THURSDAY, MAY 30, 1918.

GARDENING: OLD AND NEW.

The Standard Cyclopedia of Horticulture. By L. H. Bailey. In six volumes. Vol. v., P–R. Pp. v+2423–3041+plates. Vol. vi., S–Z and Supplement. Pp. v+3043–3639+plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916–17.) Price 25*s.* net each vol.

THE excellence of Prof. Bailey's "Cyclopedia of Horticulture," the earlier volumes of which have already been noticed in these pages, is maintained in the fifth and sixth volumes, which have now appeared and arrived safely in this country. We can imagine no more interesting or stimulating reading for British horticulturists than the articles on subjects grown by them and also cultivated in America.

The differences of climate between the States and this country are reflected in the different horticultural treatment practised by European and American experts. Thus, in the case of the strawberry we find that in the southern districts of the United States it is the practice to take one crop only and then to discard the plants, whereas in our more moderate climate growers generally take three crops before ploughing up their plantation.

Again, as is to be expected in the case of so American a genus, the grape-bearing species of Vitis are treated of in a far more comprehensive manner than in any British cyclopædia; indeed, we confess to a glad surprise to learn that there are no fewer than thirty-six species of Vitis which bear edible grapes.

Here and there the British horticulturist will notice omissions, as, for example, the failure of the author responsible for the article on tulips to cite among the "literature" the admirable monograph of Mr. Dykes on that genus of plants.

The rapidly growing importance of California as a seed-raising country is strikingly illustrated by the statement in the article "Seed and Seedage" that the seeding acreage under lettuce, onion, and sweet-pea—most popular of flowers in America—is no less than 5000. In addition to these seed crops, America contributes large and increasing quantities of seed of the culinary pea, bean, cabbage, radish, and others; nevertheless, the American imports of garden seed alone are of the annual value of two million dollars.

Among the important genera described in these volumes are Primula, Prunus, Pyrus, Rosa, and Solanum, and each is dealt with in a thorough manner. It is noteworthy that, as admitted in the article on the potato, America, like ourselves, has awakened late to the great importance of this crop; Germany alone of all the great nations seems to have taken advantage of the fact that this plant is the most productive of all cultivated food plants. Whereas half the huge crop raised in Germany is used for food for stock or for commercial purposes, only 1 per cent. of the far smaller crop is similarly employed in America.

The treatment of *Primula sinensis*—that queen of flowers for glass-house cultivation—is too meagre to satisfy the British florist, and none of the chief varieties—so interesting both scientifically and floristically—is mentioned. Nor do we think that Prof. Bailey would concur in the statement with respect to peas (p. 2490): "Left to themselves, the varieties of peas soon lose their characteristics through variation."

Broadly speaking, however, the information provided in the cyclopædia is accurate and comprehensive, and we advise all British horticulturists to provide themselves with a copy. Once they possess it, it will be in constant use.

PRINCIPLES AND METHODS OF SCIENCE TEACHING.

A Text-book in the Principles of Science Teaching. By Prof. G. R. Twiss. Pp. xxvi+486. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 7*s.* 6*d.* net.

THIS book is a treatise on the principles and methods of science teaching in secondary schools, and is intended to serve as a text-book on education in training colleges and as a guide to all who are concerned with science teaching and its organisation. It is a large book of twenty-four compact chapters, each being a veritable mine of information. At the end of each chapter there are valuable lists of reference books and sets of questions for further study, and in the appendices are given a selected list of science books suitable for school libraries, a bibliography for teachers, and a list of scientific periodicals.

In the earlier chapters are set forth the principles which should underlie all science teaching, the meaning of science, the viewpoint of the science teacher, and the educational value of science in discipline and culture. The rest of the book is devoted to the details of the methods of class-teaching in biology, geography, physics, chemistry, and what is known as "general science," and to an elaboration of the design of classrooms and laboratories, with catalogues of furniture, apparatus, and plant.

