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The Explosion at the Nitrogen Fixation Works, Oppau.

ON the morning of September 21 an explosion causing enormous damage occurred at the nitrogen fixation works of the Badische Anilin und Sodafabrik at Oppau, near Ludwigshafen, on the Rhine. The town of Oppau has been entirely wrecked and presents the appearance of war-devastated ruins, and the neighbouring village of Edigheim has met with the same fate. Numbers from 500 to 2000 are given as estimates of the killed, and the other casualties must be very large. It is stated that the explosion was felt 175 miles away at Munich. Photographs which have come to hand of the scene of the disaster show a huge crater.

The history of the works at Oppau is of great interest, and their importance to Germany was supreme during the war, for it was there that synthetic ammonia was produced in enormous quantities sufficient, together with ammonia from another synthetic source and from gas works, to enable Germany to obtain nitric acid for the manufacture of high explosives, when the supply of Chile saltpetre, the former source of that acid, had been cut off by the Allies.

The experimental work on the combination of nitrogen and hydrogen carried out by Haber and his colleagues at Carlsruhe had been closely watched and partly subsidised by the Badische company, which ultimately took over the process, and after a trial in an existing factory it erected the works at Oppau shortly before the war to operate the Haber-Bosch process. The necessity for fixing nitrogen from the air after the first set-back to the German attack brought about a large extension of these works, until, it is stated, about 200 tons of ammonia a day were produced there. The magnitude of this technical achievement is apparent when one considers the enormous volumes of hydrogen and nitrogen that had to be prepared and purified, the mechanical and chemical difficulties that had to be overcome in bringing about their combination under heat and pressure in large steel bombs charged with a catalyst, and the complexity of the contingent plant for movement of gases and liquids and for absorption and concentration. Many millions sterling were expended on the construction of the plant, which required several thousands of skilled workers to operate it.

The ammonia thus formed was largely converted into nitric acid by the Ostwald-Mittasch method during the war, but since then it has been used for the manufacture of fertilisers, such as ammonium sulphate and ammonium nitrate. The formation of ammonium nitrate is particularly favourable, as it involves oxidation of only a portion of the ammonia to nitric acid. The Germans claim to have overcome the difficulties of the application of this hygroscopic salt for agricultural purposes, and to have had good results from its use.

In addition to the Oppau factory, a still larger one operating on the same lines has been erected at Merseburg, in central Germany, capable, it is said, of producing 800 tons of ammonia a day.

While the cause of the disaster will no doubt be fully investigated, the significant statement is attributed to one of the directors that the explosion must have taken place in a store of "ammonium sulphate saltpetre." Presumably a store of ammonium nitrate (Ger. ammonsalpeter) with or without admixture with ammonium sulphate is meant. In another account the quantity of this material is given as 4000 tons. Although ammonium nitrate was used in very large quantities in this country during the war for mixing with trinitrotoluene to form amatol, no accidents occurred in handling it. Circumstances have, however, occurred, mostly elsewhere, that have thrown some suspicion on its being quite innocuous from the point of view of danger; but to bring ammonium nitrate, which is an explosive body, up to the pitch of violent explosion or detonation requires the application of a very intense initial impulse. This has been done by detonating in its midst a high explosive, and a comparative measure of the violence of ammonium nitrate itself and of its mixtures with trinitrotoluene was quoted in a recent lecture to the Chemical Society. The appearance of the crater formed in the Oppau explosion is reminiscent of the effect of the detonation of a large quantity of explosive, and the result of the inquiry into the cause of the disaster is awaited with much interest. The factory is in the zone occupied by the French, and medical and other assistance is being rendered by them and by the other Allied troops on the Rhine.

Applied Chemistry.

(1) *An Introduction to the Chemistry of Plant Products.* Vol. 1: *On the Nature and Significance of the Commoner Organic Compounds of Plants.* By Dr. P. Haas and T. G. Hill. Third edition. Pp. xiii+414. (London: Longmans, Green, and Co., 1921.) 16*s.* net.

(2) *Kieselsäure und Silicate.* By H. le Chatelier. Berechtigte Uebersetzung by Dr. H. Finkelstein. Pp. xi+458. (Leipzig: Akademische Verlagsgesellschaft m.b.H.: Gustav Fock, 1920.)

(3) *The Volatile Oils.* By E. Gildemeister and Fr. Hoffmann. Second edition by E. Gildemeister. Authorised translation by Edward Kremers. Second volume. Pp. xx+686. (London: Longmans, Green, and Co., 1920.) 32*s.* net.

(4) *The Fundamental Processes of Dye Chemistry.* By Prof. H. E. Fierz-David. Translated by Dr. F. A. Mason. Pp xiv+240+19 plates. (London: J. and A. Churchill, 1921.) 21*s.* net.

(1) MESSRS. HAAS AND HILL'S "Chemistry of Plant Products" is now in its third edition. As it has been reprinted, the opportunity has been taken to rearrange the subject-matter and to devote more attention to physiological problems. This has caused a considerable enlargement of the work, which will now appear in two volumes. The present volume—the first of the series—deals primarily with the chemistry of the subject and, in the main, consists of the chemical matter of the earlier editions, revised and brought up to date, and to some extent rewritten. It is arranged under ten sections, viz.: Fats, oils, and waxes, and phosphatides; aldehydes; carbohydrates; glucosides; tannins; pigments; nitrogen bases; colloids; proteins; and enzymes. Each section is largely subdivided, so as to make it as comprehensive as possible. There is, of course, no necessary chemical connection between the several sections. It is probably impossible to devise a perfectly rational scheme of classification, as in a well-ordered treatise of chemistry, where the several parts are knit together in more or less logical sequence. The scheme adopted by the authors certainly serves to bring together all the more important facts connected with the chemistry of plants and plant products, and with the aid of an excellent index and an ample bibliography there should be little difficulty in the search for information.

The analytical section is one of the most commendable features of the work. It has been carefully compiled, and the several methods are adequately described. It is perhaps impossible now to make the change, but honour is not given where honour is due by ascribing to Fehling the method of determining certain sugars by the reduction of an alkaline tartrate solution of copper sulphate. The real author of this method was the French chemist Barreswil, and his name should be given to it. The merit of the German chemist consisted in studying the conditions under which the method gave consistent and uniform results, but he added no original feature to the process. In consequence of the great development of the sugar industry in Germany, Fehling's directions were generally followed in that country, and his name came to be associated thereby with the method. Similar instances of misappropriation are not unknown in German chemical literature.

(2) Dr. Finkelstein's translation of le Chatelier's admirable monograph, "La Silice et les Silicates," was made during the winter of 1913–14—that is, within a few months of the appearance of the French work—but its publication has been delayed by the occurrence of the Great War. The delay has, however, enabled the translator to include a certain amount of new matter dealing with refractories, and has thereby added to the value of the treatise. Le Chatelier's work on silicic acid and its industrially important compounds is unquestionably the most learned contribution yet made to the literature of the subject. It is a model of what such a monograph should be—excellently arranged, clear, concise yet adequately full, and scrupulously accurate. The compilation of such a work must have required an enormous amount of research and reading, in addition to an intimate personal acquaintance with the subject based upon long-continued original inquiry. Indeed, this note of originality, obvious on almost every page, is one of the most characteristic features of the book. It is to be seen in the judicious and critical treatment of the subject-matter, even when the author is dealing with other men's work, all of which is

tried and tested in the light of a personal experience well-nigh omniscient so far as regards the material in question.

Dr. Finkelstein has done his work excellently, and his translation reads well. He has managed to convey something of the clarity and polish of style of the original. The book is well illustrated with *clichés* from the French edition, and is admirably printed. It is, however, worthy of a better index.

(3) The printing of the English translation by Dr. Kremers of the second volume of the second edition of the standard work, by Gildemeister and Fr. Hoffmann, on the volatile oils was completed in 1916, but its publication was delayed until last year. The treatise, which is the most authoritative work on the so-called essential oils, is produced under the auspices of the well-known firm of Schimmel and Co., of Miltitz, near Leipzig, who are among the leading manufacturers of these products, and have contributed largely to our knowledge of their chemistry by the systematic investigations which they have caused to be made. In fact, a very considerable amount of the analytical and physical data concerning this particular class of substances emanates from their laboratories.

The number of the essential oils already known, and more or less well investigated, is legion. The volume before us describes the chemical and physical characteristics of upwards of 400, and includes only the oils up to and embracing those of the Zygophyllaceæ and of part of the Rutaceæ of Engler's "Syllabus der Pflanzenfamilien." Another volume will be required to deal with the rest. Many of these substances are obtainable in very small quantity, and have little or no commercial value. Others are important articles of trade and produced in large quantities. Whether they are made in large or in small amounts, their regular investigation is part of the routine work of the Schimmel laboratories, and the results are published periodically in their well-known reports; ultimately they find their way into the successive editions of this treatise. Of course, the book also takes note of other published work. Indeed, its bibliography is an important and valuable feature of the work. Practically everything that is known at the time of compilation or revision on the subject of volatile oils is probably to be found in it.

The book is suitably illustrated with reproductions from photographs and drawings of apparatus and distilling plant, and it is also provided with excellent maps of the areas of production of some of the more important oils. Its bibliography and index are remarkably complete. As a work of reference it leaves little to be desired.

(4) Dr. F. A. Mason has put the colour industry of this country under an obligation to him by his translation of Prof. Fierz-David's well-known work on "The Fundamental Processes of Dye Chemistry." It deals with the general operations—sulphonations, nitrations and reductions, chlorinations, oxidations, condensations, azotisations, and couplings—incidental to the manufacture of synthetic colouring matters, and describes the intermediates employed and the special apparatus needed. These operations should be carried out on a semi-manufacturing scale, and the apparatus involved should be similar in character to that employed in actual practice. The several processes are described in full, and illustrated by drawings and plans, such as an engineer could work from, of the plant to be used.

Valuable features of the book are the notes on works technique and on works management, which are based on an extensive practical experience. It will surprise some people to be told that, as compared with other industries, the value of the entire world production of dyes is very slight, its worth, according to Prof. Fierz-David, being in 1913 20,000,000*l.*—not more than a tenth part of the value of the wool crop, or a fifth of the cotton crop, or a third of the rubber crop. The chance, therefore, that synthetic dyes, made in Germany, can furnish any considerable fraction of the amount demanded by the Allies by way of "reparations" is not so great as is generally supposed. At the same time that is no reason why the manufacture, which is a staple industry in Germany, should not bear its proper share of the penalty which Germany has incurred by her unrighteous acts.

Institution and Behaviour in Fijian Society.

Fijian Society; or, The Sociology and Psychology of the Fijians. By the Rev. W. Deane. Pp. xv+255. (London: Macmillan and Co., Ltd., 1921.) 16*s.* net.

MR. DEANE'S work deals, among other topics, with the child-life, games, religion, ancestor-cult, sacred stones, symbolism, moral character, etiquette, fishing, food-prohibitions, and cannibalism of the Fijians. He does not attempt to give more than a sketch of some aspects of Fijian life, and some value is taken from his work by his habit of quoting other authorities instead of telling his own story. The authoritative work on Fiji has yet to be written, and ethnologists are eagerly awaiting some such work from the pen of Mr. A. M. Hocart, whose preliminary sketches give promise of so much to come.

The work under notice is, in its way, excellent. In his treatment of psychology the author does not follow the usual practice of accounting for the beliefs and practices of uncivilised folk by means of some extemporised psychological explanation. On the contrary, his work contains some of the soundest social psychology that it has been our good fortune to read for many a day. The author is keenly aware of the interrelationship of social institution and behaviour. For instance, he, along with the Rev. T. Williams, fails to detect any element of wonder in Fijian religion, but finds plenty of fear. He does not, however, claim that this fear has been aroused in the Fijian by his experience of natural phenomena; on the contrary, "the answer is to be found in his history and past social life." The Fijian race has had a warlike past, and the people have been at the mercy of cruel, warlike chiefs. "He knew what invasion meant, and he was a victim to the war-terror by night and day. . . . Fear was 'bred in his bone.' It is not wonderful, therefore, that fear came out in his religious life . . . at the present time, fear is inseparable from the Fijian nature, and . . . this fear is the result of his history and past social environment."

Again, in speaking of the moral character of the Fijian, Mr. Deane says: "Many people are led by erroneous or narrow conceptions of social life in general to forget that the Fijian's past is crystallised in his present social surroundings, and they proceed forthwith to pronounce judgment upon him as if he had had the same history as a European. The diagnoses of such people are, therefore, often unjust, caustic, and unscientific. For they take single threads of his character, and judge therefrom the warp and woof of all." In some capital chapters on the influence of social organisation on behaviour, the author sums up his method of inquiry in terms that reveal his attitude: "So far we have examined the Fijian character as *expressed* in certain religious beliefs, social customs, and ceremonial symbols. We shall now study it more directly as the *outcome* of particular social institutions." He proceeds forthwith to give an analysis of the effects of communism upon human behaviour that should be read by some of our individualists, as well as by the communists, for both will find there something to learn that will not entirely please them. Fijian communism has its good, as well as its bad, side.

It is interesting to note that the great increase of warfare and cannibalism in Fiji was due to the introduction of firearms. Europeans have much to answer for in the matter of stirring up strife in various parts of the earth. "The ancient legends describe a peaceful immigration of a few half-shipwrecked and forlorn people. . . . It is not till long after that any serious war is even hinted at"—a state of things that is apparently typical of the early history of the Pacific.

Altogether a readable and eminently human book, with much reasoning on human behaviour far in advance of that usually found in ethnological literature.

W. J. PERRY.

Laboratory Designs.

Laboratories: Their Planning and Fittings. By A. E. Munby. With a historical introduction by Sir Arthur E. Shipley. Pp. xix+220. (London: G. Bell and Sons, Ltd., 1921.) 25s. net.

AN up-to-date compendium of experience in all that pertains to laboratory design and fittings is provided by this volume, which is well illustrated by plans and sketches of many of the latest buildings for scientific work in schools and colleges. It is accompanied by a criticism of different types, while useful suggestions will be found for making the best use of laboratories run on the more orthodox system of teaching science.

A perusal of the book will well repay those responsible for the extension of science teaching in our educational establishments, and will help to prevent those costly mistakes which, through insufficient knowledge of what has been done elsewhere, have in the past so often characterised the building of scientific laboratories. The publishers, as well as the author, are to be congratulated on the publication of a really useful book in handy size, well bound, and with excellent letterpress.

The first chapter, "The Scope and Inception of Building Schemes," deals with the factors which affect the ultimate design of the building. It is a suggestive presentation of the subject and a comprehensive analysis of the problems that must be considered before any plans can be set out.

Mr. Munby in no way attempts to define the actual requirements of any particular type of school or course of work. His book is intended rather to assist the designer in obtaining the best and most efficient equipment within the limit prescribed by funds available or methods of teaching. Naturally, this has led him to discuss details and designs for the most advanced courses in various branches of science with all the elaboration of subdivision that is found in laboratories of university rank.

For schools a much simpler scheme of fittings is necessary; it is in connection with schools rather than with colleges that new buildings are likely to be required in the near future, although it is impossible to standardise their requirements. The author rightly points out that a great change is taking place in educational methods, and that natural science is likely in the future to become, at least in its elementary stages, more and more diffused into other school subjects, so that eventually every class-room may require special fittings, while the *rôle* of the laboratory as a thing apart may gradually disappear. Such evolution is well exemplified in the teaching of geography. Hence considerations such as these must materially affect all laboratory arrangements and must not be lost sight of in the development of any scheme embarked upon; provision must always be made for extension or adaptation.

The book is refreshingly free from bias; alternative plans are discussed, advantages and disadvantages pointed out, and it is wisely left to the reader to decide what to adopt, modify, or omit.

It is difficult to find any subject concerning the equipment of laboratories and lecture theatres omitted, no matter how trivial. Every possible fitting seems to be described, and the latest designs referred to, in addition to the many valuable hints as to the general arrangements of rooms, their accessibility, relative position, and organisation. Thus while the book itself is not so much constructive as descriptive, it will enable those upon whom is placed the responsibility of all future buildings for science teaching to have at hand a useful guide and trustworthy adviser.

Chap. 2 concerns the requirements of chemistry, chap. 3 those of physics, and chap. 4 those of biology and geology. In chap. 5 the supply of gas, water, steam, and electricity, the ventilation of fume cupboards and hoods, and the more detailed forms of drains are discussed.

The last chapter contains a good description of science buildings: (1) of recent school designs, (2) of recent designs for advanced work, and (3) of recent foreign designs.

Mr. Munby has ably presented his subject, the mass of detail and information being admirably arranged and indexed. The well-executed plans of the various types of laboratories drawn to scale will enable the reader to compare the merits of the various designs, and the many sectional drawings which illustrate points of special construction add much to the value of the book.

CHAS. E. BROWNE.

The History of Anatomical Illustration.

History and Bibliography of Anatomic Illustration in its Relation to Anatomic Science and the Graphic Arts. By Ludwig Choulant. Translated and edited, with notes and a biography, by Dr. Mortimer Frank. With a biographical sketch of the translator and two additional sections by Dr. F. H. Garrison and Dr. E. C. Streeter. Pp. xxvii+435. (Chicago, Ill.: The University of Chicago Press; London: The Cambridge University Press, 1920.) 10 dollars net.

SCIENTIFIC books have short lives. A text-book that makes an especial appeal is sometimes edited and re-edited, and may last, in a form scarcely recognisable from its first state, for a generation or even for two. On the other hand, works containing new and original contributions are eagerly read for a short time, and their results rapidly absorbed into the pages of their successors. The older work then takes its place on the less accessible shelves of the library, and is sought from time to time only by the conscientious bibliographer. The ecological relationships of living and of dead literature may be compared to that of certain plant masses in which the upper surface alone is living and growth takes place on the hidden mass of dead vegetation.

It is the special and probably unique distinction of Ludwig Choulant (professor of medicine at Dresden, 1823–60) that he was the author of two works of reference that have remained in continuous, unedited, and constant use for man's allotted span. These works are, it is true, limited in range and used by few, but within their own field they stand as yet unrivalled and unchallenged. Choulant was a man without genius, but of wonderful erudition and sound judgment, and with a real gift for the most minute accuracy combined with great power of literary condensation. His "Handbuch der Bücherkunde für die ältere Medicin," first published in 1828, appeared in a new edition in 1842. This second edition is still by far the best and most complete bibliography of ancient medicine, and is an essential reference book in every medical library, and quite indispensable to the medical historian. It may be doubted if there has ever been printed another reference book in any field that exhibits such extreme accuracy. Knowledge has naturally advanced in the century that has passed since it first appeared, and there are, therefore, lacunæ in Choulant's work. But the constant use of the book for many years has never revealed to the present reviewer a single error that its author could have avoided, nor has he ever been able to hear of the detection of one by other workers.

