The discovery of leaf-scar infection modifies ideas as to the treatment of apple canker, and possible control measures were considered.

PARIS.

Academy of Sciences, April 11.—M. Georges Lemoine in the chair.—P. **Appell**: The periodic movement of a fluid.—B. **Baillaud**: Observations of the solar eclipse of April 7, 1921, at the Paris Observatory.—H. **Douvillé**: The explanation of the appearance of certain new forms of Lamellibranchs.—A. **de Gramont**: The utility in physical astronomy of the consideration of sensibility of lines of the spectrum.—M. **de Sparre**: The maximum yield of turbines.—M. Emile Borel was elected a member of the section of geometry in succession to the late Georges Humbert.—P. **Humbert**: The polynomials of Hermite-Didon and the Laplace functions in hyperspace.—A. **Denjoy**: The characters of certain integrable functions and the corresponding operations.—C. **Nordmann**: The apparent diameter of α Orion. The apparent diameter of this star has been recently determined by Michelson, making use of an interference method the principle of which is due to Fizeau. Michelson's figure 0·046″ is compared with the figure (0·059″) obtained by the author's indirect method based on photometry.—E. **Esclangon**: Observations of the eclipse of the sun of April 8 made at the Strasbourg Observatory.—A. **Lebeuf**: The eclipse of the sun of April 7, 1921. *Résumé* of observations carried out at the Besançon Observatory.—M. **Moreux**: Observation of the eclipse of the sun of April 8, 1921. The phenomenon of the black drop was seen during this eclipse.—M. **Michkovitch**: Observations of the Reid comet (1921*a*) made at the Observatory of Marseilles with the Eichens 26-cm. equatorial. Positions are given for April 4, 5, and 6.—J. **Mascart**: The eclipse of the sun of April 7, 1921, at the Observatory of Lyons.—P. **Stroobant**: The flattening of the spheroid of Saturn. From the displacements of the line of nodes of the satellites an average figure of 0·1027 or 1/9·74 is found for the flattening. This value is probably more accurate than data based on direct determinations.—A. **Dauvillier**: The structure of the L series.—G. **Reboul** and R. **Luce**: The influence of the geometrical form of solid bodies on the chemical actions which they undergo. Further experimental confirmation of the conclusions arrived at in an earlier confirmation; the velocity of reaction is always greatest at the points where the radius of curvature is smallest.—A. A. **Guntz**: An automatic apparatus for recording the variations of a gaseous mass with time. The manometer measuring the volume changes in the gas has a fine nichrome wire stretched throughout its length; this forms an arm of a Wheatstone bridge, and thus the volume changes converted into resistances are recorded photographically. The whole of the gas is kept at constant disgregation by balancing against a compensation tube kept at a constant temperature. This balance is maintained automatically by a separate electrical arrangement.—C. **Matignon** and Mlle. G. **Marchal**: The use of enamelled bombs in calorimetry. Some of the enamels now in use for lining calorimetric bombs are attacked by dilute acids, and the amount dissolved is sufficient to interfere with the accuracy of the nitric acid correction, and also with the use of the bomb in analytical determinations (sulphur, phosphorus, etc.). The effect is most marked with new enamel.—G. **Dupont**: Contribution to the study of the acid constituents of the resinous exudation from the pine. The dextro- and lævo-pimaric acids. By the usual methods of extraction the lævo-acid is converted into its optical isomeride. The technique necessary for the isolation of either acid in a pure state is described.—J. **Rouch**: Observations of the electrical field of the atmosphere during the eclipse of the sun of April 8, 1921. The electrical field underwent a marked diminution; there was a lag of about an hour from the middle of the eclipse.—A. **Briquet**: The Low Country of Picardy north of the Somme; the line of the ancient bank.—S. **Stefanescu**: The asymmetry and the technical longitudinal sections of the crown of the molars of mastodons and elephants.—A. **Dehorne**: Heterotypy in the somatic mitosis of *Corethra plumicornis*.—P. **Wintrebert**: The aneural irritability of the ectoderm revealed by the ciliary displacement of the embryo in *Rana temporaria*.—W. **Kopaczewski**: Surface tension and antianaphylaxy. A criticism of the views and experiments of M. A. Lumière on the importance of surface tension in connection with anaphylactic shock.—M. **Kayser**: Researches on the azobacter.

Books Received.

Aspects of Plant Life, with Special Reference to the British Flora. By Robert L. Praeger. (Nature Lover's Series.) Pp. 208. (London: S.P.C.K.; New York: The Macmillan Co.) 6*s*. net.