In his earlier chapters the author emphasises the principles which he holds should form the basis of science teaching. He tells us truly—and it is a fact which, strangely enough, stands more in need of emphasis to-day than at any other time—that "modern science and modern social and industrial life are inseparably linked together, and that each in turn causes the other to advance." There is nothing new in this principle, but its application to education in schools is being rejected, one after another, by educational boards and Government committees the function of which it is to reconstruct education after the war. In America, apparently, the authorities put their faith in the principle. "The science work of the school," says our author, "must be kept in close touch with the doings of everyday life, and especially with the activities that lie nearest to the immediate interests of the boys and girls." This, we believe, is the true democratic principle of edu-

cation and the mainspring of creative life. At any rate, it is that which the people themselves are asking for, but it is the principle which at the moment is threatened with submersion.

Pure and applied science, the author insists, should not be divorced in the schools, and he has some warnings to give science teachers of the danger of "science laboratory courses," where experiments are mainly designed to verify a law, to demonstrate a fact, to determine the value of a physical constant, or merely to measure something. He is all for allowing theories to wait on practical investigations, and most teachers will now agree.

Two criticisms may be offered. The author, with all his belief in the application of science, does not go the whole way and advocate boldly the teaching of applied science in the school. He would find that such a science course would lead in the early stages at school to the elementary (so-called) scientific theories and to mathematical developments. He seems still content to "illustrate" theory by "practical applications"—which, we submit, is illogical and derogatory. However, the method of illustration is dominant to-day—except where needs must, some science may be taught with a vocational "bias," which seems unnatural, crooked, and non-creative.

Even more serious is the author's silence on what is, after all, the most vital thing in scientific education—the growth and development of the "science outlook" on life—the gospel of science.

AVIATION ENGINES.

Aviation Engines: Design, Construction, Operation, and Repair. By 1st Lieut. V. W. Pagé. Pp. 589. (London: Crosby Lockwood and Son, 1918.) Price 15*s.* net.

THE author expresses the desire in his preface that this book shall prove of use to men in the aviation section of the U.S. Signal Corps and to students who wish to become aviators or aviation mechanicians. The subject is obviously one beset with difficulties and restrictions at the present time; not only is practice changing with bewildering rapidity, but much of the information which it would be most useful to impart it is now impossible to print in any book purchasable by the public. These limitations must in fairness be borne in mind when a book on this subject is reviewed, but there are sections of it to which such considerations do not apply, and which can properly be judged on their merits—as it happens, it is in these sections that the main defects of the book are found to lie.

Lieut. Pagé sets out to provide "a complete practical treatise outlining clearly the elements" of the subject, together with sections on the design, construction, operation, and repair of aviation engines. We do not think, however, that the elements have been either clearly or accurately outlined; on p. 21 work is measured on a time basis, and is identified with power; again, on p. 25, momentum is identified with torque, and on the same page pressure, force, and power are all treated as interchangeable terms. Such confusion must spell disaster to any student desiring to acquire a right knowledge of "the elements," and it is scarcely too much to say that the theoretical section of the book would be best omitted by those who approach the subject for the first time.

The practical part of the book is very much more satisfactory, but overweighted with such irrelevant details as the use and care of files, the use and care of taps and dies, and a section on micrometer calipers and their use. Such details as these are better confined to books on workshop processes, as they are common to all engineering construction. The author has, we notice from certain advertisements included in the volume, already written books—altogether some four or five thousand pages—on such subjects as the modern gasolene automobile; the location of Ford engine troubles made easy; motor-cycles, their construction, management, and repair; and like works, and must, we should have thought, have noticed the impossibility of combining reasonable bulk with inclusion of workshop processes. This condition of practical repletion extends also to the discussion, on p. 201, of "why lubrication is necessary," since we find that "proper lubricity of all parts of the mechanism is a very essential factor, upon which the durability and successful operation of the motor-car power plant depends." As this applies equally to the aviation engine (about which the book is written), it is not understood why a reference to the motor-car is required; if this sentence, and certain of its successors, are taken from some book on car engines, it would have been better to edit them in the process.