Choulant's second great work was his "Geschichte und Bibliographie der anatomischen Abbildung" (Leipzig, 1852). This useful reference book has always appealed to a somewhat wider public than his "Handbuch der Bücherkunde." While no less accurate than its fellow, the lacunæ have become more serious with time. Notably, the curious and interesting subject of medieval anatomical illustration, entirely unknown in Choulant's day, has been created in our own time mainly by the labours of Sudhoff. Dr. Mortimer Frank, a learned young ophthalmologist of Chicago, therefore, in preparing a translation of Choulant's work, attempted to bring it up to date and to bridge the gaps. Frank's death at the age of forty-four, before his work reached the press, prevented his task from being quite so thoroughly finished as he himself had designed, but he had time to add a most valuable chapter on the medieval illustrations and to supplement largely Choulant's references. He has thus rendered yeoman service to the study of medical history. The work has been seen through the press by the accomplished historian, Col. F. H. Garrison, of the Surgeon-General's Library, assisted by Dr. E. C. Streeter, and these two writers have added useful chapters on anatomical illustration since Choulant, and on sculpture and painting as modes of anatomical illustration. The book is admirably illustrated and printed, and in its present form entirely replaces the original edition.

CHARLES SINGER.

Our Bookshelf.

Some Birds of the Countryside: The Art of Nature. By H. J. Massingham. Pp. 208. (London: T. Fisher Unwin, Ltd., 1921.) 12*s*. 6*d*. net.

ALL lovers of open-air Nature, and especially those of birds, will thank Mr. Massingham for putting together in one handy little volume those charming articles of which some have already been published in the *Spectator*, *Contemporary Review*, and elsewhere. Throughout the book the reader is by felicitous phrase and by the inborn sympathy of the author with Nature in all her moods transported into the "field"; yes, even when the chapter is entitled "Bird-haunted London." With singular literary skill Mr. Massingham presents his pictures, whether of landscape or of his favourite birds, so vividly that scene, incident, and character live in the reader's mental vision. No writer of our acquaintance has succeeded better in seeing into and interpreting the behaviour of birds, and that without undue anthropomorphism. But the reading of character extends beyond a nice and artistic sympathy with feathered life, for the chapters on "Gilbert White and Selborne" and "Charles Waterton" are masterly appreciations of two diametrically different naturalists. In each we end the chapter feeling that we know the man better than ever before, and understand why the fame of one, but not that of the other, has widely endured. If we may be allowed one critical request, it is to entreat Mr. Massingham not to use the word "intrigue" when "interest" will do just as well—indeed, much better. The latter is English, and the former is, we devoutly trust, a mere passing affectation. The book is, however, a very notable addition to the literature of natural history, and should find a place in every library, large or small.

London Trees. By A. D. Webster. Pp. xii+218+32 plates. (London: The Swarthmore Press, 1920.) 15*s*. net.

LONDONERS owe a debt of gratitude to Mr. Webster for this book. Not until its pages have been read will one in a thousand of the inhabitants of the Metropolis have any conception of the variety of trees that grow within its limits. The ubiquitousness of the plane and its surpassing merit as a London tree are apt to give the impression that there is little else. It is, of course, the fact that many of the more uncommon species are hidden away in private or semi-private grounds. The garden of Fulham Palace, for instance, is classic ground to students of trees, for here in the early years of the eighteenth century grew the finest collection of trees in Britain, planted by Compton, then Bishop of London. Fulham is a place very different from what it was 200 years ago, but even now, Mr. Webster tells us, the grounds there are rich in rare and curious trees, some probably the finest in London.

The book consists of two parts. The first and larger is an alphabetical list of London trees briefly but, for the general reader, sufficiently described, with information as to where they are to be found. The second deals with parks, squares, and other open spaces, both public and private, and mentions the more notable trees to be found in each. There are a few errors; the old but exploded idea that the common elm was introduced by the Romans is revived; the author says *Celtis australis* is well represented in the London area, but we doubt if he could find a single tree; nor will the statement that *Platanus occidentalis* occurs in considerable numbers throughout London find general acceptance.

W. J. B.

The Statesman's Year-Book, 1921. Edited by Sir J. Scott Keltie and Dr. M. Epstein. Fifty-eighth annual publication. Revised after official returns. Pp. xliv+1544. (London: Macmillan and Co., Ltd., 1921.) 20*s*. net.

THE fifty-eighth annual issue of this indispensable year-book is before us, and, as usual, it has been revised up to the eve of going to press. The amount of information is no less noteworthy than the care with which it is edited and the consequent absence of errors. As in previous editions, the volume consists of three parts dealing respectively with the British Empire, the United States, and other countries. The States of the world, enjoying more or less independent rank, now number sixty-four, counting the British Empire as one. Since the last edition of the book the list has been increased by Esthonia, Georgia, Latvia, and Fiume, while Montenegro has been sunk in Yugo-Slavia, or, to use its unwieldy official name, the Serb, Croat, and Slovene State. Irak, Palestine, and Armenia, as well as some of the amorphous States in process of emerging from the Russian ruin, are still placed under the countries of which formerly they were constituent parts. The information respecting Russia has been furnished from official Soviet sources, but that Government seems unable to provide recent statistics for Siberia. Of the two maps, one shows the Baltic and adjacent States, including the new access of Finland to the Arctic Ocean, and the other shows the Slesvig boundary adjustment. The introductory tables give statistics of the British Empire for 1919–20, the world's production of gold, silver, sugar, etc., the distribution of shipping and naval strength, and other useful information. The covenant of the League of Nations is given in full, and there is a list of the treaties of peace and official publications thereon.

Advanced Lessons in Practical Physiology for Students of Medicine. By Dr. R. Burton-Opitz. Pp. 238. (Philadelphia and London: W. B. Saunders Co., 1920.) 18*s*. net.

No subject in the medical curriculum affords so great a variety in the scope and manner of its presentation as does that of experimental physiology. Probably no two schools are alike in their treatment of this fundamental branch of medical training.

Dr. Burton-Opitz's text-book describes a course which strikes one as being too comprehensive. Omitting physiological chemistry, it takes the student over a range of experimental work beginning with the nerve-muscle preparation of the frog and passing to more advanced experiments, such as cerebral localisation and gastro-enterostomy in the living mammal. The course is adapted to the requirements of Columbia University, and, if faithfully followed by the student, takes him far into the practical details of medicine and surgery; but most teachers in this country are satisfied if they give the student a good grounding in some part of the subject and illustrate the more important animal experiments by demonstration. Our laws, indeed, prevent the student from carrying out much of the experimental work which is possible in America.

The course is divided into fifty lessons, for each of which the author states in his preface three hours should be available. One may be permitted to doubt if the student can digest the amount of material prescribed, and few medical schools are in possession of the staff and equipment necessary. The book contains little theory, and the practical directions are in some instances very brief, but they are intended to be supplemented by lectures and demonstrations. The book is not one that will be much used in this country, but it contains valuable suggestions, and will be a useful addition to the literature of the laboratory.

P. T. HERRING.

Papers Set in the Mechanical Sciences Tripos, 1912, 1913, 1914, 1915, 1919. Pp. iv+57. (Cambridge: At the University Press, 1920.) 4*s*. net.

THE student of engineering is by implication a student of branches of science such as mechanics, thermodynamics, electricity, etc., but he studies these subjects from a point of view differing widely from that of the student of pure science. In view of the vast importance of engineering and other technological practice in modern life, there may be some danger of the claims of science as such being somewhat disregarded, and it is therefore of interest to see in what way representative schools of engineering in this country deal with the pure science that enters into their curricula. We get an insight into this by means of the examination papers that are set for honours students in engineering, and the Cambridge University Press affords us an opportunity of doing so in connection with the Cambridge school of engineering. The papers included in the present publication are on applied mechanics, heat, theory of structures, and electricity. The questions demand a sound knowledge of the physical theory of each subject and of its mathematical development, while at the same time they presuppose a close acquaintance with the practical applications for engineering purposes.

Insanity and Mental Deficiency in Relation to Legal Responsibility: A Study in Psychological Jurisprudence. By Dr. W. G. H. Cook. Pp. xxiv+192. (London: George Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., 1921.) 10*s*. 6*d*. net.

MUCH has been written on the responsibility of insane and feeble-minded persons for criminal offences, but Dr. Cook has broken more novel ground in bringing together all available evidence on the difficult question of civil responsibility, a subject which has been rarely dealt with as a whole. In doing so he makes a survey of more than two hundred leading cases and of the laws of many foreign countries. The results thus summarised may, as Sir John Macdonnell, late Senior Master of the High Court of Justice, states in a foreword, "prepare the way for a re-statement of our law in accordance with the teaching of modern psychology." It would be beyond the scope of NATURE critically to review this work, but we may agree with the words from the foreword already quoted, that it will "educate professional opinion, and help to reconcile the lawyer, the physician, and the psychologist."

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.]*

Scientific Publication.

DR. BRIERLEY (NATURE, September 8, p. 41) makes several incontrovertible statements and some suggestions that one is less willing to accept. Possibly the views of one who has been an editor off and on for forty years, as well as writer, publisher, and researcher, may assist Dr. Brierley and other struggling colleagues.

It is, as Dr. Brierley says, only the worker going over the same ground who needs to read the details, and I agree that he needs more numerous and more accurate details than he generally gets; for other readers a good summary should be provided. It is also true that those "other readers" are the more numerous, and yet they vary in their requirements so that no single summary is likely to suit them all; each may wish to refer to the full text for the elucidation of some point in which he is interested or ill-informed. It would therefore be unsatisfactory to confine papers to summaries, or even to what one may call "large type matter." But, apart from this, even in abstruse subjects the number of original workers is surely greater than Dr. Brierley allows for. There may not be many in one country, but they are dispersed throughout the world. The Japanese and the American and the New Zealander cannot come to London every time they wish to refer to a manuscript. The proposal to make a few copies by some cheap process is, I suspect, illusory. At the moment compositors and pressmen may be sucking our blood, but normally linotype printing is as cheap a process as any. I therefore advocate printing papers in full, with all necessary detail and adequate illustration.

This, Dr. Brierley will reply, leaves us worse off than before. What, then, are the remedies? Dr. Brierley tells us that a lot of papers are only to mark time or make a show. He is an editor. Does he accept such papers? The remedy is in his own hands. Or has he lost his blue pencil? But even the better-class papers can stand some editing and condensation. A large number of scientific workers are far too lengthy (I do not mean too long); they use six words where one will do, and, like the bad speaker, take up space with telling us how brief they propose to be and what a heap of good cargo they have been compelled to jettison. These faults will increase as linguistic training, especially in Latin, decreases in our schools.

Many of our scientific journals, especially those started in years of prosperity, are needlessly sumptuous. No journal need cut out matter so long as it allows a quarter of a page or more to the author's title and titles. The illustrations in these journals are often on an absurdly large scale, and there is too much printer's "fat." Footnotes are generally a sign of undigested matter and chaotic thought. They add to the expense, and should be suppressed (this is a hint to Dr. Brierley as editor). Sensible and succinct methods of referring to literature are being adopted and enforced by modern editors, but there is room for improvement. On this and similar matters there are the Reports of the British Association Committee on Zoological Bibliography and Publication, which I shall be glad to send to inquirers.

Some authors have a habit of writing a separate paper on each aspect of a single subject; and three such papers may appear in one number of a journal, each with its quarter-page heading and half-page blank at the end. This habit is much in evidence in the modern journals to which I have referred. There are other authors who write slight variants of the same article for several periodicals. Since they are not paid for their trouble they have no excuse for thus inflicting themselves on a weary public. Suppress them, Mr. Editor! The preliminary notice is frequently a form of this self-advertisement.

We must look at this question as men of business. Does the world want our stuff or does it not? There is a public undoubtedly, though not a very large one. If you give it good value it will pay the price. It is the editor's duty to increase the value of his wares and to cut down the unnecessary costs. His publisher must advertise with the right people and get the right people to advertise with him. If everyone concerned does his duty, I believe a scientific journal, even the purest, can be made to pay its expenses. Heroic remedies are not wanted. F. A. BATHER.

Natural History Museum, South Kensington, S.W.7, September 12.

DR. BRIERLEY'S communication on this subject in NATURE of September 8 (p. 41) is well worth reading again, and my sole object in writing this letter is to direct attention to it, for it appears to me that Dr. Brierley indicates how the problem may be attacked upon sound lines. The method he suggests is "to make a radical change in the format of our scientific journals, with or without an alteration in the existing structural relations of the learned societies." Any "lumping together" of the publications of our scientific societies would undoubtedly meet with much opposition; sentiment, vested interests, and natural conservatism stand in the way. The proposal that only well-digested summaries of papers should be published would certainly lead to saving in money and time, with little countervailing loss.

Dr. Brierley has stressed the saving in money, but the saving in human energy and time is of equal, if not greater, importance. No scientific worker can or dare limit his reading to the confines of his special subject, and "that inundated feeling" is fast becoming a prevalent complaint.

In a new world there will be established for each branch of science in each country a single publication in which all original work will appear; it will be administered by the societies and institutions devoted to that branch of learning, and all progressive work will be entitled to a place in it in the form of a full summary. Subordinate branches of the same subject will be accommodated in separate series as they grow in importance. The monthly, quarterly, or annual indexes of the publication will provide a complete current guide to the subject, and the worker will know exactly where to go for his information. A good national and international sale will be assured; and as all the volumes will be of the same size, there will be a considerable saving in space, material, and temper.

Meanwhile, the innumerable journals that live by advertisements, discussion, and abstracts will continue to fulfil their function and will survive according to their merits; the scientific worker will take in those that are most useful. But for original papers he will turn only to the British publications for British results or to the corresponding French ones for those of France, and so on. In January each year he will be in possession of part 1 for that year, and by December 31 he will have the annual volume complete with indexes, just as in any well-managed journal of to-day.

This vision is not new, and, human nature being what it is, a vision it is likely to remain. Still, if science is "organised common sense," something may be done by applying it to the machinery of publication. Dr. Brierley has made a beginning by taking a square look at the subject. J. A. H.

Jermyn Street, London, S.W., September 19.

Is Bisexuality in Animals a Function of Motion?

It was long ago pointed out by Claus that hermaphroditism in animals finds its most frequent expression in fixed and sluggish animals, and in certain parasites. A large amount of work on sex-phenomena has been done since Claus's time, and his generalisation has been confirmed. There is thus no doubt of the fact that there is a close correlation between an inactive life and hermaphroditism, so close indeed that the present writer is ready to cast suspicion on the supposed bisexuality of any sedentary animal. It is seen therefore that absence of motion is in some way directly or indirectly associated with an hermaphrodite expression of sex.

After Claus a number of writers suggested that fixed or sluggish animals or parasites would accumulate an excess of nutritive products, a condition which was considered sufficient in itself to account somehow for hermaphroditism. This point of view was accepted and developed by Geddes and Thompson, who arrived at the conclusion, in their work on "Evolution and Sex," that "hermaphroditism is primitive and that the unisexual state is a subsequent differentiation: the present (*existing*)[1] cases of normal hermaphroditism (*therefore*) imply either persistence or reversion." More recent workers appear to have neglected the wider aspects of the problem of sex, and to have concentrated on the question of the *mechanism* of sex-determination. Recent discoveries of hermaphroditism, and particularly some cases studied by the writer, have directed attention to a speculation which indeed follows naturally from Claus's observations, namely, *is hermaphroditism a direct physical consequence of a fixed or sluggish life, and conversely, is bisexuality in a species a direct physical consequence of a freely moving habit of life?*

This view has been examined in a preliminary way and has been tested in some of the present writer's recent researches with results which are meagre, but promise more success by a method which involves following closely the life-history of *individuals* of a species. It is to be expected, moreover, that with all the ups and downs in the progress of evolution there will exist an infinite variety of circumstances to obscure such an underlying principle as that suggested above, even should the principle obtain in nature. A phylogenetic explanation of hermaphroditism is unsatisfactory in that it is inherently inconclusive, and in that there is no method of testing it, whereas the speculation advanced here can be tested, and, if found wanting, can be rejected.

In a survey of the sex-phenomena in the animal kingdom it is found, generally speaking, that forms which are slow-moving, sedentary, or of fixed parasitic habit are hermaphrodite—*i.e.* an *individual* will produce eggs and sperm either simultaneously or separately in the course of its life-history—and that animals which are active during life are bisexual, whilst animals which fall into an arbitrary category of sluggish or slow-moving forms, for example Lamellibranch Molluscs, exhibit a wide range of sex-phenomena, from apparent bisexuality to definite simultaneous hermaphroditism. This is not the place to go into full technical details, but it may be mentioned that in the category of fixed or sedentary or sluggish animals (excluding Protozoa) which are hermaphrodite may be entered: Sponges, so far as sex is known in the group, sedentary Cœlenterates (but apparently not all), practically all the members of the following groups—Platyhelminthes (the flat-worm group), Leeches, Oligochæta, Polyzoa, Ascidians, euthyneurous and pteropodous Molluscs, practically all fixed Arthropods, *i.e.* Cirripedia—and various sedentary forms in other groups. Amongst animals which are free-living, active, and bisexual are most Arthropods, all cephalopodous and most streptoneurous Molluscs, and all vertebrates except a few sluggish or parasitic forms. In the intermediate category of groups which are composed mainly of slow-moving forms may be placed Lamellibranch Molluscs, Amphineura, Echinoderms, Polychætes, and Nemertine worms. In all these latter groups hermaphroditism occurs to some extent,[2] and indeed Mortensen[3] has shown recently that a very large number of Ophiuroids are hermaphrodite. Now, in view of recent work on hermaphroditism there is legitimate reason to doubt the supposed bisexuality in a very large number of forms belonging to the groups mentioned here, as may be seen from a review of the sex-phenomena in the oyster and the common limpet. In the oyster (*O. edulis*) we now know that some forms change from males into females and back again into the male condition. In this species, therefore, looked at as a whole, males change into females and females into males. In the limpet (*Patella vulgata*) it would appear that some males change into females, but that individuals very rarely show signs of sex-change owing to a distinct break between the male-functioning stage and the female-functioning stage. *It is therefore possible that in some supposed bisexual species males may change into females and females change into males,* since a parallel series of changes is known to occur in the oyster[4] (*O. edulis*). In such cases the actual sex-conditions in the species could only be found out by following the life-history of individual animals.