The Yearbook of the Universities of the Empire, 1921. Edited by W. H. Dawson. Pp. xiv+571. (London: G. Bell and Sons, Ltd.) 15*s*. net.

Le Destin des Etoiles: Etudes d'Astronomie physique. By Svante Arrhenius. Traduction française by T. Seyrig. (Nouvelle Collection scientifique.) Pp. v+224. (Paris: F. Alcan.) 8 francs net.

Thermodynamics and Chemistry. By Prof. F. H. MacDougall. Pp. v+391. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 30*s*. net.

The Practice of Silviculture. By Prof. Ralph C. Hawley. Pp. xi+352. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 22*s*. net.

The Formation of Colloids. By Prof. Th. Svedberg. (Monographs on the Physics and Chemistry of Colloids.) Pp. 127. (London: J. and A. Churchill.) 7*s*. 6*d*. net.

Man and his Past. By O. G. S. Crawford. Pp. xv+227. (London: Oxford University Press.) 10*s*. 6*d*. net.

Critical Microscopy: How to Get the Best out of the Microscope. By Dr. Alfred C. Coles. Pp. viii+100+iii plates. (London: J. and A. Churchill.) 7*s*. 6*d*. net.

Drugs in Commerce: Their Source, Preparation for the Market, and Description. By John Humphrey. (Common Commodities and Industries.) Pp. xi+116. (London: Sir I. Pitman and Sons, Ltd.) 3*s*. net.

Stella Maitland; or, Love and the Stars. By Hester P. Hawkins. Pp. viii+249. (London: Simpkin, Marshall and Co., Ltd.) 6*s*. net.

Faune de France. By Prof. R. Koehler. No. 1: Echinodermes. Pp. 210. (Paris: P. Lechavelier.)

Post-Graduate Teaching in the University of Calcutta, 1919–20. Pp. 112. (Calcutta: University Press.)

Diary of Societies.

THURSDAY, MAY 5.

IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10 and 2.30.—H. Brearley: The Welding of Steel in relation to the Occurrence of Pipe Blow Holes and Segregates in Ingots.—Dr. J. E. Stead: Solid Solution of Oxygen in Iron.—H. T. Ringrose: Scientific Control of Combustion.—J. E. Fletcher: Open-hearth and Other Slags—their Composition and Graphic Methods for determining their Constitution.—S. H. Fowles: Notes on the Cleaning of Blast-furnace Gas.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. S. Myers: Psychological Studies: (1) The Localisation of Sound.

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital, Paddington), at 4.30.—Prof. L. Hill: Capillary Blood Pressure and Œdema.

ROYAL SOCIETY, at 4.30.—Dr. H. Head: Release of Function in the Nervous System (Croonian Lecture).

LINNEAN SOCIETY, at 5.—Prof. J. Stanley Gardiner: Reports on Collections from the Indian Ocean for Issue in the Society's Forthcoming Transactions, vol. xviii.—E. R. Speyer: Insects

in relation to Reproduction in Coniferous Trees.—Prof. W. J. Dakin: The Collections from the Houtman Abrolhos Islands in 1913.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 5.—F. C. Eden: Architecture and Travel.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss F. E. Webb and Others: Individual Training in the School.
INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Discussion on Tariffs (continued).
CHEMICAL SOCIETY, at 8.—G. A. R. Kon: The Formation and Stability of *spiro*-Compounds. Part IV. The Formation of Ketones Derived from Open-chain and Cyclic Glutaric Acids by the Thermal Decomposition of their Calcium Salts.—G. W. Monier-Williams: The Hydrolysis of Cotton Cellulose.—J. L. Baker and H. F. E. Hulton: Amylases of the Cereal Grains: Rye.
ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Annual General Meeting.—H. Curtis: Angioma of the Vagina Spontaneously Evacuated.—Dr. A. E. Giles and Others: The Causes and Treatment of Sterility.

FRIDAY, MAY 6.

IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10 and 2.30.—S. N. Brayshaw: The Prevention of Hardening Cracks, and the Effect of Controlling the Recalescence of a Tungsten Tool Steel.—Dr. J. Newton Friend: The Protection of Iron with Paint against Atmospheric Corrosion.—K. Honda, T. Matsushita, and S. Idei: The Cause of Quenching Cracks.—W. E. Hughes: Slip-lines and Twinning in Electro-deposited Iron.—A. Westgren: Röntgen Spectrographic Investigations of Iron and Steel.—J. H. Whiteley: Cupric Etching Effects produced by Phosphorus and Oxygen in Iron.
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.45.—Annual General Meeting.
ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Sir Napier Shaw, Col. E. Gold, W. H. Dines, and F. J. W. Whipple: The Structure of the Atmosphere up to 20 kilometres. Chairman: Dr. G. C. Simpson.
INSTITUTE OF TRANSPORT (Graduates and Students' Section) (at Royal Society of Arts), at 5.—D. J. Owen: Docks and Harbours: General Structural Lay-out, Systems of Control, Operation, and Charges.
JUNIOR INSTITUTION OF ENGINEERS, at 8.—D. W. Wood: Fire Resistance of Aggregates for Reinforced Concrete.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Robert Robertson: War Developments of Explosives.