The book is of interest—and of use—to those who are experienced enough not to be misled by the inexact theory, and can select what is useful from what is not; but as a book for students or young airmen of any sort we much prefer the "Aero-Engines" of Mr. Burls, which is so much in use in our own Flying Service.

H. E. W.

OUR BOOKSHELF.

A Check List of North American Amphibians and Reptiles. By L. Stejneger and T. Barbour. Pp. iv+125. (Cambridge, Mass.: Harvard University Press, 1917.) Price 10*s.* 6*d.* net.

THIS is the third list of the kind issued in America, the earlier being by Cope (1875) and by Yarrow (1882). In the meantime, two monographs have been published by the Smithsonian Institution, viz. Cope's "North American Batrachia" (1889) and the same author's "Crocodilians, Lizards, and Snakes of North America" (1900), which, as Dr. Barbour observes in the Introduction, "are frequently erratic and inaccurate." There was great need of a fresh stock-taking of this rich herpetological fauna, so many striking forms having been added since the publication of Cope's monographs, such as, for instance, *Typhlomolge rathbuni* (Texas), *Ranodon olympicus* (Washington), *Batrachoseps*

major (S.W. California), *Leurognathus marmorata* (North Carolina), *Typhlotriton spelaeus* (Missouri), *Ascaphus truei* (Washington), *Rana virgatipes* (New Jersey), *Phrynosoma brevicornis* (Texas), *Neoseps reynoldsi* (Florida), *Crotalus willardi* (Arizona).

The new check list "has been prepared generally upon the basis of the American Ornithologists' Union Check List of Birds, and following that example, it has included the species and subspecies which the authors deem valid and of certain occurrence in North America, north of the Rio Grande, and in Lower California, Mexico." The higher groups and genera are in systematic sequence, but the species are in alphabetical order, which is regrettable and surprising on the part of the authors, whose perfect knowledge of the subject should have been imparted by arranging the species according to their relationships; in the larger genera, a subdivision into sections would have been a help to the student, and added greatly to the value of this catalogue.

Notwithstanding the protest raised against the constant changes in the scientific names of genera and species which appeared, over the signatures of so many distinguished zoologists, in this journal ten years ago, the process of "revision" goes on as before, and it is lamentable to notice such substitutions as Eurycea for Spelerpes, Gastrophryne for Engystoma, Coluber for Zamenis, Micrurus for Elaps, etc. G. A. B.

The Photographic Industry of Great Britain, 1918. Pp. 247. (London: British Photographic Manufacturers' Association, Ltd.)

FORTY firms who manufacture photographic goods have banded themselves together as "The British Photographic Manufacturers' Association, Ltd.," for the purpose of extending their export trade by developing to the fullest possible extent friendly business relations with buyers in the Overseas Dominions and in foreign countries. This is the first annual handbook of the association. The important parts of it are printed in English, French, Spanish, and Russian, and many of the members' announcements (or advertisements), which fill the second half of the volume, are also given in the four languages, though some omit the Russian version, and others are content with English and French or English alone. After the list of members comes an article by Mr. G. E. Brown which gives a concise sketch, first of the history of photographic invention, and secondly of the photographic industry of to-day. He shows how British invention and British industry stand in the very foremost position. Indeed, if it were possible to abolish all that originated in this country, there would be very little, if anything, left of photography. The handbook gives a classification of makers under the headings of the goods they offer, registers of trade names and trade marks, and various other data to facilitate international dealings. The secretary of the association will be glad to send a copy of it to any established dealer abroad who does not receive one and applies to him for it.

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.*]

The Promotion of Post-graduate Work and Research.