If it be supposed that hermaphroditism is a direct physical result of a sedentary life, and bisexuality a direct physical result of an active life, it would appear that there should be some fundamental difference in the physical condition of the general body or in particular organs—*e.g.* the gonad—in these two classes of animals. This deduction should therefore yield a method of testing the speculation. I do not know of any such fundamental difference in physical condition between sedentary and active forms, but the known electrical changes which occur during the activation of muscular and nervous tissues, together with the results of recent studies on electrical characters of tissue elements, lead one to hope that if physical differences of this kind do occur they may be found in the near future. A fundamental difference in physical condition between sedentary and active animals, correlated with different sexual conditions, is probably the touchstone of this speculation, and offers a definite problem for bio-physicists. Contemplation of success in the discovery of such a fundamental difference arouses visions of the determination of sexual characters of species by some sort of physical constant, and a faint

1 The words in italics have been inserted by the present writer.

2 I have found that *Lineus lacteus*—a sluggish Nemertine living in gravel at half-tide level—is definitely hermaphrodite; both eggs and sperm are mature in a single individual at the same time.

3 Th. Mortensen, "On Hermaphroditism in Viviparous Ophiuroids," *Acta Zoologica*, pp. 1-18, 1920. (Stockholm.)

4 It must be pointed out that we have as yet no clear proof that *all* male oysters or *all* male common limpets change into females; and the present writer's work has shown that sex-change in the slipper-limpet from male to female may be almost indefinitely delayed according to circumstances (Proc. Roy. Soc., B, vol. 81, 1909, pp. 468-84, and unpublished work).

discernment of a possible method of controlling sex.

It is interesting to note that pursuit of this speculation leads one to a view of the paramount importance of the individual as a whole in determining its characters, and in this respect recalls Darwin's hypothesis of pangenesis. It may be pointed out, moreover, that quite apart from theoretical questions the conditions which determine whether an animal is to be hermaphrodite or bisexual must be considered before any reasonable hope can be entertained of understanding the processes underlying sexual differentiation in a bisexual species. Indeed, some inkling of the need for sex might be obtained from an understanding of the conditions resulting in hermaphroditism, and an explanation of sex on purely physical lines would be captivating from the point of view of the student of nature as a whole. The old idea that an individual is female because its metabolism is mainly anabolic, or male because mainly katabolic, is unsatisfactory, and it has already been pointed out that it is just as likely that an individual is anabolic because of its femaleness, or katabolic because of its maleness.

In reviewing the incidence of hermaphroditism and bisexuality throughout the animal kingdom (again excluding Protozoa) one cannot but be impressed by the independence shown by the organism, which would appear to be able to order its sexual manifestations in a manner entirely independent of phylogenetic considerations, and suggests such a ready response to conditions of life as is perhaps not generally conceived.

The practical points arising out of these speculations may be summarised as follows: Is there a fundamental physical difference between sedentary and active organisms in the whole body or in parts, and if so, is this difference correlated in any way with particular sexual manifestations? To what degree is our present knowledge of the sexual conditions in slow-moving or fixed animals reliable? On the basis of the speculations advanced here any animals which are sedentary, fixed, or slow-moving may be suspected of hermaphroditism in some form.

No wholly satisfactory explanations have been advanced for either hermaphroditism, bisexuality, or indeed sex itself. Sex is universally expressed amongst the higher living organisms at least, so that one is tempted to ask: Is sex merely a property of living matter and hermaphroditism that modification of the property resultant upon the absence of motion in the living organism, and bisexuality that modification dependent upon free motion? For there appear to be sufficient grounds for rejecting the idea that animals are sedentary because they are hermaphrodite.

J. H. ORTON.

The Laboratory, Plymouth, September 19.

The Separation of Mercury into Isotopes.

EARLY in 1920 Harkins and Broeker reported a separation of chlorine into isotopes, which amounted at that time to an increase in density equal to 1550 parts per million. About six months later Brønsted and von Hevesy reported a separation of mercury, which was, however, only about one-thirtieth as great, or 50 parts per million. On account of the slightness of the density change reported for mercury, the evidence that it had been separated did not appear to be conclusive, so it seemed worth while to attempt a confirmation by the same method—that is, a vaporisation at low pressures. As a result of 4 cuts of 2 on the heavy fraction or residue the density has been increased by 69 parts per million, and by the same number of cuts on the light fraction it has been decreased 62 parts, or the total density change obtained is 133 parts per million, or 0·027 units of atomic weight.

The mercury was purified by electrolysis, by five fractional distillations at low pressure in a current of pure air, and by one fractional distillation in a high vacuum.

The present evidence that an actual separation of isotopes has been obtained with mercury rests largely in the quantitative agreement between the results of Brønsted and von Hevesy and ourselves with respect to the extent of the separation obtained by a definite cut, which will be termed the *efficiency* of the process. If the efficiency of our ideal apparatus, in which solid carbon dioxide and ether were used for cooling, is rated as 100 per cent., then the efficiency attained by the previous investigators is 75 per cent., while our less ideal apparatus gave 93 per cent. when operated slowly and as low as 80 per cent. when operated rapidly.

We have obtained evidence which seems to indicate that a slight separation of the isotopes of mercury has been secured by a very slow distillation at very low pressures, though a more rapid distillation gave no detectable difference in density.

The relative changes produced in the *atomic* weights of different elements by a definite cut may be termed the separation coefficients. These have the values listed below as determined by calculation, the coefficients for chlorine compounds representing the change in the atomic weight of chlorine. The calculated coefficients are:—Neon, 0·00843; magnesium, 0·00868; lithium, 0·00450; nickel, 0·00758; hydrogen chloride, 0·00950; methyl chloride, 0·00690; chlorine, 0·00494; methylene chloride, 0·00413; chloroform, 0·00295; carbon tetrachloride, 0·00229; and hydrogen bromide, 0·00614. Thus the atomic weight changes most rapidly when chlorine is used in the form of hydrogen chloride. The experimentally determined coefficient for mercury is 0·00570, which is not specially large.

The rate of separation of two isotopes is very nearly proportional to the square of the difference of their atomic weight (or molecular weight when a compound is used), to the product of the mol fractions of the two isotopes, to the logarithm of the cut, and inversely proportional to the atomic (or molecular) weight. This statement and the above coefficients apply as well to molecular diffusion at low pressures as to vaporisation at low pressures.

It is of interest to note that many molecular substances must appear in many isotopic forms. Thus if there are two isotopes of chlorine and three of magnesium there are nine isotopic forms of $MgCl_2$ and seven forms of C_6Cl_6, while if there are six isotopes of mercury there are sixty-three isotopic forms of Hg_2Cl_2, which occurs in the form of a vapour. Five of the seven isotopic hexachlorobenzenes also occur in several isomeric forms. Isotopes may be able to produce stereoisomerism with respect to infra-red rays.

WILLIAM D. HARKINS.
R. S. MULLIKEN.

University of Chicago, August 31.

Relation of the Hydrogen-ion Concentration of the Soil to Plant Distribution.

THIS subject has recently assumed prominence among ecologists and soil chemists, and Dr. Atkins's interesting letter, with its valuable data, published in NATURE for September 15 (p. 80), directs general attention to it and to the need and scope for further work thereon.

It seems very desirable to bear in mind that there are strong indications that the relation between the hydrogen-ion concentration and the flora of a soil is mediate, and not immediate. Hoagland has shown that barley will withstand a very much greater hydrogen-ion concentration in a water-culture solution than it will tolerate in a soil. Also, it is known that plants which are usually very susceptible to acidity will thrive in certain soils of California and Sweden the *p*H of which is between 4 and 5, and that those plants growing in those soils show no response to liming. The inference is that the effect of the hydrogen-ion concentration *of the soil* on plants is indirect, and that there is some ulterior factor the fluctuations of which are commonly, but not invariably, accompanied by fluctuations of hydrogen-ion concentration. In the search for that ulterior factor it has been fairly well demonstrated that in many soils certain polyvalent ions (chiefly aluminium ions) are the primary cause of the effect of acid soils upon plants. It is clear that in mineral soils variations in the aluminium-ion concentration will roughly correspond with variations in the hydrogen-ion concentration.

I am not aware that any explanation has been advanced to account for the fact stated above, that in some soils a high hydrogen-ion concentration is not accompanied by that effect on plants which usually accompanies such hydrogen-ion concentration in soils. The fact alone seems to preclude any possibility of the effect in question being directly and immediately due to the hydrogen-ion, and if it is due to the aluminium-ion it remains to be shown that a high hydrogen-ion concentration in a soil may sometimes exist without a corresponding concentration of aluminium-ion. That may occur in the presence of much organic matter, for it is well known that in the presence of almost any hydroxy-organic compound aluminium (and ferric) ions are "masked." Presumably the aluminium, in such circumstances, becomes part of a complex electro-negative ion—certainly it does not behave chemically like the aluminium-ion.

So far as I can ascertain, the Californian and Swedish soils that have a high hydrogen-ion concentration which is without detriment to plant growth are all peat soils, and it seems likely that the absence of "sourness" in the presence of acidity may be due to the effect of certain organic compounds upon aluminium salts. This possibility is being investigated here and it seems to offer a solution of some other soil-plant problems.

The accumulation of such valuable data as that given by Dr. Atkins is, as that writer says, necessarily slow. Even at the risk of making it slower it seems important to remember that the ultimate interpretation of such data is likely to be possible only in the light of detailed knowledge of the soils concerned. The relation of hydrogen-ion concentration to plant growth is a relatively simple problem: the relation of the hydrogen-ion concentration *of the soil* to plant growth is a very complex problem.

Norman M. Comber.

Department of Agriculture, The University, Leeds,
September 17.

The "Proletarisation of Science" in Russia.

Like the majority of people in this country, where the news we receive about what is going on in Russia is often misleading, I know little about the working of the "proletarisation of science" on which Dr. Boris Sokoloff writes in Nature of September 1. But the omission by Dr. Sokoloff of any account of the constructive elements of this "proletarisation," with one of which I have recently become acquainted, suggests that he is more concerned with spreading propaganda against "Bolshevism" than with giving an outline of all the features, good and bad, of the attitude of Bolshevism to science.

The particular constructive element to which I refer is the effort of the Soviet Government to bring the fundamental conclusions of scientific thought within the reach of the "proletariat" with the deliberate purpose of shaping the mental outlook of the masses, and especially of the rising generation, in such a way that the standard of values in everyday affairs will be based on a naturalistic interpretation of man's environment and of his relations to it. In pursuance of this end the Soviet Government has already issued a whole series of elementary text-books ("Estestvenno-Nauchnaya Biblioteka"), which aim at explaining the scientific position in terms intelligible to the "proletariat," many of whom have learned to read only since the advent of Bolshevism. They are written by scientific men who have remained in Russia, and who, like most of our own men of science during the war, have temporarily suspended their "free" researches in order to take part in work directed to particular ends considered by the State to be more immediately important under the existing emergency. The series includes such subjects as "How Man Arose," "Human and Animal Evolution," "The Origin of the World," "What Chemistry and Physics Teach Us," "Popular Astronomy," "Brain and Spirit," "Outline of the History of Geological Knowledge" (by Prof. A. P. Pavlov), etc., as well as translations of Geikie's "Physical Geography" and other books.

It would be difficult to imagine the present Government of any of the nations of Western or Central Europe, evincing such a faith in science, as able to bring about the "change of heart" on which alone a new society could be founded, that in the midst of all the horrors of blockade, invasion, and civil war its publishing department would issue broadcast to the "proletariat" a whole library of introductions to scientific thought.

H. Lyster Jameson.

Bees and Scarlet-runner Beans.

I have been much interested by Mr. Harford J. Lowe's letters upon this subject in Nature (August 12, 1920, and July 28 and August 11, 1921), and have been led by them to observe the runner beans in my own garden, which lies fourteen miles to the north-west of London. My experience differs somewhat from Mr. Lowe's, and may be worth recording. Although I searched diligently through the whole summer, I did not, until September 1, find a single open flower that had not been pierced through the base of the corolla by the humble-bees in the way described. During the drought there was never more than an occasional pod, although the plants were strong and the flowers very abundant. But after the rain which fell on August 17 pods at once began to form freely, and there has been a plentiful and continuous crop ever since. I then examined the withered petals clinging to the young pods, and found that these also had always been pierced at the base.

It is clear, therefore, that the evil practice of the humble-bees does not necessarily lead to barrenness, and may possibly not do any harm at all. The drought is indicated as the direct or indirect cause of the initial failure of the crop. Now, in mid-September, the humble-bees do not come out so early, and in the morning I have found a very small proportion of uninjured flowers which were being visited by the honey-bees through the legitimate entrance.

H. B. Heywood.

The Norman Lockyer Observatory.

By PROF. H. H. TURNER, F.R.S.

CAN an observatory be run on the co-operative principle or as a joint stock company? The idea is a novel one, but it is the function of science to make experiments, and the tentative beginnings of the experiments in this directon are not unpromising.

The reasons for establishing an observatory at Salcombe Regis in the first instance need not, perhaps, at the present moment be recalled. Suffice it to recognise that the observatory exists, is well equipped with instruments and an excellent climate, and has an efficient, though small, working staff; it has, moreover, the advantage of association with a great name, the brightness of which promises to shine out more clearly as the dust of controversy is swept away by the fresh breezes of modern research.

Years before anyone else, Norman Lockyer suggested that there was an ascending and descending scale for stellar temperatures, which is now the orthodox modern view. It is true that the modern recognition of this characteristic of stellar evolution is based on grounds differing from those chosen by Lockyer for the erection of his theory, and the difference might have been vital. We owe Prof. Eddington a debt of gratitude for stating fearlessly that the difference is small compared with the sameness, and it is matter for congratulation that this recognition was forthcoming, if not actually in the presence of Sir Norman Lockyer, at any rate in the presence of his family, who were able to carry the account of it to him almost immediately. None of those who were present at the little gathering at Sidmouth which followed the meeting of the British Association at Bournemouth in 1919 are likely to forget it.

In the two years which have elapsed since that meeting events have moved quickly, at any rate in some ways. First, there has been at least one other visit of importance—Mr. and Mrs. Evershed were able to spend sufficient time at Salcombe Regis to report very favourably as to its observing climate. Their experience in judging climate is well known; we need only recall the expedition to Nelson (New Zealand) in connection with the offer of Mr. Cawthron to found a solar observatory, and the several expeditions to Kashmir with their varying fortunes. From these adventures has emerged the conviction that a moist climate is preferable to a dry—a conviction which, although at variance with some conclusions adopted in recent years, returns to the views of Sir William Herschel, who has recorded the magnificence of a night for observing when the dew had been so heavy that those who slept while he was at work could not believe on waking that there had not been heavy rain. The satisfaction of Mr. and Mrs. Evershed with Salcombe Regis is, therefore, in keeping with their previous conclusions; it seems even possible that when they leave Kodaikanal and return to England presently (an event which we shall regard with mixed feelings) they may even select Salcombe Regis for their next place of work; but that, of course, is still to be decided.

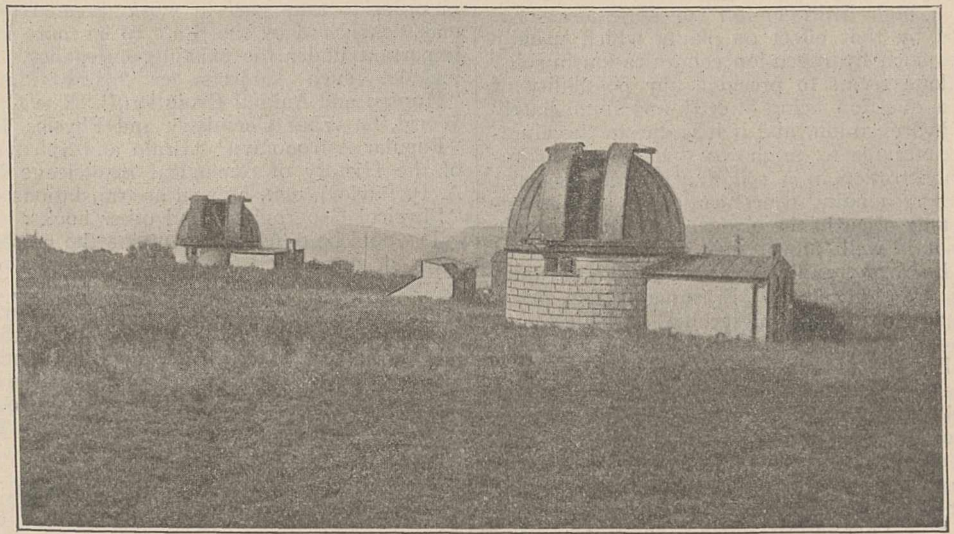


FIG. 1.—Norman Lockyer Observatory. The Frank McClean dome on the right and the Kensington dome on the left. View looking south-west.

Another visit to England, though not actually to the observatory itself, has been also attended with happy results. Mr. W. S. Adams, of Mount Wilson, was in England in 1919 on his way to and from the Brussels Conference; it was natural to consult him about the work of the Norman Lockyer Observatory, which at that time was limited to the taking of stellar spectra and classifying them on Lockyer's principle of classification. Adams suggested at once that it might be possible to measure the spectra in the manner he has developed for the determination of the absolute magnitude of a star, from which its distance might be deduced. This suggestion has been taken up at the observatory with very creditable success. It is obvious that to take up new work of this delicate kind involves much preliminary experiment; the method depends essentially on estimating the relative intensities of pairs of lines in the same spectrum, and the uncertainties attending estimates of intensity are well known; but these difficulties have been courageously faced. We may quote a sentence from the last report:—"A wedge has been designed and constructed for this purpose, and a preliminary series of measures made to test its suitability. This method of measuring relative intensities of the lines appears to be quite satisfactory, and two reports on the work which have been sent to the Research Committee have been commented upon very favourably."

Should this early promise be maintained, the observatory will have initiated a line of work new to England, and, indeed, so far as we know, new everywhere excepting at Mount Wilson. Meantime the former work of classification will not be neglected, and will possibly be extended by adding accurate determinations of the Harvard classification for comparison with those of the Lockyer classification. Such a systematic comparison must be of great value for arriving at a final standard system, whatever that may be.

It is a special pleasure to reflect that this work accords so closely with the ideas of the late Dr. Frank McClean, F.R.S., whose telescope has been presented to the observatory by his sons. Dr. McClean's own work in classification of spectra, especially for stars in the southern hemisphere, and his measurement of some of them by which he discovered for the first time the existence of oxygen in the stars, are matter of history; and it may safely be asserted that if he were alive to-day to make a choice he could scarcely have found work for his old telescope in closer conformity with that which it executed in his own capable hands.

His sons have throughout shown a filial interest in the observatory, and their share in the endowment of it has been very generous; but there are natural limits to private munificence, or at any rate to the purses of one or two individuals, and if the observatory is to prosper as it deserves, further help, which is urgently needed, must be sought for elsewhere; and this brings us back to the question with which we started—viz. Can an observatory, and especially can this particular observatory, be run as a joint enterprise? The idea was put forward first in June, 1914, but the war brought inevitable delays, so that only recently has it been possible to face the situation definitely.