SATURDAY, MAY 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. C. C. Baly: Chemical Reaction.

MONDAY, MAY 9.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.
ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Col. Sir Sidney Burrard: The Origin of Mountain Ranges.
INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at Chartered Institute of Patent Agents), at 7.
INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Meeting), at 7.—W. H. Sawyer: The Engineering Aspect of Modern Iron-foundry Practice.
FARADAY SOCIETY (at Chemical Society), at 8.—E. K. Rideal and U. R. Evans: The Problem of the Fuel Cell.—L. F. Knapp: The Solubility of Small Particles and the Stability of Colloids.—Prof. F. G. Donnan: Note on a Formula Expressing the Variation of Surface Tension with Temperature.—Studies in Capillarity: Continuation of Discussion held at Manchester on the following papers:—A. Ferguson: Part I. Some General Considerations and a Discussion of the Methods of Measuring Interfacial Tensions.—A. Ferguson and P. E. Dowson: Part II. A Modification of the Capillary Tube Method for the Measurement of Surface Tensions.
SURVEYORS' INSTITUTION, at 8.—T. A. O'Donahue: The Valuation of Mineral Properties, with Special Reference to Post-War Conditions.

TUESDAY, MAY 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Keith: Darwin's Theory of Man's Origin in the Light of Present-Day Evidence.
INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Prof. P. Carmody: Trinidad as a Key to the Origin of Petroleum.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—R. I. Pocock: The Auditory Bulla and other Cranial Characters in the Mustelidæ (Martens, Badgers, etc.).—G. S. Thapar: The Venous System of the Lizard, *Varanus bengalensis*, Daud.—Dr. C. W. Andrews: The Skull of *Dinotherium giganteum* in the British Museum.
ROYAL PHOTOGRAPHIC SOCIETY, at 7.—L. P. Clerc: The Theory of the Screen in Half-Tone Work.—K. C. D. Hickman: Suggestions for a New Printing Process.—Prof. The Svedberg: Behaviour of the Silver Bromide Particles in Dry Plates towards Light, α and β Rays.
QUEKETT MICROSCOPICAL CLUB, at 7.30.

WEDNESDAY, MAY 11.

NEWCOMEN SOCIETY (at Iron and Steel Institute), at 5.—Rhys Jenkins: Rise and Fall of the Sussex Iron Industry (conclusion).
ROYAL SOCIETY OF ARTS, at 6.—A. E. Hayes: Phonoscript: A New Method in the Phonetic Teaching of English Pronunciation.
ROYAL MICROSCOPICAL SOCIETY (Metallurgical Section), at 7.30.—G. Patchin: The Application of Microscopy to the Metal Industry.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 8.

THURSDAY, MAY 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. S. Myers: Psychological Studies: (2) The Appreciation of Music.
INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital, Paddington), at 4.30.—Sir James Mackenzie: The Opportunities of the General Practitioner are Essential for the Investigation of Disease and for the Progress of Medicine.
ROYAL SOCIETY, at 4.30.—*Probable Papers*.—G. W. Walker: The Problem of Finite Focal Depth revealed by Seismometers.—E. A. Griffiths: A Liquid Oxygen Vaporiser.—Dorothy M. Palmer and W. G. Palmer: Some Experiments on the Catalytic Reduction of Ethylene to Ethane.—W. G. Palmer: The Catalytic Activity of Copper. Part II.—Prof. J. F. Jenkin and D. N. Shorthose: The Total Heat of Liquid Carbonic Acid.—Dr. A. O. Rankine: The Viscosity and Molecular Dimensions of Gaseous Cyanogen.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.

FRIDAY, MAY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.
PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—L. Hartshorn and E. S. Keeping: Notes on Vacuum Tubes used as Detectors of Electrical Oscillations.—B. W. Clack: The Coefficient of Diffusion of Certain Saturated Solutions.—Dr. G. D. West: Experiments on Thermal Transpiration Currents.
ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.—Annual General Meeting.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. W. Bateson: The Determination of Sex.

SATURDAY, MAY 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. C. C. Baly: Chemical Reaction.

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