IN the article bearing the well-known initials "W. A. T." in NATURE of May 9 on the above subject, the writer has quoted from a report of the Academic Council to the Senate of the University of London a *summary* of reasons for and against the institution of a new doctoral degree. The report referred to has been approved and adopted by the Senate, and a copy is enclosed for your information. Among the reasons for the establishment of such a degree, the first is:—

"That it would be the means of strengthening the unity of the Empire by increasing the number of students from the universities of the British Empire who pursue their graduate studies in Great Britain."

On this the writer says:—

"Of all these considerations [*i.e.* the reasons in the summary] it appears to the writer that the first is, at the present time and probably for generations to come, of greatly preponderant importance. And in declining the proposals which come to it from his Majesty's Dominions beyond the seas, the Senate has missed a great opportunity for the development of the University."

The proposals as formulated by the President of the University of Toronto in a letter dated April 30, 1917, are as follows:—

"It will be necessary for the universities of Britain to establish some doctor's degree which will be within reach of our best students who hold our preliminary degree, provided they are required to spend not more than three years in Britain in order to obtain it."

A student coming from a foreign or Colonial university immediately after graduation can enter for the M.Sc. examination after pursuing an approved course as an internal student of the University of London extending over not less than two years. If successful, further attendance at a prescribed course of study will not be required. It is possible for him to return home to continue his studies, and to present a thesis for the D.Sc. degree after the prescribed interval of time. On the other hand, if he continues his studies abroad for two years after taking his preliminary degree and produces work of sufficient merit, he may be excused the M.Sc. examination and allowed to proceed to the D.Sc. examination after a period of study as an internal student of the University of London of not less than two years. The provision that four years must elapse between the date of the examination, in virtue of which he is registered, and the date of his D.Sc. examination can be shortened in exceptional cases.

It would appear from the above that, although the Senate has not instituted a new degree, the opportunities for overseas students to carry on research and to proceed to higher degrees in the University of London are ample.

The main reason for declining to establish a new degree is that it would damage the standard of the existing doctorates. The writer's estimate of that standard as set out in his article is not flattering. If it is accurate, there is no case for the establishment of a doctorate of a lower standard.

One of the resolutions passed by the Conference of Universities of the United Kingdom, held on May 18, 1917, was as follows:—

"The existing doctorates of the home universities should, if possible, be maintained, and their present standard should not be lowered."

The words "if possible" in this resolution seem to give away the case, and justify the Senate in the action it has taken.

In the paragraph of the article immediately following that from which I have already quoted the writer destroys the argument as to the extreme importance of the establishment of the new degree. He says that "university professorships will be filled everywhere by men who have shown by their work and teaching that they are qualified and eager to advance knowledge in their respective subjects, and the abler students will go to the abler teachers. . . . Degrees have very little to do with the matter."

This is the heart of the matter, and is exactly what is implied in the second reason given by the Academic Council against the establishment of a new degree, namely, that "the abler students come to London on account of the facilities for study, and not primarily to get an English degree." If the writer of the article will read over again the documents in support of the *summary* of reasons given by the Academic Council for and against the establishment of the new degree, he will find in the report of the Imperial Studies Committee that emphasis is laid on "the opportunities of work under English scholars of international reputation." These opportunities are included in the facilities for study, which, in the opinion of the Academic Council, do not consist wholly of "museums, libraries, and laboratories."

It should be borne in mind that the conclusions of the Academic Council are in entire accordance with the opinion of the members of the Imperial Studies Committee, of which the chairman is Lord Bryce, and which includes many members who are not only acquainted with the academic point of view, but also able to bring to bear on this matter their varied experience of public affairs. M. J. M. HILL.

University College, London, W.C.1, May 14.

HAVING already expressed my view in the article which is criticised by Prof. Hill, I can only add that America and Canada have asked for one thing, and the University of London, in response to their demand, has offered another. Which of the two parties is supported by the more cogent reasons for its action is a matter of opinion. Mine has been already sufficiently expressed, and I am supported by the belief that it is shared by others who are more intimate with the feelings and conditions which led to the original request from overseas. W. A. T.

May 18.

Proposed Society of Science Students.