FIG. 2.—Norman Lockyer Observatory. Offices and terrace, looking north.

The quickest way to make clear the nature of the suggested new departure is to quote the following sentence from the little handbook compiled by Major Lockyer (6*d.*) giving an excellent account of the observatory: "Anyone can further the interests of the observatory by joining the corporation, either by subscribing a guinea a year, and thus becoming an annual member, or by paying 10*l.* and becoming a life member." Communications should be addressed to the honorary secretary, Capt. W. N. McClean, 1 Onslow Gardens, London, S.W.7. There are, of course, the executive council of thirteen names, and a research committee of four names (the Astronomer Royal and the professors of astronomy at Cambridge, South Kensington, and Oxford) prepared to give advice on scientific matters; there is also a most distinguished list of eight foreign members; but it is the hope and intention to make the direction as democratic as possible, if members of the corporation are ready to manifest an interest in the affairs of the observatory.

What are the prospects of such a novel method? A little reflection suggests at once a few directions in which advances may be made, and we may trust the future in this as in other scientific work to open up new avenues. We may begin with the well-known and widespread desire of many people to have opportunities of using a fairly large telescope; they cannot afford to possess one, and perhaps are not prepared, even if they could afford the instrument, to face permanent work with it; but they would welcome the possibility of work for a time with an instrument of some size which they need not purchase. Existing observatories can scarcely meet this desire; they have their own work to do, and their staffs are not generally more than sufficient to do it. Recently the Astronomer Royal has generously placed a large telescope at the disposal of some well-known amateurs on a special occasion, and it may be possible to extend this courtesy further; but it is an entirely new departure, and may find natural limits. At the Norman Lockyer Observatory there are as yet no limits to the possibilities, except the smallness of the staff, and should there prove to be a real demand for opportunities of work for a few months the arrangements are as yet fluid enough to meet the demand. Of course, the expenses must be met, just as must those of any other scientific society. At present the number of members of the corporation is limited by the constitution to three hundred, and it is obvious that the normal subscriptions, even when this limit is reached, which is not so yet, would be far from sufficient, without generous donations, for the upkeep of the observatory. If, however, the corporation could be extended to the dimensions of a scientific society, the question of expense might find an answer. It may be confidently asserted that those who made the experiment of working at the observatory for a week, or a month, or a year would enjoy the experience; Sidmouth itself is a well-known resort, and the observatory has a splendid outlook.

It is by no means necessary that the work selected by a visitor should be confined to night work. There are spacious offices and computing rooms, in which a piece of photographic measurement, or of computational work, or even literary work, could be carried on in pleasant and healthy surroundings.

There may be many who are desirous of the kind of holiday which will take them into new surroundings and yet can be combined with work which they could scarcely do in an hotel or in lodgings, or they possibly have some instrumental idea to be tested for which their own home scarcely provides a site. One of the conspicuous advantages of the Norman Lockyer Observatory is its splendid expanse of 7 acres, where even a large experiment could be conducted without interference with existing plant. The horizon is quite clear, the library and other buildings having been placed under the brow of the hill so as not to obstruct it.

The sight of this wonderful amount of space is enough to raise envious thoughts in the breasts of those who have to struggle with lack of room, and is apt to start various trains of thought. What is to happen to all our astronomical libraries, already full to overflowing, in twenty years' time? Shall we not be driven to the selection for preservation of a few representative lines only, seeking references elsewhere when they fall outside these lines?

The idea of a comprehensive central reference library thus suggests itself. At present it exists, indeed, at the rooms of the Royal Astronomical Society; but space in London is limited and valuable, and the time may come when it must be sought elsewhere. The broad acres at Salcombe Regis may find a use of this kind. A case nearly analogous is that of astronomical photographs. There is in England no great reference store such as that at Harvard, where questions of astronomical history may be settled. Those of us who have profited by this great resource of Harvard have at times felt a little ashamed to draw on Transatlantic courtesy without doing something in return. The characteristic of any collection of the kind is growth—fairly rapid growth—and here again the broad acres have their attractions.

But these are visions of the future. Returning to the more practical present, we may remark that those who use the observatory should certainly include research students from the universities or elsewhere, especially those who may wish to become acquainted with the particular work being done at the observatory, as above outlined. The goodwill of the staff has already been manifested to one such student, and they are preparing to receive another. Here again there is an absence of prescribed conditions which can scarcely attach to universities themselves. They must in self-defence make conditions of joining the university, or some equivalent, which may not be convenient to the intending researcher. No doubt the Norman Lockyer Observatory will expect some *quid pro quo* if it is to continue to exist, but the conditions are as yet to be fashioned. It is for those who join the corporation, if they will, to determine, for instance, whether membership shall carry with it the possibility of recommending a friend to the privileges of the observatory, and on what terms; indeed, the possibilities are so wide that even to give representative instances may have the appearance of narrowing them. They might even include (though here we are venturing on rather dangerous ground) provision for the mere sightseer—the man or woman who "has never seen the moon through a telescope." This is scarcely possible with the present small staff, but if ways and means could be found it would be well worth while for other observatories to be among the subscribers to the corporation, if they could thereby transfer a part or the whole of their embarrassments from sightseers. It is worth remarking that the situation of the Norman Lockyer Observatory would probably attract this type of visitor, who naturally expects to climb a tower or a hill, and would not be disappointed. But we should prefer to lay stress on the more serious uses of the observatory.

The Oxford Expedition to Spitsbergen, 1921.

Ornithological Observations.

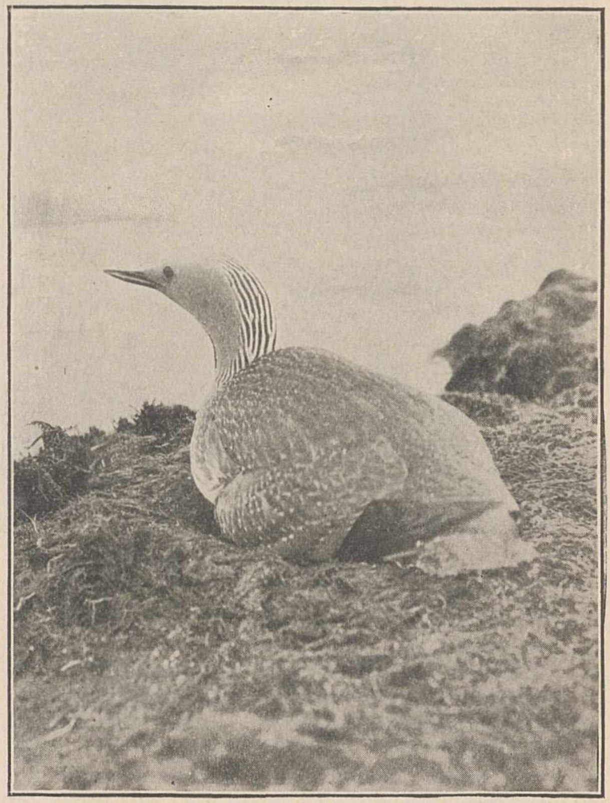
By the Rev. F. C. R. Jourdain (Leader of the Expedition).

ALTHOUGH the collections made by members of the expedition have not yet been worked out, it is now possible to form some idea of the extent to which our knowledge of the Spitsbergen group has been increased by the Oxford Expedition of 1921. Owing to difficulties caused by industrial unrest both in England and Norway, the original plans had to be considerably modified, and it was agreed to carry out a biological survey of the southern half of Bear Island, with special reference to the ornithology, before proceeding to the west coast of Spitsbergen.

Practically no work of any importance in this field has ever before been undertaken by Englishmen, and no collections from here exist in any British museum. The only important works on the ornithology of this most interesting, but somewhat inaccessible, spot are Swenander's "Beiträge zur Fauna der Bären-Insel," published in the K. Svenska Vet-Akad. Handl., Bd. xxvi. (1900), and some passages in the great work of Koenig, "Avifauna Spitzbergensis" (1911). Swenander visited Bear Island in 1899, and recorded twenty-two species, while Koenig increased the number to thirty-six, but some of these rest on rather dubious evidence.

The northern half of Bear Island is flat, and covered with innumerable lagoons, but the southern half is hilly, and the coast line consists almost entirely of bold cliffs, which are the resort of millions of sea birds. It is this portion of the island which was investigated by the expedition. Two hitherto unrecorded breeding species were recognised in 1921, and both cases are of great interest as filling up gaps in the distribution of the species concerned. Additions were also made to the list of casual visitors, but more important was the acquisition of a series of nearly eighty skins of breeding species and more than 300 eggs from the island. Equally valuable are the biological notes on the share of the sexes in incubation, the courtship and breeding habits, of which very little has been recorded in the case of these Arctic species.

Actual work on the Spitsbergen group did not begin until June 25. Here, again, it must be remembered that the latest English work on the ornithology of Spitsbergen is Mr. Trevor Battye's paper in the *Ibis*, 1897, pp. 574–600. No series of skins from here with any pretension to completeness exists in any British museum. The eggs of the Barnacle Goose have previously been taken by only one expedition, viz. that of Prof. Koenig in 1907 and 1908, and the twelve eggs then obtained were the only wild-laid eggs known to science till the present season, when twenty-two eggs were obtained by the Oxford Expedition.



[*Photo, Seton Gordon.*

FIG. 1.—Red-throated diver on nest.

Mr. J. S. Huxley's researches on the courtship of the Red-throated Diver (*Colymbus stellatus*) (Fig. 1) and the Grey Phalarope (*Phalaropus fulicarius*) are referred to later, and need not be touched upon here.

In Mr. Trevor Battye's paper only twenty-nine species were recorded from all sources. Since then the total has been raised to fifty-three, and of these no fewer than thirty are now known with certainty to breed locally. Probably one of the most valuable results of the expedition will prove to be the additional light thrown on the breeding ranges of many northern forms. For example, in Koenig's great work only about seven definite occurrences of the Turnstone (*Arenaria interpres*) are recorded, of which two are also mentioned by Trevor Battye. Yet in 1921 not only were specimens actually obtained from two localities in Ice Fjord, but also about nineteen pairs were met with breeding in one restricted district on the north coast, and adults, young in down, and eggs were collected. This clears up the mystery of the distribution of this species, which is known to nest quite commonly in Greenland up to 82° 30′ on the west side, as also in Novaya Zemlya; while up to the present no details of breeding in the Spitsbergen group have been available. Similarly the Dunlin (*Erolia alpina*), hitherto known solely as an occasional visitor, has now been shown to breed in at least one district. Definite information as to the northern limit of the breeding grounds of the Ringed Plover (*Charadrius hiaticula*) and the nesting-range of the Barnacle Goose (*Branta leucopsis*) are also now available for the first time.

[*Photo, Seton Gordon.*

FIG. 2.—Purple sandpiper on nest.

The skins obtained from Spitsbergen, nearly two hundred in number, are particularly interesting from the fact that they include a number of young birds in down plumage, such as Turnstone (*Arenaria interpres*), Grey Phalarope (*Phalaropus fulicarius*), Pink-footed Goose (*Anser brachyrhynchus*), Little Auk (*Plotus alle*), Glaucous Gull (*Larus hyperboreus*), and Brunnich's Guillemot (*Uria lomvia*), which are little known and not represented in most collections. Another valuable point is the presence of a large series of all the three species of geese which nest in the group in the flightless stage, thus furnishing excellent material for the study of the moults of these birds.

The eggs are of equal interest. In every case when a nest of any species of goose or duck has been taken the down and feathers have also been carefully collected. The eggs of *Branta leucopsis* have already been mentioned, but useful series of those of *B. bernicla* and *Anser brachyrhynchus* have also been taken. No eggs of the Puffin from Spitsbergen exist in collections so far as we are aware, and even Koenig's expedition failed to obtain any; but there are four in the Oxford Expedition's collection. Mandt's Guillemot (*Uria grylle mandtii*), Grey Phalarope (*Ph. fulicarius*), Purple Sandpiper (*E. maritima*) (Fig. 2), and Turnstone (*A. interpres*), are all represented in the collection, while two authentic clutches of eggs of the King Eider (*Somateria spectabilis*) are of especial value as furnishing trustworthy data for the description of eggs and down.

In one respect the expedition was unlucky. The Spitsbergen Ptarmigan (*Lagopus hemileucurus*) was absent in 1921 from several districts where it was plentiful in 1920. Feathers and droppings of the previous year were seen in hundreds; even fragments of last year's eggs were found, but the birds were absent from their old haunts. Possibly a migratory movement, due to the open weather of the winter of 1920–21, may have been the cause of the absence of these birds, but our knowledge of this species is too fragmentary at present for us to hazard an opinion.

It must not be imagined that even now the ornithology of Spitsbergen has been worked out. The eastern side can be reached only in favourable seasons and late in the summer, and even then ice conditions vary from day to day, and the explorer may have to beat a hurried retreat or run the risk of being frozen in. Naturally its secrets can be disclosed only very gradually, and probably always very imperfectly. Even among the birds of the western coast we meet with problems which still await solution. We are still in doubt as to the status of the Snowy Owl (*Nyctea nyctea*), though the weight of evidence points to the probability of a few pairs being resident and more or less parasitic on the Ptarmigan. The long-tailed Skua (*Stercorarius longicaudus*) is also something of a problem, and the evidence with regard to its breeding not quite conclusive; and there is evidently a good deal still to be learned as to the Sanderling (*Crocethia alba*). It is hoped that the material brought back by the expedition will also help to clear up the vexed question as to the races of the Puffin (*Fratercula arctica*), as to which there is much division of opinion.

Some interesting observations bearing on the sexual selection theory were made by Julian S. Huxley on the Red-throated Diver (*Colymbus stellatus*), confirming and extending the conclusions reached by him in his paper on the courtship of *Podiceps cristatus* (Proc. Zool. Soc., 1914). After the birds have mated for the season, elaborate courtship ceremonies take place between the mated pair. At times the two birds swim near each other with necks arched and the open beak half submerged, uttering a special cry. At others, one bird will dive all round and about the other, sometimes emerging almost vertically from the water, as does Podiceps. The active performer in such cases may be either the male or the female.

There thus exist, as in the Crested Grebe, *mutual* nuptial ceremonies. The bird's bright colouring and special nuptial activities are connected with the bird's sexual life, but not secondary sexual characters—epigamic, but not sex-limited.

Of particular interest were the observations made on the period during which the birds are separating into pairs for the season. At this time, too, they indulge in special ceremonies, in which, however, rarely two, but usually three (or even four), individuals participate. The birds submerge the whole body with the exception of the breast; the neck is thrust slightly forward and the head held out, so that the appearance is that of a miniature Plesiosaur. In this attitude the birds plough through the water, as if running races. This ceremony was never observed later, and is certainly connected with the choice of mates. Most remarkable of all, it appears almost certain that two females may thus "compete" for a single male as well as *vice versa*. In any event, we have as a new feature that in this species the mutual or common nuptial activities of the two sexes extend even into the pairing-up period, where, if anywhere, sex-limited display and Darwinian sexual selection might be expected. This period was not observed in the previous work on Podiceps. The need for some theory of "mutual selection" to supplement the Darwinian theory of sexual selection is thus further emphasised.

Favourable opportunities for observing the nuptial activities of Phalaropes and Purple Sandpipers, in both of which reversed sexual coloration and habits occur, were unfortunately very few. It is, however, suggested that (1) the pressure of Arctic life acts as an encouragement to small size in the waders; (2) that, *per contra*, the short breeding season requires the eggs to be large, in order that their development may be hastened; this, in its turn, will limit the reduction in size of the female; (3) the female will therefore tend to be bigger than the male; (4) in almost all birds (excluding Raptores) brighter colour of the male accompanies larger size. Presumably size, pigmentation, and psychological activity are all controlled together by the endocrine secretion of the gonad. It is thus probable that larger size of the female in these species will be associated with that type of metabolism which favours more intense pigmentation; (5) the more protectively coloured male could then more advantageously undertake incubation.

A discussion of this suggestion, however, would involve the handling of large bodies of evidence. It is, in any event, clear that the condition has developed from one in which both sexes were similarly coloured, and both shared the duties of incubation.

To sum up, we have here a series of nearly three hundred skins as well as about five hundred eggs, together with full diaries and field notes from members of the expedition. It is hoped that the reports on these collections will embody what is already known of the Spitsbergen and Bear Island group, and provide us with a dependable and handy manual on the birds of the archipelago. The coming of the oil engine has already affected the fauna considerably, and probably will do so even more in the future, and it is important to record the changes of the last ten or fifteen years. Koenig's fine work is bulky and expensive, and a concise account of the bird life, embodying the results of the present expedition, would be a most valuable work of reference as well as a permanent memorial of what is perhaps the only serious ornithological work undertaken by English men or women in the Arctic since Mr. Henry Pearson's last voyage to Russian Lapland more than twenty years ago, with the sole exception of Miss Haviland's adventurous journey to the mouth of the Yenisei in 1914.

The Present Position of the Theory of Descent, in Relation to the Early History of Plants.[1]

By DR. D. H. SCOTT, F.R.S.

IT has long been evident that all those ideas of evolution in which the older generation of naturalists grew up have been disturbed, or, indeed, transformed, since the re-discovery of Mendel's work and the consequent development of the new science of genetics. Not only is the "omnipotence of natural selection" gravely impugned, but also variation itself, the foundation on which the Darwinian theory seemed to rest so securely, is now in question.

The small variations, on which the natural selectionist relied so much, have proved, for the

[1] Abridged from the presidential address delivered to Section K (Botany) of the British Association at Edinburgh on September 9.

most part, to be merely fluctuations, oscillating about a mean, and therefore incapable of giving rise to permanent new types. The well-established varieties of the Darwinian, such as the countless forms of *Erophila verna*, are now interpreted as elementary species, no less stable than Linnean species, and of equally unknown origin. The mutations of De Vries, though still accepted at their face value by some biologists, are suspected by others of being nothing more than Mendelian segregates, the product of previous crossings; opinion on this subject is in a state of flux. In fact, it is clear that we know astonishingly little about variation. Dr. Lotsy, indeed, proposes to dispense with variation altogether, and to find the true origin of species in Mendelian segregation; inheritable variability, he believes, does not exist; new species, on his bold hypothesis, arise by crossing, and so, as he points out, we may have an evolution, though species remain constant. Thus everything apparently new depends on a re-combination of factors already present in the parents. "The cause of evolution lies in the interaction of two gametes of different constitution."

I am aware that very surprising results have been obtained by crossing. Nothing could well have been more striking than the series of Antirrhinum segregates which Dr. Lotsy showed us some years ago at a meeting of the Linnean Society; and now we hear of an apetalous Lychnis produced by the crossing of normally petaloid races. We do not know yet to what extent that sort of thing goes on in Nature, or what chance such segregates have of surviving. Still, if one may judge by Dr. Lotsy's experimental results, ample material for natural selection to work on might be provided in this way.