FOR some time past we have had in mind the desirability of the existence of a society of young scientific students for mutual help. There are no doubt many enthusiastic students of science who, like ourselves, have to rely chiefly on their own efforts for their progress in science, and we think that it would be of great advantage to them if they could co-operate in such matters as the purchase of apparatus, materials, and books, and combine for mutual help. There is no society which fully provides for these, and we have decided, after careful consideration, to endeavour to try to get into touch with some of this class of students through the columns of NATURE. Will those students who are interested in the subject please communicate with Mr. P. E. Owens, 28 Jesse Terrace, Castle Hill, Reading? J. A. BUTLER.

P. E. OWENS.

CLOUDS AT THE ROYAL ACADEMY.

THE smoke and haze which commonly obscure the sky in large cities, and the otherwise restricted outlook, allow the town dweller inadequate opportunities for the study of clouds, but to those who live in the country, and to the observant worker in a town when spending a holiday away from his native place, the ever-varying cloud effects form quite as attractive an object of interest as the countryside itself. This being so, it might be thought that in landscape scenes artists would devote at least as much attention to the sky and the clouds above as to the hills and valleys below. That this is not the case will be painfully evident to the meteorologist, or even to the ordinary intelligent observer of Nature who visits the Royal Academy and makes but a cursory examination of its walls. Let it be granted at once that there are notable exceptions, but the conclusion cannot be resisted that to many artists the clouds form a very subsidiary part of the picture, and are put in to produce what to the artist's eye is presumably a pleasing effect, but without the least regard to natural truth.

The majority of the clouds appearing in this year's exhibition belong to the strato-cumulus or fracto-cumulus type, though, as would be expected, the hard convection cumulus, the most striking of all clouds, is not neglected. Perhaps the most remarkable feature is the almost entire neglect of high clouds of the cirrus and cirro-cumulus types, which produce some of the most beautiful effects in Nature. Cirro-cumulus is shown in one or two sunset pictures, and a not entirely successful attempt has been made in one case to depict the sun shining feebly through an alto-stratus veil; but true cirrus is almost entirely unrepresented. In "The Passing of Autumn" (91) the meteorologist may think that he detects a fragment of false cirrus showing up against a rather fine cumulus, but the remaining clouds in this picture spoil what might otherwise have been a successful cloud study. True cumulus should surely be a cloud type which would lend itself to the artist's needs without any departure from the forms provided by Nature; but in many cases these clouds are given the most grotesque and unreal shapes, which completely spoil the picture to the observant lover of the country. On the other hand, some of the most successful clouds in the exhibition appear in B. W. Leader's "The Weald of Surrey" (51) and A. R. Quinton's "The Road over the Downs, Sussex" (695), where clouds of the cumulus and strato-cumulus types are both true to Nature and blend admirably with the peaceful scenes depicted. Less peaceful, but with an equally admirable effect, is A. W. Parsons's "Rolling from the West" (196), where similar clouds are depicted over the sea. In the most prominent picture of the second gallery, "Cader Idris" (87), H. Hughes-Stanton includes clouds of the cumulus type which, in their hard outlines and rather unnatural colouring, are very jarring when inspected from any of the nearer parts of the room; but if the picture is

viewed from the greatest distance possible the effect becomes more attractive, and the lights and shadows of the clouds blend into one another in a more harmonious whole. A very similar effect is produced in the smaller work by the same artist, "Welsh Hills near Barmouth" (602).