Dr. Lotsy's theory that new species originate by Mendelian segregation, if true, would have the advantage that it would make quite plain the meaning of sexual reproduction. Hitherto there has been a good deal of doubt; some authorities have held that sexual reproduction stimulated, others that it checked, variation. But, if we eliminate variation, and rely solely on the products of crossing, we get a clear view—"species, as well as individuals, have two parents"; sexual reproduction can alone provide adequate material for new forms, and can provide it in unbounded variety.

Again, though Dr. Lotsy himself is far from sanguine on this point, the crossing theory might be helpful to the evolutionary morphologist, for breeding is open to unlimited experiment, and we might hope to learn what kinds of change in organisms are to be expected. For example, the Lychnis experiment shows how easily a petaloid race may become apetalous. Such results might ultimately be a great help in unravelling the course of evolution in the past. We should gain an idea of the transformations which might actually have taken place, excluding those which were out of the question. At present all speculation on the nature of past changes is in the air, for variation itself is only an hypothesis, and we have to decide, quite arbitrarily, what kind of variations we think may probably have occurred in the course of descent. One need only recall the various theories of the origin of the seed from the megasporangium to realise how arbitrary such speculations are.

But, while recognising certain advantages in the theory of the origin of species by crossing, it is not for me to pronounce any opinion as to its truth. It is only the present position of the question that concerns us to-day. Some modern geneticists believe that there is evidence for mutation by the loss of factors, apart from the effects of crossing. Dr. Lotsy considers that such changes, if proved, can afford no explanation of progressive evolution. "Evolution by a process of repeated losses is inconceivable." It has, however, been pointed out by Dr. Agnes Arber, in her recent admirable book on water-plants, that, on any theory of evolution, "what organisms have gained in specialisation they have lost in plasticity." This is true, but it is not clear that this admitted loss of potentialities is the same thing as the loss of factors, in the sense of genetics.

Turning for a moment to Darwin's own theory of the origin of species by means of natural selection, the efficacy of the latter in weeding out the unfit is, of course, still acknowledged, and some geneticists allow it a considerable *rôle*. But there is a strong tendency in these days to admit natural selection only as a "merely negative force," and as such it has even been dismissed as a "truism." Now Darwin's great book was most certainly not written to enunciate a truism. He regarded natural selection as "the most important, but not the exclusive, means of modification" ("Origin of Species," p. 4). It was the continual selection of the more fit, the "preservation of favoured races," on which he relied, and not the mere obvious elimination of the unfit, and this great idea (so imperfectly understood by many of his contemporaries and successors) he worked out with astonishing power, in the light of the changes which man has produced, with the help of his own artificial selection.

It may be that the theory of natural selection, as Darwin and Wallace understood it, may some day come into its own again; certainly it illuminated, as no other theory has yet done, the great subject of adaptation, which to some of us is, and remains, the chief interest of biology. But in our present total ignorance of variation and doubt as to other means of change, we can form no clear idea of the material on which selection has had to work, and we must let the question rest.

For the moment, at all events, the Darwinian period is past; we can no longer enjoy the comfortable assurance, which once satisfied so many of us, that the main problem had been solved—all is again in the melting-pot. By now, in fact, a new generation has grown up that knows not Darwin.

Yet evolution remains—we cannot get away from it, even if we hold it only as an act of faith, for there is no alternative, and, after all, the evidence of palæontology is unshaken. I have thought it fair to lay stress on the present state of uncertainty in all that concerns the origin of species. On another occasion I even ventured to speak of the return of "pre-Darwinian chaos." But out of this chaos doubtless light will come. Last year, during a joint discussion on genetics and palæontology, I specially remember a remark by Miss Saunders, our then president, that Mendelism is a theory of heredity, not of evolution—a caution not unneeded, though, as the crossing hypothesis shows, the connection between the two conceptions may prove to be a very close one.

Genetics is rendering the greatest service to biology generally in ensuring that organisms shall be thought of as races, not as isolated individuals, mere chemical and physical complexes, at the mercy of the environment. The whole tendency of modern work is to show that in living things heredity is supreme. An organism is what it is by virtue of the constitution of the germ-plasm derived from its parents. Dr. Church says that "the more fundamental reactions, as expressed in morphological units of construction, have been established as constants beyond any hope of change." This statement is an important one for the palæontologist, for all our attempts to trace descent rest on the assumption that, in a general sense and as regards certain well-established characters, "like breeds like."

The question, What do we mean by a "species"? is far too difficult a matter to discuss now. Whatever we may think of Darwin's theory, his "Origin of Species" is at any rate a classic, and I believe we cannot do better than continue to use the word in the same sense as Darwin used it—*i.e.* essentially in the sense of a Linnean species.

That many Linnean species are real units of a definite order is generally admitted. Dr. Lotsy himself dwells on their distinctness, which depends on their usually not inter-crossing, and appears to be shown by the fact that among animals members of the same species recognise each other as such and habitually breed together. Such habitual breeding together under natural conditions is perhaps the best test of a species in the Linnean sense. "The units within each Linneon (= species) form an inter-crossing community." (Lotsy.) He adds: "Consequently it is Nature itself which groups the individuals to Linneons." These "pairing communities" have recently been re-christened by Dr. Lotsy "syngameons," a good name to express this aspect of the old "species."

I do not propose in these brief remarks to venture on that well-worn subject the inheritance of acquired characters—*i.e.* of such characters as are gained during the lifetime of the individual by reaction to the environment. There has always been a strong cross-current of opinion in favour of this belief, especially, in our own time, in the form of "unconscious memory," so ably advocated by Samuel Butler and supported by Sir Francis Darwin in his presidential address to the British Association at Dublin. Professor Henslow, as we all know, is a veteran champion of the origin of plant structures by self-adaptation to the environment. On the other hand, some geneticists roundly deny that any inheritance of somatically acquired characters can take place. In any case, the evidence, as it seems, is still too doubtful and inadequate to warrant any conclusion, so, however fascinating such speculations may be, I pass on.

To bring these introductory remarks to a close, we see that while the theory of descent or evolution is undisputed, we really know nothing certain as to the way in which new forms have arisen from old. During the reign of Darwinism we commonly assumed that this had happened by the continual selection of small variations, and we are no longer in a position to make any such assumption.

We have been told on high authority that "as long as we do not know how *Primula obconica* produced its abundant new forms it is no time to discuss the origin of the Mollusca or of Dicotyledons." (Bateson.) Yet this is just the kind of speculation in which a palæontologist is apt to indulge, and if kept off it he would feel that his occupation was gone! However, so long as we may believe, as already said, that, on the whole, like breeds like, that grapes do not spring from thorns or figs from thistles, there is perhaps still sufficient basis for some attempt to interpret the past history of plants in terms of descent. But certainly we have learnt greater caution, and we must be careful not to go far beyond our facts, and, in particular, to avoid elaborate derivations of one type of structure from another where the supposed transitional forms have but a purely subjective existence; we have realised the difficulty of tracing homologies. We may still be allowed to seek affinities, even where we cannot trace descent. And though we may sometimes go a little beyond our tether and give rein to bolder speculations, there is no harm done so long as we know what we are doing, and there may be even some good in such flights if our scientific use of the imagination serves to give life to the dry bones of bare description. On this subject I am somewhat more optimistic than Dr. Lotsy, who, abandoning his "Stammesgeschichte" point of view, has dismissed all attempts at phylogenetic reconstruction as "fantastic."

There are some questions of the highest interest that at present can scarcely be approached in any other but a speculative way. Within the last year or two new points of view have thus been opened out. For example, Dr. Church's able essay on "Thalassiophyta and the sub-aerial transmigration" has brought vividly before us the great change from marine to terrestrial life. Dr. Church puts the actual conquest of the land in the foreground. We watch the land slowly rising toward the surface of the primeval ocean, the rooted sea-weeds succeeding the free-swimming plankton, and then the continents slowly emerging and the drama of the transmigration, as the plants of the rock-pools and shallows fit themselves step by step for sub-aerial life when the dry land appears. It is a striking picture that is thus displayed to our view—whether in all respects a faithful one is another question; we must not expect impossibilities. The doubts which have been raised relate first to the assumed world-wide ocean, which seems not to be generally accepted by geologists. If continental ridges existed from the first (*i.e.* from the original condensation of watery vapour to form seas), the colonisation of the land may have followed other lines and have happened repeatedly. Perhaps, after all, that would not greatly affect the botanical aspects of the transmigration.

Dr. Church believes that the chief morphological characters of the land flora were first outlined in the sea; that such characters were not newly assumed after transmigration, but that they merely represent an adaptation to sub-aerial conditions of a differentiation already attained at the phase of marine phytobenthon (rooted sea-weeds). At the same time it is not suggested that any existing class of sea-weeds can be taken as representing the ancestry of the land flora; the transmigrant races are, as Algæ, extinct—they may have been Green Algæ of a high grade of organisation, on a level now perhaps most nearly represented by the highest of the Brown Sea-weeds.

Thus the transmigrants, which were destined to become the parents of the land flora, are pictured as already highly organised and well differentiated plants, which only needed to provide themselves with absorptive instead of merely anchoring roots, and with a water-conducting system (xylem and stomata) in order to fit themselves for sub-aerial life, while, on the reproductive side, the great change remaining to be accomplished was the adaptation of the spores to transport by air instead of by water.

Some botanists find a difficulty in accepting the suggestion that plants already elaborately fitted out for a marine life could have survived the transition, however gradual, to a totally different environment. Such thinkers prefer to believe that lower forms may have been more adaptable, and that morphological differentiation had, in a great degree, to start afresh when the land was first invaded. My own sympathies, I may say, are here with Dr. Church, for I have long inclined to the belief that the vascular plants were, in all probability, derived from the higher Thallophytes. The view of the late Prof. Lignier, now so widely accepted, that the leaf, at least in the megaphyllous or fern-like vascular plants, was derived from specialised branch-systems of a thallus, assumes, at any rate, that the immediate ancestors possessed a well-developed thallus, such as is now known only among the higher Algæ.

The question now arises, how far have we any evidence from the rocks which may bear on the transmigration and on the nature of the early land flora? Quite recent discoveries, especially those from the famous Rhynie Chert-bed, have shown that in Early Devonian times certain remarkably simple land-plants existed, which in general configuration were no more advanced than some very ordinary sea-weeds of the present day. At the same time these plants were obviously fitted for terrestrial life, as shown by the presence of a water-conducting tissue and stomata, and by the manifestly air-borne spores. These simplest land-plants are the Rhyniaceæ (Rhynia and Hornea), while the third genus, Asteroxylon, was more advanced and further removed from any possible transmigrant type.

Dr. Arber was so impressed by the primitive character of Rhynia (the only one of these genera then known) that he boldly called it a Thallophyte, while recognising, in respect of anatomical structure, an intermediate position on the way to Pteridophyta. This is not really very different from the view taken by the investigators themselves, though they call the plants Pteridophytes, which they certainly are if we go by internal structure rather than external morphology. But if, as Kidston and Lang suggest, the Rhyniaceæ "find their place near the beginning of a current of change from an Alga-like type of plant to the type of the simpler vascular Cryptogams," they must have been very primitive indeed, and might even be regarded as fairly representing the true transmigrants which had not long taken to the land.

It is true that the Middle Devonian is much too late a period for the original transmigration (I believe there is some evidence for land-animals in the Lower Silurian), but one may argue that some of the transmigrant forms may have survived as late as the Devonian, just as the Selaginella type seems to have gone on with little change from the carboniferous to the present time. There must have been many such survivals of earlier forms in the Devonian period, if Arber was right in regarding all the characteristic plants of the Psilophyton flora as "much more probably Thallophyta than Pteridophyta." There is, in fact, no doubt that the earlier Devonian flora is turning out to have been on the whole more peculiar and more unlike the higher plants than we realised a few years ago. The Early Devonian plants cannot usually be referred to any of the recognised groups of Pteridophytes, and this is not owing to our imperfect knowledge, for it is just in those cases where the plants are most thoroughly known that their unique systematic position is most manifest. Arber called all the plants in question "Procormophyta"—an appropriate name. As Kidston and Lang point out in their later work, the three groups—Pteridophyta, Bryophyta, and Algæ—are brought nearer together by the Rhynie fossils.

Yet there is evidence that about the same period stems with the highly organised structure of Gymnospermous trees already existed. I refer to remains of which *Palaeopitys Milleri*, from the Middle Old Red Sandstone of Cromarty, is the type. We need much further investigation of these higher forms of Early Devonian vegetation, but we know enough to impose caution on our speculations.

The Rhyniaceæ, at all events, were leafless and rootless plants. In one species of Rhynia and in Hornea the aerial stems are entirely without any appendages, while in the other Rhynia there are hemispherical swellings, which have been identified by Arber with certain states of the spines in Psilophyton. The emergences of *R. Gwynne-Vaughani* have been interpreted as nascent leaves, but more recent observations, showing their late histological origin, have rendered this hypothesis very doubtful.

In Asteroxylon, a higher plant altogether, the stem is clothed with quite distinct leaves, though they are somewhat rudimentary as regards their vascular supply. Have we, in these plants, and others of contemporary date, the first origin of the leaf from a mere non-vascular emergence, or had reduction already begun, so that in Rhyniaceæ, for example, the leaves were in the act of disappearance? In the former case we should be assisting at the birth of Lignier's phylloids, the microphylls of the Lycopod series.

But the opposite view may also be tenable. We have already seen that these plants have been referred both to the Pteridophytes and the Thallophytes; they also show signs of Bryophytic affinities, and I understand that it has even been proposed to include them in the Bryophyta, in which case every possible view will be represented. The Sphagnum-like structure of the columellate sporangium or sporogonium of Hornea and Sporogonites may justify the Bryophytic attribution, and it is then, of course, easy to extend it to Rhynia. If we were to adopt this opinion we should probably have to regard these simple Devonian plants as representing stages in the reduction of the sporophyte to a sporogonium, the leaves being already nearly or quite lost, while the branched thallus was still much in excess of the simple seta of the modern Moss or Hepatic. Naturally we know nothing of the gametophyte, so that the material for comparison is limited. Kidston and Lang, however, have recently pointed out that the presence of spore-tetrads clearly indicates the existence of a gametophyte.

I make no attempt to decide between these views. There can be no reasonable doubt that the Psilophytales generally represent an earlier phase of cormophytic life than any of the groups previously recognised. But we must not assume that *all* their characters were primitive. It has been pointed out that the Rhyniaceæ were peat plants, and that the peat flora is apt to be peculiar. Under such conditions it is not improbable that a certain amount of reduction may have already been undergone, though this is not the view taken by the investigators.

The recent work on the Early Devonian flora has wide bearings. It has long been noticed that among the fossils of that period no typical fern-fronds are found. Those remains which are most suggestive of fern-like habit consist merely of a naked, branched rachis. It used to be assumed that the absence of a lamina might be explained by bad preservation. But, as Prof. Halle points out, the chief reason for condemning the preservation as bad was the fact that a lamina was absent!

The evidence really seems to indicate that the so-called fronds of that age did not possess a leaf-blade. As Prof. Halle says: "In the Lower Devonian, finally, we find frond-like structures bearing sporangia, but no fronds with developed laminæ. One can hardly escape the conclusion that the 'modified' fertile fronds may represent the primitive state in this case and that the flattened pinnules are a later development, as suggested by Prof. Lignier." These naked fronds may, in fact, be regarded as the little-differentiated branches of a thallus.

The evidence, as at present understood, seems to suggest that, in the earlier Devonian flora, ferns, properly so called, may not yet have been in existence. The predecessors of the ferns were there, no doubt, but not, so far as we know, the ferns themselves. Yet it seems that highly organised stems of a gymnospermous type were already present at about the same period. Thus the evidence from the older Devonian flora, so far as it goes, materially supports the opinion that the seed plants cannot have arisen from ferns, for the line of the Spermophyta seems to have been already distinct at a time when true ferns had not yet appeared.

The idea, which I once advocated, that the Gymnosperms were derived, through the Pteridosperms, from the ferns must, I think, be given up, on grounds which were stated two years ago at the Bournemouth meeting of the Association. It is safer to regard the Pteridosperms, and therefore the seed plants generally, as a distinct stock, probably as ancient as any of the recognised phyla of vascular Cryptogams, and derived from some unknown and older source. At the same time the striking parallelism between the Pteridosperms and the true ferns must be recognised. These views are essentially in agreement with those previously expressed by my friend Dr. Kidston.

The significance of the Pteridosperms has perhaps been somewhat misunderstood. It now seems that they do not, as some of us once imagined, indicate the descent of the seed plants from ferns, but rather show that the seed plants passed through a fern-like phase; they ran a parallel course with the true cryptogamic ferns, and, like them, sprang from some quite early race of land plants, such as Rhynie has revealed to us. But the phylum was never any more fern-like than the Pteridosperms themselves.

On our hypothesis, the Upper Palæozoic phyla, with which we have to reckon, are the Pteridosperms (representing the early phase of the seed plants), the ferns, the Sphenophylls, the Equisetales, and the Lycopods. These five lines were probably all well differentiated in the Upper Devonian flora.

When we get back to the Middle and Lower Devonian the case is completely altered. Not one of the five phyla is here clearly represented, unless it be the Spermophyta; for these we have the evidence of apparently gymnosperm-like stems. Thus the field is left absolutely open to speculation. We may imagine either that the various phyla converged in some early vascular stock (illustrated by the Psilophytales), or that they ran back in parallel lines to independent origins among the transmigrant Algæ and, perhaps further still, to separate races of purely marine plants. Both views are represented in the publications of recent authors.

Dr. Arber, in his "Devonian Floras," maintained the early existence of three distinct lines of descent: the Sphenopsida, Pteropsida, and Lycopsida. Each of the three lines is described as descended from thallophytic Algæ of a distinct type. Thus Arber's view was decidedly polyphyletic.

Dr. Church, from quite a different point of view, arrives at somewhat similar conclusions, but he goes further. He says: "Speaking generally, it appears safer to regard a 'race' or 'phylum' as the expression of a group of organisms which derived their special attributes from the equipment of a preceding epoch, if not in one still further back. Thus all the main lines of what is now land flora must have been differentiated in the Benthic epoch of the sea (*i.e.* as algal lines), as all algal lines were differentiated in the Plankton phase. The possibility is not invalidated that existing groups of land flora may trace back their special line of progression to the flagellated life of the sea, wholly independently of one another (Pteridophyta)."

Thus the idea of independent parallel lines of descent is carried to its extreme limit. "Each phylum goes back the whole way, without any connection with anything else." Of course, this thorough-going polyphyletic conception is involved in the doctrine already mentioned that morphological differentiation was attained in the sea before the transmigration.

I have cited Dr. Arber and Dr. Church as independent representatives, approaching the question from quite different sides, of the polyphyletic or parallel-phyla hypothesis. The opposite view, of convergent monophyletic races, is also well supported. Prof. Halle, after speaking of the possible relation of the Psilophyton type to Lycopods on one hand and ferns on the other, adds: "From this point of view the whole pteridophytic stock would be monophyletic, the Lycopsida and the Pteropsida being derived from a common form already vascular. It would not thus be necessary to assume a parallel evolution of a similar vascular system along two different lines."

Kidston and Lang, in the light of their Rhynie discoveries, regard Halle's survey as "a fair statement of the present bearing of the imperfectly known facts." They add: "The geological age and succession of the Early Devonian plants are, on the whole, consistent with the origin of the various groups of vascular Cryptogams from a common source." We have already referred to the bryophytic features, which have been recognised in the Rhyniaceæ. Kidston and Lang make use of these to extend their tentative conclusions to the Bryophyta. In concluding their third memoir they say: "In Rhynia and Hornea we have revealed to us a much simpler type of vascular Cryptogam than any with which we were previously acquainted. This type suggests the convergence of Pteridophyta and Bryophyta backwards to an algal stock. The knowledge of Asteroxylon confirms and enriches our conception of a more complex but archaic type of the vascular Cryptogams, which supports the idea of the divergence of the great classes of Pteridophyta from a common type, and links this on to the simpler Rhyniaceæ." The monophyletic view, though stated with appropriate caution, could not be more clearly expressed

It is evidently impossible to decide between the two theories in the present state of our knowledge; we are now only beginning to acquire some conception of the vegetation of Early Devonian times. The discovery, however, of the existence at that period of an unexpectedly simple race of vascular plants to some extent favours a monophyletic interpretation. To some minds, too, the important points in which all existing Pteridophyta, however diverse, agree will still suggest a common origin not too remote. Among such common characters may be mentioned the alternation of generations with the sporophyte predominant; the development both of the spores and the sexual organs; and the histology, especially of the vascular system and the stomata. The community of reproductive phenomena is explained by Dr. Church on the principle that reproductive phases are inevitable and are therefore the same in all phyla. A like explanation may to a certain extent be applicable to somatic features, some of which may be the necessary consequences of the sub-aerial transmigration. Thus a polyphyletic hypothesis may no doubt be justified, but it urgently needs to be supported by further evidence of the actual existence of separate stocks among the earliest available records of a land flora.

The study of fossil botany has led to results of the utmost importance in widening our view of the vegetable kingdom and helping to complete the natural system, to use Solms-Laubach's old phrase once more. One need mention only the Mesozoic Cycadophytes, the Cordaitales, the Pteridosperms, the Palæozoic Lycopods and Equisetales, the Sphenophylls, and now, most striking of all, the Psilophytales, to recall how much has been gained. We have indeed a wealth of accumulated facts, but from the point of view of the theory of descent they raise more questions than they solve. In this address I have briefly touched on some of the most general and most speculative problems in the hope of giving an opening for discussion. It might have been more profitable to deal in detail with definite facts of observation, but recent discoveries have brought us face to face with the great questions of descent among plants. However imperfect our data may be, both as regards the method and the course of evolution, the problems suggested, nevertheless, make urgent claims on our attention.

The Shackleton-Rowett Oceanographic and Antarctic Expedition.

By DR. HUGH ROBERT MILL.

THE Shackleton-Rowett expedition, the preliminary plans of which were outlined in NATURE for July 7, p. 602, left St. Katherine's Dock in the *Quest* on Saturday, September 17, remained at Sheerness for a few days to complete the fitting of the wireless telegraphy apparatus, and sailed from Plymouth on Saturday last, September 24, at 5 p.m.

So much publicity has been given to the plans and prospects of this expedition, and such stress laid by headlines and large type on the minor incidents of preparation and departure, that one reader might be excused if he viewed it all as what, for lack of a more ancient and decorous term, he might be tempted to call a mere stunt; while another of a more generous disposition could scarcely be blamed for looking on it as a great oceanographical expedition. As a matter of fact, it is designed to be neither the one nor the other. The *Quest* is a very small vessel, and she has started on a very big voyage, full of dangers and risks that it is probable no committee of geographical or nautical experts would recommend any selected leader to undertake; but no such committee was created or consulted, and Sir Ernest Shackleton bears on his own broad shoulders all the responsibility for the plan of the expedition, the choice of his comrades, and the fight with the very real difficulties of a great and romantic adventure. Even if no scientific results were aimed at, this revival of the old spirit of maritime knight-errantry which has invigorated our sea-history since Elizabethan days is a thing to be proud of and grateful for in an age of disillusion, low ideals, and love of ease. The members of the expedition include the most experienced polar explorers and men who have been trained in the almost incredible hardships of minesweepers, submarines, and "Q"-ships.

Sir Ernest Shackleton has, however, a very clear and useful programme of scientific work, in which he sought the advice and secured the help of many authorities, including the Admiralty and the Air Ministry. He has not tried to make the *Quest's* voyage a second *Challenger* expedition, or in any way to anticipate the renewal of the large-scale oceanographical research ably sketched out by Prof. Herdman and wisely postponed to a more convenient, and, we trust, not very far distant, season. The *Quest* is fitted with the latest machines for deep-sea soundings, and if her voyage is completed along the route projected the results should be of great importance, especially in the Enderby quadrant of the Antarctic. Some may be inclined to doubt the possibility of taking exact soundings from so small a vessel in high seas, but in the early days of telegraph-cable surveying with the crudest appliances excellent results were obtained, in depths far more than a thousand fathoms, from sailing vessels smaller than the *Quest*. No surveying ship probably has been better equipped for fixing accurate positions, as it should be possible to rate the chronometers by wireless time-signals during the greater part of the cruise. Deep-sea temperature observations and the collection of water-samples to be preserved for examination on shore should also be possible. The size of the ship makes it hopeless to attempt deep-sea dredging or trawling, but shallow-water dredging will no doubt be carried out when occasion offers, and the collection of plankton will be greatly facilitated by the low freeboard and comparatively slow speed of the ship.

Much interest attaches to the meteorological work to be done on board, and especially to the upper-air investigations for which provision has been made by the Meteorological Office. The small seaplane carried by the *Quest* will be very useful in piloting the vessel in ice and in the search for doubtful islands *if* it can be put together successfully and transferred safely from the ship to the sea and back again; but this part of the equipment must be viewed as an experiment the success of which is not to be acclaimed until it has been proved. Magnetic observations will, it is hoped, be made a special feature of the scientific work, and for the first time, we believe, a gyroscopic compass will be carried into high latitudes, where its indications should be of extreme value, as the track should carry the *Quest* across the region of maximum change of variation where the magnetic needle is of least value. Opportunities will doubtless occur for magnetic work on ice-floes and perhaps also on islands if local attraction is not too strong.

The *personnel* of the Expedition was announced as follows:—

Sir Ernest Shackleton, leader and captain; Commander Frank Wild, second-in-command; Commander Frank Worsley, hydrographer and sailing-master; Lieut.-Commander D. G. Jeffrey, navigator; Major A. H. Macklin, surgeon; Capt. L. D. A. Hussey, meteorologist; Lieut. A. J. Kerr, chief engineer; Major R. Carr, airman; Capt. G. V. Douglas, geologist; Capt. G.

Wilkins, naturalist; Mr. J. C. Bee-Mason, photographer and kinematographer; Mr. G. Smith, second engineer; Mr. J. Dell, electrician; Mr. Harold Watts, wireless operator; D. Ericson, gunner; C. J. Green, cook; Boy Scouts N. E. Mooney and J. W. Marr. The members of the scientific staff enumerated above will also work the ship, and on leaving Plymouth two additional members were shipped for the first part of the voyage in the persons of Mr. Gerald Lysaght and Mr. McLeod. Of the complete ship's company of twenty all told, no fewer than five accompanied Sir Ernest Shackleton on his Antarctic expedition in the *Endurance* in 1914.

Obituary.

Dr. Walter George Ridewood.

Dr. Walter G. Ridewood, whose sudden death occurred on September 19, was born in London on February 1, 1867. He was educated at Enfield Grammar School, of which his father, Mr. W. S. Ridewood, was headmaster for many years. He was at the Royal College of Science from 1883 to 1887, becoming an associate and taking first classes in both biology and geology. In 1888 he took his B.Sc. degree in the University of London, with first-class honours in zoology, and in 1897 he became D.Sc. In the meantime, in May, 1888, he had been appointed assistant to the director at the British Museum (Natural History), where he was employed in making the wonderful series of anatomical preparations exhibited in the Central Hall of that institution. In this kind of work Dr. Ridewood was without rival, his extraordinary manual skill and technical knowledge being supplemented by a thorough grasp of the principles of morphology and a close acquaintance with its literature. He also organised and prepared several special exhibitions, among the most important being the Darwin Centenary Exhibition and the series of preparations illustrating the different modes of flight in the animal kingdom. This series is still on exhibition, and is an excellent example of his work. For these and other exhibitions he prepared valuable illustrated guide-books. He severed his connection with the British Museum in 1917, after twenty-nine years' service, his resignation being greatly regretted by his colleagues.

In addition to, and for the most part relating to, his work in the museum Dr. Ridewood published a long series of valuable memoirs, mostly dealing with the comparative anatomy of the Vertebrata. Only some of the more important of these can be referred to: "On the Cranial Osteology of the Teleostei" (five papers in the Proc. Zool. Soc., 1904, and in the Journ. Linn. Soc., vol. 29: these were intended to be used in a general work on the osteology of fishes, never published); "On the Air-bladder and Ear in the British Clupeoid Fishes" (*Journ. of Anatomy*, vol. 26); "On the Structure and Development of the Hyobranchial Skeleton and Larynx in Xenopus and Pipa" (Journ. Linn. Soc., vol. 26: this was his thesis for the D.Sc. degree). He also wrote on a new species of Cephalodiscus from the Cape Seas, and on the Pterobranchia of the Antarctic (*Discovery, Scotia,* Australasian, and *Terra Nova* Expeditions). His chief paper relating to the Invertebrata is the "Monograph on the Gills of the Lamellibranchia" (Phil. Trans., 1903); this he illustrated by a series of models in the British Museum. His last published work is an important memoir, "On the Calcification of the Vertebral Centra in the Sharks and Rays" (Phil. Trans., 1921). In this he was able to show that Hasse in his great work on the same subject had "overestimated the importance of the disposition of the calcified masses and laminæ in the centrum as a taxonomic feature." Another completed paper on the development of the skull in the whalebone whales remains to be published.

Dr. Ridewood was a man of a singularly quiet and retiring disposition, which perhaps in some cases led to his real character being misunderstood. Actually his reticence was a mask covering a genuine kindliness which often showed itself in the great amount of trouble he would take to help anyone who asked for his advice and assistance. During the war he drove a Red Cross ambulance in France for nearly two years.

Apart from zoology, Dr. Ridewood's chief interest was in music. He was an extremely good performer on the flute, and for many years was a member of various amateur orchestras, especially of the Strolling Players. He made a thoroughly scientific study of his favourite instrument, but does not seem to have published anything on the subject.

He was for twenty-three years lecturer on biology in the Medical School of St. Mary's Hospital, London, and was reader in zoology in the University of London. He was also a life member of the Linnean, Geological, Zoological, and Malacological Societies.

C. W. A.

Notes.

We learn from the *Times* that Sir Thomas Holland, who recently resigned his post as Minister of Industries in the Governor-General of India's Council as a protest against the suspension of prosecution in connection with alleged corrupt practices in the supply of munitions, left Simla on Friday last for England. The whole facts of the case are not before us, but so far as we can make them out Sir Thomas Holland has been sacrificed to political expediency. In a recent speech the Viceroy, Lord Reading, suggested that the trouble would not have arisen had the post of Minister of Industries been filled by a lawyer instead of a man of science, and we may put our own interpretation upon this view. Sir Thomas Holland appears, however, to have consulted two members of the Viceroy's Council, one of whom was probably the legal member, before censuring the official and firms involved in the Calcutta munitions case, and the gravity of his offence was that he did not consult the Viceroy himself. But surely it is the duty of the legal member of the Council to advise his non-legal colleagues, and if Sir Thomas Holland had his approval that ought to have been sufficient. If nothing can be done in India without consulting the Viceroy personally, administration will be slower than ever. The truth seems to be that Sir Thomas Holland made many enemies by his attacks on profiteers, and their hostility, with that which lawyer administrators often display towards scientific men who enter what they consider to be their own special preserves, has resulted in the removal of one who was to them a troublesome Minister. Whatever may be said in favour of the strictly legal view of the case, common sense is on the side of Sir Thomas Holland, who may be assured that his action will be supported by scientific workers everywhere. The claim that a Minister of Industries should necessarily be a lawyer is one against which we must enter the strongest protest both on account of science and of efficiency. We trust that when Parliament meets the whole question will be raised in the interests of probity and justice.

THE announcement in the *Times* of September 24 of the successful synchronisation of speech and action in kinematography by means of photographic films bearing suitable sound records is the natural outcome of the work expended on this problem in numerous different countries. Sweden, through MM. Bergland and Frestadius, has apparently been fortunate enough to reach success first. It is indeed surprising that the achievement has been so long delayed. Speaking-films, apart from synchronisation, have been in existence for a long time, having been first made by Ernst Rühmer about 1900, and called by him the "photographophone." Rühmer made his films by photographing upon them the fluctuating light proceeding from a "speaking arc," and the reproduction was effected by making use of the well-known property of selenium of controlling a telephonic current when actuated by variable illumination. More recently (Proc. Phys. Soc., vol. 32, p. 78) Prof. A. O. Rankine has made speaking-films by a different method, in which the voice imposes fluctuations of intensity on a beam of light issuing from a constant source, the reproduction from the film record again being by means of selenium. The whole problem is closely related to telephony by light, of which a description was given in NATURE of February 5, 1920 (vol. 104, p. 604). In photo-telephony the speech is transmitted by light and reproduced immediately; in speaking-films a photographic record is made for future reproduction. The *Times* article does not make quite clear by what process M. Bergland makes the sound-film, but it probably does not differ fundamentally from those previously used. The novelty of M. Bergland's work appears to be the successful realisation of synchronism between the picture-bearing and the sound-record-bearing films. This has been done by the obvious method of running the two films on the same shaft, both during the taking of the double record of action and speech and during reproduction. In addition, sufficient valve amplification to actuate a loud-speaking telephone has been successfully applied to the selenium-controlled currents.

A PUBLIC meeting was held in Edinburgh on September 13 last under the auspices of the National Union of Scientific Workers, when Prof. H. Levy delivered an address entitled "The Function of the Scientist in Organised Research." Prof. Levy laid stress on the fact that by research new fields of inquiry were being opened up and new crafts being created. The status of the work itself, as well as that of the worker, must therefore receive consideration. Any tendency to make research a commercial undertaking was deprecated as liable to stifle investigations of fundamental importance, though possibly of an abstract nature. For the direction of research it was suggested that the best administrators would be men of scientific attainments who understood the conditions best adapted for good work; men of science must therefore be trained in administration. On the other hand, the idea of training the administrator in research was regarded as out of the question, the two faculties being, when approached in this order, diametrically opposed. As regards the status of the research worker, it was maintained that such security of tenure must be granted as would admit of unfettered criticism, and that the remuneration attached to appointments of a scientific nature, whether administrative or practical, should correspond with that attached to posts of a similar grade in other branches of Government service. The co-operation of men of science of all kinds was necessary in order to promote the interests of research.

DISPATCHES from Col. Howard Bury to the *Times* describe the further efforts of the Mount Everest Expedition to find a practicable route to the summit of the mountain. Unfavourable weather at the end of August having interfered with mountain climbing, Col. Howard Bury and Mr. Wollaston explored the lower valley of the Kamachu from the expedition's base at Kharta. They crossed the Samjunla at 15,000 ft. and the Chogla at 16,100 ft., reaching a remarkable lake called Ruddamlamtso, which is regarded as holy and is the destination of annual pilgrimages. Two thousand feet above the lake is the village of Sakideng, once a place of considerable size, but now practically deserted since a pestilence wiped out the inhabitants. From Sakideng Col. Bury descended the Kama and Kamachu valleys, which were found to be densely forested. The Arun Valley was reached at about 7500 ft. The village of Lungdoe, some 4000 ft. above the river, was found to lie in a region of great fertility and luxuriant crops of millet, cucumbers, and pumpkins.

LATER news from Col. Howard Bury, published in the *Times*, is to the effect that the approach to Mount Everest up the Kamachu or Shinchu Valley, indicated by the local inhabitants, proved to be useless. No possible way was discovered of ascending the cliffs surrounding the Kamgshung glacier. Attention was then turned to the upper valley of the Kharta, about which nothing could be learnt from the inhabitants. Ascending the glacier at the head of the valley the explorers ascended gentle slopes through deep snow to a col at 23,000 ft., from which it appeared possible to reach the northern ridge of Mount Everest. Soft snow and warm weather prevented any further advance, so that efforts were concentrated on preparing a base as high as possible. With this end in view a camp was established about eighteen miles up the Kharta Valley at about 17,500 ft., a second camp at about 20,000 ft., and a third camp at the 23,000-ft. col. It is possible a fourth camp was to be made between 23,000–24,000 ft. on the slopes of Mount Everest itself. Messrs. Mallory and Bullock left Kharta on August 31 for the advanced camp to await suitable weather conditions. Mr. Raeburn has rejoined the expedition.

THE *Quest*, with the Shackleton-Rowett Expedition on board, was given an enthusiastic send-off on leaving Plymouth for the south on September 24. The first stage of the journey is to the Salvage Island, a small group of rocky islets occasionally visited by Portuguese fishermen, but otherwise uninhabited, lying 160 miles south of Madeira and 85 miles from Teneriffe. From there the *Quest* will sail *via* St. Paul's Rocks, South Trinidad, Tristan da Cunha, and Gough Island to Cape Town, where she is due about December 1. Sir Ernest Shackleton announces that the expedition is fully equipped for deep-sea research and meteorological work, and will pay particular attention to magnetic observations. In wireless equipment the ship has two transmitting sets, one with a night range of 2000 miles, a receiving set fixed on board, two shore sets which can if necessary be used in her lifeboats, and a small set for the seaplane. A slight change in plans is announced; after returning from the Weddell Sea *via* South Georgia and Bouvet Island the *Quest* will visit Cape Town a second time before leaving for the Marion and Heard Islands and the Pacific.

THE number of ordinary scientific meetings of the Chemical Society to be held during the coming year has been increased with the object of affording greater facilities for papers to be read before the society. The first meeting will be held at Burlington House on Thursday, October 6, at 8 p.m. Following the custom of the last few years, the council has again arranged for the delivery during the session of three special lectures which, by the courtesy of the council of the Institution of Mechanical Engineers, will be held in the lecture-hall of that institution (Storey's Gate, S.W.1). The first, entitled "The Genesis of Ores," will be delivered by Prof. J. W. Gregory on Thursday, December 8, at 8 p.m. On February 9th, 1922, Sir Ernest Rutherford will lecture on "Artificial Disintegration of Elements"; while the last lecture, by Dr. H. H. Dale, entitled "Chemical and Physiological Properties," will be held on June 8, 1922.

THE Scientific and Technical Group (of members) of the Royal Photographic Society has just issued the third quarterly number of "Photographic Abstracts." It contains nearly 300 classified abstracts of publications concerning photography from practical and theoretical points of view, besides descriptions of the published results of those whose pleasure or duty it is to investigate the innumerable scientific problems connected with photography and its applications to the various branches of science and industry. There is also a classified list of about ninety recently issued patents, which deal chiefly with details of mechanism, given in title only, with full information as to the country of origin, the date and the official number, and finally an index of authors' names. Practically speaking, the journal is a descriptive index of the progress of photography in all its various aspects and applications, and it should meet with a wide appreciation, not only by photographers, but also by students, scientific investigators, photographic manufacturers, and those engaged in any industry in which photography is utilised. Those who conduct the journal merit hearty congratulations that they have in the third number brought it to such a pitch of perfection.

THE Department of Scientific and Industrial Research announces that the MS. copy of the "Bibliography of Lubricants" compiled by the Lubricants and Lubrication Inquiry Committee, referred to in the Report of the Committee of the Privy Council for 1919–20 (Cmd. 905), has been placed in the library of the Department at 16–18 Old Queen Street, Westminster, S.W.1, and is available for reference. Owing to the expense which would be involved, it is not possible to print this bibliography as originally intended. The bibliography contains in a classified form references to every paper on lubricants and lubrication which was considered by the Committee as being of definite importance. It is divided into two main parts, the papers being classified according to authors and subjects. The references themselves are divided into two sections, one dealing with the chemical, the other with the engineering and physical aspects of the subject.

FREE public lectures are to be delivered at the Horniman Museum, Forest Hill, S.E., each at 3.30 o'clock, as follow:—On October 8, "The Life and Habits of Mason Bees," F. Balfour-Browne; on October 15, "The Egyptian Pyramids," Miss M. A. Murray; on October 22, "Dredging for Marine Animals," H. N. Milligan; on October 29, "The Folk-lore of Seafaring Men," E. Lovett; on November 5, "A Naturalist on the African Lakes," Dr. W. A. Cunnington; on November 12, "Insect Collecting and its Value," F. Balfour-Browne; on November 19, "The Dawn of History in Egypt," Miss M. A. Murray; on November 26, "The Natural History of Dogs," H. N. Milligan; on December 3, "Exploring on Lake Mœris (Lower Egypt)," Dr. W. A. Cunnington; and on December 10, "Folk-lore Records from Italy, France, and Belgium," E. Lovett.

THE annual meeting of the American Metric Association will be held at Toronto on December 29 next.

The objects of the meeting are to bring together public officials, engineers, business men, and others who are interested in securing for the United States and Canada the benefits of the general use of the metric system and to utilise the information thus gained in guiding the metric movement. So far as possible the papers to be presented will outline the steps which would be necessary to make the suggested change in industry and the law. The Britten-Ladd Metric Bill now before the United States Congress will be among the subjects discussed. Suggestions and queries should be sent to the American Metric Association, 156 Fifth Avenue, New York City.

The following committee has been appointed by the Medical Research Council, in consultation with the Ministry of Health, for the investigation of the causes of dental decay:—Prof. W. D. Halliburton (chairman), Mr. N. G. Bennett, Mr. L. Colebrook, Dr. J. M. Hamill, Sir Arthur Keith, Mrs. E. Mellanby, Mr. J. H. Mummery, and Mr. C. J. Thomas. Dr. J. M. Hamill is the secretary of the committee.

A conversazione of the Royal Microscopical Society will be held at the Mortimer Halls, Mortimer Street, London, W.1, on Wednesday, October 5, from 7.30 to 10.30 p.m.

The Harveian oration of the Royal College of Physicians of London is to be delivered at 4 o'clock on Tuesday, October 18, by Dr. H. Spencer.

One modern school of anthropologists explains the origin of civilisation as starting from Egypt. It is therefore important to investigate how far this dissemination of culture can be recognised in Africa itself. At the Edinburgh meeting of the British Association the question was considered in a paper on "Egyptian Influence on African Death Rites," by Mr. T. F. McIlwraith. He found, particularly on the Guinea coast and in the Congo Valley, cases of desiccation of the corpse, delayed interment without the use of preservatives, burial in coffins decorated with anthropomorphic figures, and statues intended to house the soul or to serve as effigies on the grave. The fact remains that these analogies to Egyptian culture are found in West and Central Africa, not in the nearer regions of the east and south. This, he suggested, could be explained by seafarers from Egypt founding a centre on the Congo coast, whence elements of Egyptian civilisation penetrated inland or by overland influences, which had been wiped out by later intrusions of pastoral peoples.

In connection with Mr. A. E. Harris's letter on *Ceratium furca* (Nature, September 8, p. 42), suggesting that this organism may be moving inland, Mr. J. W. Williams, of Bewdley, Worcester, writes to say that he and Mr. H. Weaver have found the curious organ-pipe diatom *Bacillaria paradoxa*, Gmel., in abundance in the Staffordshire and Worcestershire Canal at Stourport and in Wilden Pool; Mr. Weaver has also found the organism in Charlton Pool and Hartlebury. Mr. Harris states that for a number of years *Bacillaria paradoxa* has been recognised as a constituent of the fresh-water algæ of the dykes and drains of the north-east and east of England, although its normal habitat is in salt or brackish water. That it has been found in districts hitherto unexplored is not necessarily proof that it is actually advancing inland.

Some interesting observations on two British mammals form the subject of notes in the *Irish Naturalist* for September. Mr. A. W. Stelfox records his observations on a curious flight made one evening in July by a hairy-armed bat (*Nyctalus Leisleri*). The bat made an upward and zigzag flight into the air and continued its ascent until out of sight. Mr. C. B. Moffat, commenting on this note, states that he has witnessed similar ascending zigzag flights on the part of the same species of bat on three occasions, and is of opinion that the animal, which, by reason of its early and short period of flight, must live on day-flying insects, hopes by its ascending flight to find clearer air and a more abundant supply of insects. In the second note Mr. A. Sheals supplies evidence to show that squirrels, contrary to prevailing belief, bring forth their young quite early in the year. Mr. Moffat endorses Mr. Sheal's opinion in a commentative note, and remarks that there is reason to believe that the young squirrels born about midsummer or later are second broods.

Mr. R. I. Pocock writes on otters in the September issue of *Conquest*. His article is prefaced by a general consideration of amphibious mammals, with special reference to those characters acquired independently by species, wholly unrelated to each other, which have adopted the amphibious habit, such as the quality of the fur, the strengthening of the "whiskers" of the upper lip, and a general form of body so built as to offer the least possible resistance to water. Dealing specially with otters, the author notes their world-wide distribution and uniformity in character, due to their habit of entering the sea to fish and their ability to travel along the waterways of the world. Mr. Pocock throughout the article brings out in an interesting manner the correlation of structure with habit. Some otters, like the African otter, have given up aquatic life, and, in consequence, the bristles on the upper lip have lost much of their stiffness and the webs on the feet are reduced in size. The true sea or fur-bearing otter is of special interest in this connection. Compared with freshwater otters it has a shorter tail, smaller and more delicate fore-paws, and very large flipper-like hind-paws. This is correlated with a general habit of swimming mainly with its hind limbs and the absence of any need for rapid movement through the sea on account of its independence of swift-swimming fishes as food. It feeds mainly on mussels and other shell-fish, crabs, and sea-urchins. The article concludes with a consideration of the affinities of otters. Mr. Pocock supports the generally accepted view that otters are related to the martens, and may be described with considerable truth as aquatic, fish-eating martens.

An illustrated account of the trials of the motor tanker *Conde de Churruca* appears in the *Engineer* for September 16. This vessel was constructed by

Sir W. G. Armstrong, Whitworth and Co., Ltd., and has twin screws driven by Armstrong-Sulzer Diesel engines. These engines are the largest engines of the type which have, up to the present, been fitted in a British mercantile vessel. The vessel has been constructed on the Isherwood longitudinal system, and is 370 ft. long; the gross tonnage is 4550, and the mean draught is 24 ft. 3 in. with 6500 tons dead-weight on board; under these conditions the speed is $11\frac{1}{2}$ knots. Each engine has four cylinders, 600 mm. bore and 900 mm. stroke, and develops 1250 brake-horse-power at 100 revs. per min. During the trials the fuel consumption of the main engines was 0·421 lb. per brake-horse-power per hour. The pistons are cooled by the Sulzer spray system, in which a spray of sea-water plays inside the piston and is discharged against its inner walls. The system works under atmospheric pressure with an open discharge, so that the engineer can gauge the temperature of each piston and cylinder unit.

A PARTNERSHIP is announced between Sir Charles Bright, Mr. A. Hugh Seabrook (late chief engineer and general manager to the St. Marylebone, London, and other electric supply undertakings), Mr. A. J. Stubbs (late Assistant Engineer-in-Chief, H.M. Post Office), and Lt.-Col. H. W. Woodall (director and consulting engineer of gas and water companies) under the style of Sir Charles Bright and Partners, consulting engineers, with offices at 146 Bishopsgate, E.C.2. The establishment of this firm is of scientific interest on account of the unusual combination of experts represented by it, which marks a development of the co-operation of gas and electricity. In addition to advising upon the installation and operation of telegraphs, telephones, and wireless and electrical undertakings generally, the firm may be consulted upon gas, water, and colliery engineering. In view of the heavy cost of fuel, economies have to be studied to-day that were negligible before the war. The firm is specialising in fuel conservation in relation to the design and construction of power plants—steam, gas, electric, hydro-electric, and oil—and particular attention is being devoted to the utilisation of low-grade fuels and carbonaceous materials hitherto regarded as waste products.

Our Astronomical Column.

CONJUNCTION OF VENUS AND MARS.—Mr. W. F. Denning writes:—"A very interesting and close approach of Venus and Mars may be well observed in the morning sky of October 3 if the weather is clear. The time of conjunction is at about 11 a.m., when the two planets will be separated by a space of a little more than a third of a degree.

"The best time to observe the event will be at about 4 or 5 a.m., as the sun rises a few minutes after 6 a.m. Venus will appear by far the more brilliant orb of the pair, and its strong silvery light will make the red aspect of Mars feeble and insignificant. This occasion will afford a good opportunity to make comparative observations of this sort, but neither of the planets will be shining at its best; in fact, Mars will be at so great a distance from the earth that its brightness will scarcely exceed that of a second magnitude star.

"The two planets will be situated in the constellation Leo, and about 10° east of Regulus, the most conspicuous star in that constellation."

OBSERVATIONS OF STAR COLOURS.—The Vatican Observatory has just published four volumes dealing with observations of star colours on Schmidt's numerical scale (modified by Osthoff). Three of the volumes are separate catalogues, based respectively on the observations of Benedetto Sestini, S.J., at Rome (1844–46), with revision by J. G. Hagen, S.J., of Friedrich Krüger at Aarhus, and of Heinrich Osthoff at Cologne. The fourth is an index catalogue, combining the results of the first three, and adding the Harvard magnitudes and spectral types. The colours, on the whole, follow the spectral types fairly closely; there is, however, a physiological effect, discussed by H. Osthoff, according to which a bright star is estimated as whiter than a faint star of the same tint; he investigated this by observing bright stars with sectors of various angles over the object glass, and found that it averaged 0·3 colour-unit per magnitude. Owing to this effect, the photographic determination of colour-index has advantages over the optical method.

The following are the adopted colour-numbers for some bright stars:—Aldebaran, 6·3; Capella, 3·3; Betelgeuse, 6·5; Procyon, 2·7; Pollux, 4·4; Arcturus, 4·7; Vega, 1·3; Altair, 2·4. It is only among the faint stars of type M*b* that numbers approaching 9 or 10 are found.

THE MOTION OF THE PERIHELION OF MERCURY.—This question is now of special interest owing to the close agreement between the value of 43″ per century given by Newcomb and the value 42·89″ deduced from Einstein's theory. Newcomb estimated the probable error of his determination as 2″ per century; but an article by E. Grossmann in *Astr. Nach.*, No. 5115, re-examines the observational evidence, reaching the conclusion that the actual range of uncertainty is much greater. Newcomb based his result partly on meridian observations and partly on transits across the sun. The difficulties in observations of the latter phenomena are well known, consisting partly in the "Black Drop," and partly in the unsteady image which the sun's heat often produces. There is the further fact that the transits all take place at two particular points in the orbit, and consequently are incapable of determining the motion of the perihelion by themselves; they merely lead to an equation between different secular motions. The meridian observations are also not very satisfactory. They lead in the mean to a distance of Mercury from the sun 2″ greater than that corresponding with its period of revolution. Moreover, Herr Grossmann shows that the observations before and after 1850 (about the time when chronographic observation began) have large systematic differences. He finally obtains 29″ and 38″ as the limiting values of the secular motion indicated by the observations. It should, however, be added that a recent series of observations made with the travelling-wire micrometer of the Cape Transit-Circle gave a value very close to that of Newcomb. It may be pointed out that the quantity actually observable is the product of the motion of perihelion by the eccentricity, which amounts to only 8″ per century.

Geography at the British Association.

THE proceedings of Section E (Geography) opened with a paper by Lt.-Col. E. F. W. Lees on Aeronautical Maps. The rapid progress in aviation has necessitated the provision of special maps for airmen. The subject was considered by the International Convention for the Regulation of Aerial Navigation of October, 1919, at which some thirty States were represented. It was agreed that there shall be two series of international aeronautical maps: general aeronautical maps on Mercator's projection on a scale of 3 cm. to 1 degree of longitude on the equator, and local aeronautical maps on a scale of 1 : 200,000. For the local maps no particular projection is laid down—in many countries maps on this scale which could be adapted for the needs of airmen already exist. Col. Lees fully described the British proposals, and explained that the divergences of view with the French and Belgian authorities as regards depiction of relief on the general maps, and some other points, have now been adjusted. The maps for the British Empire are now being constructed for the Air Ministry by the Geographical Section of the General Staff. Sir Charles Close criticised adversely the employment of Mercator's projection for the general maps. After the presidential address by Dr. D. G. Hogarth on the application of geography (NATURE, Sept. 22, p. 120), Miss A. M. B. Gillett read a paper on the historical geography of the black earth region of Central Russia. In the afternoon Capt. L. V. S. Blacker lectured on his travels in Turkistan and Khorasan from 1918 to 1920.

The meetings on September 9 opened with a joint discussion with Section L on the origin of the Scottish people, opened by Sir A. Keith, followed by a joint discussion opened by Mr. G. G. Chisholm on the teaching of geography. This discussion, while directing attention to the weakness in geographical teaching in the higher forms of secondary schools, emphasised the need for specially trained teachers in the subject.

The morning of September 12 was devoted to a number of papers dealing with the geography of Edinburgh and district. Mr. F. C. Mears showed in a series of lantern slides how the medieval period of Edinburgh was a time of town-planning and civic organisation of industry and agriculture. The town in those days was laid out on a spacious plan, with a large market place on the top of the ridge. It was no exaggeration to say that Edinburgh was a garden city until the middle of the eighteenth century. Prof. P. Geddes said that the beauty of Edinburgh to-day was largely a survival, and that we were living amid the wreckage of a noble town. In no town were the natural beauties greater, but in no town had they been more completely overlooked and thrown away. He cited the complexity of the railways in Edinburgh as an outstanding example of muddle. New developments in the search for new industries threatened the town. Edinburgh might have its new industries and greater prosperity and at the same time conserve the beauties of its site if the industrial community were more cognisant of the development and evolution of the city, and understood its geographical setting and historical past. Mr. H. R. G. Inglis spoke of prehistoric Edinburgh, and described a collection of early plans of Edinburgh, lent by the Royal Scottish Geographical Society.

In a short note communicated by Mr. G. G. Chisholm, Mr. C. B. Fawcett directed attention to the great discrepancies which exist between the real population of many large urban areas and the census populations of the chief towns in those areas. In very few towns is the city boundary thrown far enough out to include all the urban population, while in many cases the existence of densely peopled urban areas is ignored in the census return by distribution among several administrative areas.

On the morning of September 13 Dr. Marion Newbigin opened the session with a paper on the Mediterranean city-state in Dalmatia. She pointed out that the early growth of independent or quasi-independent city-states was one of the most characteristic features of the Mediterranean area, a fact which suggested that such cities were a response to the geographical conditions. By an analysis of these conditions it was shown that they rendered possible local aggregations of population supported by intensive cultivation of the peculiar Mediterranean crops, and that further, the nature of these crops permitted the cultivators to dwell together in a walled town, placed on a site suitable for defence. The advantages and disadvantages of such sites were considered, especially the factors which limited growth in size. In Dalmatia, as elsewhere, the sites first chosen were not, as a rule, such as to facilitate either land or sea trade, but the limiting factors rendered it necessary that some supplement to the natural products should be found if the city were to attain any size. The significance of the sea-borne trade between the Mediterranean area and the Far East in promoting the prosperity of certain Mediterranean cities was pointed out. The lecturer then dealt more particularly with Dalmatian towns. Finally the constant recurrence of piracy, from Roman times onwards, on the Dalmatian shore was emphasised alike in connection with the medieval cities and with Italian policy to-day.

Lt.-Col. H. S. Winterbotham gave an account of the present position of the 1 : 1,000,000 map. The effect of the war on the progress of the map was curiously mixed. In some countries considerable progress was made, in others large areas were mapped on the desired scale, but not in strict conformity with the international resolutions, while in many cases the work was brought to a standstill. The provisional series of the 1 : 1,000,000 map covering most of Europe and the Near East, for which the Royal Geographical Society and the Geographical Section of the General Staff were responsible, reached 89 sheets in close, if not complete, conformity with the international scheme. Of the international map, properly speaking, only 28 sheets are published, and 132 are in course of preparation. In Europe France, Italy, Denmark, Norway, Sweden, and Britain are each at work on several of their respective sheets. In India eight sheets have appeared, and several others are in hand. Japan and Siam are also at work. In Africa sheets are in hand of the Belgian Congo, Egypt, the Sudan, and South Africa. The United States has practically all its sheets in hand, and Canada has made a beginning. In South America great blocks in Brazil, Chile, and the Argentine are under way. Nothing has been done in Australia. Lt.-Col. Winterbotham concluded by showing that maps on 1 : 1,000,000 scale exist for many other areas but not in the international style.

Miss R. M. Fleming read a paper on the geographic aspects of tradition. The share of physical and social environment in moulding tradition is easy to trace. For instance, the beauty of the Hebrew traditions was no doubt partly due to a leisurely life of wandering in vast spaces, and a familiarity with quiet solitudes. From the fact that they express the accumulated experience of past generations, an outcome of the hard conditions in which they grew, these traditions have been appreciated by the rest of the world. In studying stories of the origin of death one sees how the essential theme varies widely according to environment and experience. In certain instances Miss Fleming traced the adaptation to particular environments of a central theme. Lastly she showed how tradition grew and lingered around early trade routes.

The morning of September 13 closed with a paper by Mr. H. M. Spink on the distribution of commercial timber on the Pacific Coast of North America. In the afternoon Mr. A. W. Grabham lectured on his recent experiences in a journey from Lake Tana to Roseires, paying special regard to the water supply. The work of Section E included visits to Leith docks and the cartographical works of Messrs. J. Bartholomew and Co., and Messrs. W. and A. K. Johnston.

An Automatic Recorder of Smoke Pollution.

IN an article on "London Air" in the *Times* of August 23 Sir Napier Shaw directed attention to the clear atmosphere which was such a noticeable feature in all industrial centres during the recent coal strike. The article in question is, however, chiefly interesting for its description of an ingenious self-recording contrivance invented by Dr. J. S. Owens for the Atmospheric Pollution Committee of the Meteorological Office, which registers hourly the amount of solid atmospheric impurities. A fixed volume of air is aspirated through a small disc of filter-paper, and from the depth of shade the amount of deposit is estimated by comparison with discs of standard shades. In London the notably dirty period is from 9 a.m. to 5 p.m., *i.e.* the business hours of the day. The greatest impurity is, of course, in winter, that of a May day being about one-quarter that of a November day. The day impurity in May is of the same order as the night impurity in November. The instrument should prove useful in detecting any noticeable improvement or otherwise in the amount of solid impurities in different towns. Although Sir Napier Shaw states that these measurements of the Committee "are noteworthy as the first series of systematic observations of the pollution of the air of London and other centres of population," he has apparently overlooked the fact that a complete series of records was made in Leeds some years previously, in the course of which it was clearly established not only that the domestic fireplace is responsible for much the larger proportion of the soot emitted from burning coal, but also, more important still, that this domestic soot is much more highly contaminated with tar than that from factory chimneys. In his reference to possible means of smoke prevention from domestic fireplaces, Sir Napier Shaw makes no reference to the carefully considered report which was published in the autumn of last year by the Committee on Smoke Abatement appointed by the Ministry of Health. It was there pointed out that the ordinary open kitchen range was wasteful and inefficient, and the Committee strongly insisted on the advantage of gas-cookers where gas was available. Low-temperature coke was also advocated whenever the right sort of material could be placed upon the market—a desideratum not yet attained. But there are numerous forms of improved ranges in which coke and anthracite can be burned much more economically than in the old open range, and, of course, without the emission of smoke. It now remains for the Ministry of Health to bring pressure to bear on those engaged upon Government building schemes to adopt these recommendations. It has a unique opportunity for setting an example in atmospheric purification.

University and Educational Intelligence.

BELFAST.—Dr. J. K. Charlesworth has been appointed professor of geology in the Queen's University. Until the present session the head of the department of geology was a lecturer, but, owing to the importance of the subject, the Senate has raised the lectureship to a professorship.

BIRMINGHAM.—The University has now been in existence for twenty-one years, and in commemoration of the event the Council and Senate have invited a large number of friends of the University to a conversazione on October 7, at which the Edgbaston buildings will be open to inspection.

LONDON.—Mr. A. E. Webb has been appointed senior assistant in the department of civil and mechanical engineering of University College. Mr. C. D. Burns has been appointed lecturer in philosophy at Birkbeck College.

In connection with the department of philosophy of King's College a course of ten public lectures will be given by Prof. H. Wildon Carr on "The Modern Scientific Revolution and its Meaning for Philosophy" on Tuesdays at 5.30, beginning on October 11. In connection with the faculty of psychology a similar number of lectures on "Psychology and Psychotherapy" will be given by Dr. W. Brown on Tuesdays at 5.30 beginning on October 18.

ST. ANDREWS.—Dr. W. J. TULLOCH, lecturer in bacteriology in the University, has been appointed to be the first professor of the chair of bacteriology, established and approved by his Majesty in Council on June 27 last.

THE Salters' Institute of Industrial Chemistry has awarded fellowships for post-graduate study in the laboratories of the institute to Messrs. J. A. Gentle, F. Raymond Jones, S. J. Saint, and F. W. Turner. Scholarships have been awarded to Messrs. B. G. Banks and L. G. Laws.

POST-GRADUATE research scholarships in naval architecture of 250*l.* a year each have been awarded by the Institution of Naval Architects to Mr. H. W. Nicholls, of the Royal Naval College, Greenwich, who will carry out research on the vibration of ships, and Mr. W. R. Andrew, of Liverpool University, who will investigate the behaviour of ships at sea during a long-distance voyage, and report on shipbuilding and conditions abroad.

SOME bequests of noteworthy importance are made in the will of Mrs. L. A. Stuart, widow of Prof. James Stuart. Cambridge University Local Lecture Syndicate will receive a sum of 5000*l.* for a James Stuart endowment in memory of Prof. Stuart's work in founding the University Extension Lectures. In addition, Trinity College, Cambridge, is to receive 2000*l.*, which it is suggested should be applied to the establishment of Stuart scholarships or studentships, and a similar sum is bequeathed to Newnham College, Cambridge.

ON Tuesday, October 11, a dinner in honour of Prof. J. C. Philip will be held in the Imperial College Union, Prince Consort Road, South Kensington, at 7 for 7.30 p.m., when Sir William A. Tilden will present to him an illuminated address and gifts from his colleagues and students to express deep appreciation of Prof. Philip's active interest in every movement for the advancement of the Royal College of Science during his service, now twenty-one years, on the chemical staff of the college. The chair will be taken by Sir Richard Gregory, president of the Royal College of Science Association.

Calendar of Scientific Pioneers.

September 29, 1839. Friedrich Mohs died.—Trained at Halle and the Mining Academy, Freiburg, in 1817 Mohs succeeded Werner in the chair of mineralogy at the latter institution. He was afterwards attached to the Imperial Academy of Vienna. His most important work was his "Grundriss der Mineralogie."

September 30, 1870. William Allen Miller died.—Appointed in 1845 to follow Daniell as professor of chemistry at King's College, London, Miller the same year made some of the earliest researches on the spectra of glowing gases—researches which in 1862 led to his pioneering work with Huggins in the spectra of the heavenly bodies.

October 1, 1768. Robert Simson died.—A devoted student of the Greek geometers, Simson for fifty years held the chair of mathematics at Glasgow. His edition of "The Elements of Euclid," published in 1756, was the basis of nearly all editions for more than a century.

October 1, 1895. Ernst von Rebeur-Paschwitz died.—As a *privat docent* at Halle and an assistant at Karlsruhe Observatory, Rebeur-Paschwitz, in spite of ill-health, made important observations in seismology and improved Zöllner's instruments. He died at the age of thirty-four.

October 2, 1848. Georg August Goldfuss died.—Called to Bonn from Erlangen as professor of zoology and mineralogy, Goldfuss held a high place among German mineralogists. With Münster he published the "Petrefacta Germaniæ," an uncompleted monumental work designed to illustrate the invertebrate fossils of Germany.

October 2, 1853. François Jean Dominique Arago died.—Rendered famous at an early age by his adventures when engaged on geodetical operations in Spain, Arago became one of the best-known men of science of his day. He made important discoveries in optics and electro-magnetism, zealously advocated the undulatory theory of light, and studied the physical properties of steam and other gases. With Gay Lussac he started the *Annales de Chimie et de Physique*, in 1830 became director of the Paris Observatory, and as permanent secretary to the Paris Academy of Sciences wrote many notable *éloges*. He was also one of the first successful popularisers of science and a politician.

October 2, 1901. Karl Rudolf König died.—A native of Germany, König settled in Paris as an instrument-maker, and afterwards gained a reputation for his excellent workmanship and for his numerous inquiries and experiments in acoustics.

October 2, 1905. Dewitt Bristol Brace died.—After studying at the Johns Hopkins and Berlin Universities, Brace about 1886 became professor of physics at Nebraska. He especially studied the action of the magnetic field upon light, and was also known for his refined experiments on the æther drift.

October 5, 1880. William Lassell died.—Lassell, while engaged in business as a brewer, constructed a Newtonian reflector, with which in 1847 he discovered a satellite to Neptune. In 1848 he discovered Hyperion, a satellite of Saturn, and in 1851 Ariel and Umbriel, satellites of Uranus.

October 5, 1912. Lewis Boss died.—After serving as astronomer to the United States Northern Boundary Commission, Boss became director of the Dudley Observatory, Albany, N.Y. Especially known for his work on proper motions and star catalogues and on the orbits of comets, in 1905 he was awarded the gold medal of the Royal Astronomical Society.

E. C. S.

Societies and Academies.

PARIS.

Academy of Sciences, September 12.—M. Léon Guignard in the chair.—R. **Serville**: The conical pendulum as affected by a screen.—L. **Dunoyer**: The induction spectrum of rubidium. The metal was distilled in a vacuum into a quartz tube and the latter placed in the field of a high-frequency alternating current. The tube is luminous even at the ordinary temperature, and is a bright violet-blue at 100° C. At 200° C. the colour changes to lilac. With an exposure of twenty minutes as many as 332 lines were photographed; the arc spectrum of rubidium contains about 30 lines, and the spark spectrum about 60. A list of the wave-lengths is given, of which only two appear in the arc or flame spectra.—R. **de Mallemann**: The inversion of the rotatory power of derivatives of tartaric acid.—Q. **Majorana**: The absorption of gravitation.—M. **Stuart-Mentiath**: Granitised outcrops of the border of the Pyrenees.—E. F. **Terroine** and R. **Wurmser**: The influence of temperature on the utilisation of glucose in the development of *Aspergillus niger*.

Books Received.

Aluminium and its Alloys: Their Properties, Thermal Treatment, and Industrial Application. By Lt.-Col. C. Grard. Translated by C. M. Phillips and H. W. L. Phillips. Pp. xxiii+184+17 plates. (London: Constable and Co., Ltd.) 17*s*. 6*d*. net

Life of Elie Metchnikoff, 1845–1916. By Olga Metchnikoff. (Authorised translation from the French.) Pp. xxiii+297. (London: Constable and Co., Ltd.) 21*s*. net.

Survey of India. Professional Paper, No. 18: A Criticism of Mr. R. D. Oldham's Memoir, "The Structure of the Himalayas and of the Gangetic Plain, as Elucidated by Geodetic Observations in India." By Lt.-Col. H. McC. Cowie. Pp. ii+33. (Dehra Dun: Trigonometrical Survey.) 3*s*.

Memoirs of the Geological Survey: Scotland. Description of Arthur's Seat Volcano. By Dr. B. N. Peach. Pp. 26. (London: E. Stanford, Ltd.; Southampton: Ordnance Survey Office.) 2*s*. 6*d*. net.

A Text-book of Aeronautical Engineering: The Problem of Flight. By Prof. H. Chatley. 3rd edition, revised. Pp. xii+150. (London: C. Griffin and Co., Ltd.) 15*s*. net.

Handbuch der biologischen Arbeitsmethoden. Edited by Prof. Dr. Emil Abderhalden. Abt. 10, Methoden der Geologie, Mineralogie, Paläobiologie, Geographie. Heft 1, Lieferung 28. Pp. 128. 21 marks. Heft 2, Lieferung 35. Pp. 129–312. 30 marks. Abt. 9, Methoden zur Erforschung der Leistungen des tierischen Organismus. Teil 1, Heft 1, Lieferung 34: Allgemeine Methoden. Pp. 96. 30 marks. Abt. 5, Methoden zum Studium der Funktionen der einzelnen Organe des tierischen Organismus. Teil 7, Heft 1, Lieferung 12: Sinnesorgane. Pp. 195. (Berlin und Wien: Urban und Schwarzenberg.)

Fisheries—England and Wales. Ministry of Agriculture and Fisheries. Fishery Investigations: Series 1: Freshwater Fisheries and Miscellaneous. Vol. 2, No. 1: The Methods of Fish Canning in England. Pp. 25. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Annals of the South African Museum. Vol. 18, part 3, 5: The Odonata or Dragonflies of South Africa. By F. Ris. Pp. 245–452+plates 5–12. (London: Adlard and Son and West Newman, Ltd.) 30*s*.

Flora of the Presidency of Madras. By J. S. Gamble. Part 4: *Rubiaceae* to *Ebenaceae*. Pp. 579–768. (London: Adlard and Son and West Newman, Ltd.) 10*s*. net.

Entropy as a Tangible Conception: An Elementary Treatise on the Physical Aspects of Heat, Entropy, and Thermal Inertia, for Designers, Students, and Engineers, and particularly for Users of Steam and Steam Charts. By Eng. Lieut.-Comdr. S. G. Wheeler. Pp. 76. (London: Crosby Lockwood and Son.) 8*s*. 6*d*. net.

Mikromethodik: Quantitative Bestimmung der Harn- und Blutbestaudteile in kleinen Mengen, für klinische und experimentelle Zwecke. By Dr. L. Pincussen. Pp. 116. (Leipzig: G. Thieme.) 28 marks.

Department of Applied Statistics (Computing Section), University of London, University College. Tracts for Computers, No. 5: Table of the Coefficients of Everett's Central-Difference Interpolation Formula. By A. J. Thompson. Pp. xvi+20. (London: Cambridge University Press.) 3*s*. 9*d*. net.

Nia Cintaga Pano kaj la Vivo. Serio de tridek doktrinoj pri dieto subtenitaj de kelkaj el la plej famaj homoj. Kompilita kaj Tradukita de W. W. Trainer. Dua Eldono. Pp. 71. (Glasgow: Fraser, Asher and Co., Ltd.; Author: 329 Langside Road, Glasgow.) S.250.

The Stages of Human Life. By J. Lionel Tayler. Pp. xiv+377. (London: J. Murray.) 18*s*. net.

The Heart of Nature; or, The Quest for Natural Beauty. By Sir Francis Younghusband. Pp. xxviii+235. (London: J. Murray.) 12*s*. net.

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An Introduction to Physics for Technical Students. By P. J. Haler and A. H. Stuart. Pp. 240. (London: Library Press, Ltd.) 4*s*. 6*d*. net.

Ministry of Munitions and Department of Scientific and Industrial Research. Technical Records of Explosives, 1915–18, No. 3: Sulphuric Acid Concentration. Pp. vi+91. (London: H.M. Stationery Office.) 12*s*. net.

The Wit of the Wild. By Ernest Ingersoll. Pp. v+212. (London: G. Routledge and Sons, Ltd.) 6*s*. net.

The Care of the Adolescent Girl: A Book for Teachers, Parents, and Guardians. By Dr. Phyllis Blanchard. Pp. xxi+201. (London: Kegan Paul and Co., Ltd.) 7*s*. 6*d*. net.

Taboo and Genetics: A Study of the Biological, Sociological, and Psychological Foundation of the Family. By Dr. M. M. Knight, Dr. Iva L. Peters, and Dr. Phyllis Blanchard. Pp. xv+255. (London: Kegan Paul and Co., Ltd.; New York: Moffat, Yard and Co.) 10*s*. 6*d*. net.

Seven Ages of Childhood. By Ella L. Cabot. Pp. xxxiv+321. (London: Kegan Paul and Co., Ltd.) 12*s*. 6*d*. net.

Diary of Societies.

MONDAY, OCTOBER 3.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—G. O. Case: The Winning of Tidal Lands in British Guiana.

WEDNESDAY, OCTOBER 5.

ROYAL MICROSCOPICAL SOCIETY (in the Mortimer Halls, Mortimer Street, W.1), at 7.30.—Conversazione.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court).—Sir William J. Pope: Impressions of Canadian Tour.

THURSDAY, OCTOBER 6.

CERAMIC SOCIETY (Refractory Materials Section) (at Institution of Mechanical Engineers), at 10.30 a.m.—H. Dewey: Refractory Materials of the London Basin.—J. H. Marlow: The Marlow Gas-fired Tunnel Oven.—P. J. Woolf: A New Type of Tunnel Kiln, Oil-fired, with many Novel Features.—Dr. A. Granger: Aluminothermic Corundum as Refractory Materials.—Prof. J. W. Cobb and H. S. Houldsworth: The Reversible Thermal Expansion of Silica.—Discussion on Gas-firing.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Air-Commodore H. R. H. Brooke-Popham: Some Notes on Aeroplanes in Tropical Countries.

CHEMICAL SOCIETY, at 8.—S. J. Lewis and F. M. Wood: A New Adjustable Thermostat for all Temperatures between 0° and 100°.—A. F. Dufton: The Separation of Miscible Liquids by Distillation. Laboratory Still-heads.—A. F. Dufton: The Separation of Miscible Liquids by Distillation. A Continuous Laboratory Still.—P. K. Dutt, H. R. Whitehead, and A. Wormall: The Action of Diazo-salts on Aromatic Sulphonamides. Part I.—A. B. Manning: Neutral Salt Action on the Hydrolysis of Ethyl Formate.—A. Shimomura and J. B. Cohen: Synthetic Optical Activity.—T. A. Henry and H. Paget: Chenopodium Oil.—C. K. Ingold and E. A. Perren: Experiments on the Synthesis of the Polyacetic Acids of Methane. An Addendum to Parts I. and III.—C. K. Ingold and W. J. Powell: Experiments on the Synthesis of the Polyacetic Acids of Methane. Part IV. The Preparation of β-carboxymethanetriacetic Acid.—The Late H. R. Le Sueur and C. C. Wood: The Mechanism of the Action of Fused Alkalis. Part II. Action of Fused Potassium Hydroxide on Phenylglyceric Acid.

FRIDAY, OCTOBER 7.

CERAMIC SOCIETY (Refractory Materials Section) (at Institution of Mechanical Engineers), at 10 a.m.—General Meeting.

WEST LONDON MEDICO-CHIRURGICAL SOCIETY (at West London Hospital), at 8.30.—Sir G. Lenthal Cheatle: A Study of Breast Cancer in Relation to the Cancer Problem (Presidential Address).

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