When looking at a wide stretch of country, whether it be an extensive plain as seen from the top of a range of hills, or the hills and valleys of a mountainous country viewed from some vantage point, the most attractive effects are often obtained on a day when the sky is covered with detached clouds of the cumulus type, causing a bright contrast between the light and shade on the country below. A scene of this kind is depicted by Bertram Priestman in "The Walls of Langstrothdale" (114), but to the critical observer the whole is spoilt by the unreality of the clouds themselves, though the shadow effect on the ground is more successful. The only type of cloud which is almost uniformly well dealt with is where the "clouds" appear as mountain mists, and one concludes that artists must subject this type to much more study than the clouds in the sky above. Some of these mountain mist effects are notably good. "The Head of the Glen," by Peter Graham (439), and "Yarrow: 'The Vapours Linger Round the Heights,'" by Alfred Parsons (126), may be mentioned amongst others in this connection. In "Easedale Tarn, Westmorland" (207), J. H. Crossland has shown us clouds over a mountain-top which are delightfully real. Attempts to indicate showers passing over a landscape generally lead to a more successful portrayal of the dark falling rain in the shower than of the cumulo-nimbus cloud above. This appears to be a subject that might give far more realistic and attractive results than any shown in this year's exhibition. "The Gravel Pit," by Arthur Friedenson (583), seems to be the most successful of those exhibited. The high cloud at sunset in B. W. Leader's "Still Evening" (175) raises an interesting speculation as to the probability of the conditions shown being true to life. Bands of high cloud are brightly tinted pink in the rays of the setting sun, whereas other clouds in the same part of the sky, but at an apparently higher level, are illuminated, but without colour. The writer does not remember a case of this kind coming under his observation, although it appears not to be impossible. The interesting and quite common case where the high clouds are illuminated with a pink glow, while the lower ones have already passed into the shadow of the earth, does not seem to have attracted the artist's imagination. Very interesting information as to the relative heights of different cloud layers may sometimes be obtained in these circumstances.

Observers often, in dealing with Nature herself, have difficulty in deciding to which of the artificial types of the international classification a cloud belongs, so infinite are the varieties which occur, but all meteorological observers who visit the Academy will undoubtedly give a sigh of relief that they are not expected to classify the strange shapes which appear in the sky in "Evening" (233), to mention one case only, though it does not stand alone. In "Wind from the South" (383) the artist presumably set out to portray falling snow; but surely with a title so meteorological he might have given more careful attention to the meteorological elements in his picture. Finally, all who hold that gunfire has an influence on rainfall should undoubtedly visit the Academy for confirmation of their views. If the clouds over the battlefields of France really take the forms shown in some of the pictures (notably "Dawn," 333), few will have the hardihood to maintain that the rainfall or even the entire climatic conditions of the neighbourhood may not be seriously affected.

J. S. D.

THE CARNEGIE TRUST FOR THE UNIVERSITIES OF SCOTLAND.

A FEW months ago (NATURE, January 10, p. 369) attention was directed to a report of a special committee appointed by the British Science Guild and published in the journal of the Guild for December last. The report discussed the manner in which the trustees of the Carnegie Trust for the Universities of Scotland were carrying out their purpose of strengthening and developing scientific research, a question which was raised by Prof. Soddy in *Science Progress* for January, 1917. The recent issue of the sixteenth annual report of the Carnegie Trust seems to call for some further comment in connection with the criticisms then advanced.

The report shows how the grants have been distributed during the year 1916–17. Since this is the fourth year of the third quinquennial period, no vital changes in the general character of the report are to be expected. A new feature is the list of the trustees and the members of the executive committee, which is printed on the back of the title-page. When it is borne in mind that one of the main purposes of the Carnegie Trust is to improve and extend the opportunities for scientific study and research, it is matter for some surprise that of the twenty trustees four only can be regarded as men of science with direct knowledge of the meaning and methods of research. There is improvement, however; for originally there were only two, and for a short interval none, who could be ranked as men of science.

As regards distribution of grants under Clause A of the trust deed, the present war conditions have naturally had important effects. Large sums granted towards the cost of new buildings have not been expended. In the case of the Universities of Glasgow and Aberdeen these sums are simply held over; but in the case of Edinburgh a sum of 31,000*l.*, originally allocated over the five years for buildings and permanent equipment in chemistry and anatomy, has been diverted for the endowment of a professorship of chemistry in relation to medicine, a professorship of French, and two new

lectureships, one in Italian and one in Spanish. The institution of a separate chair for chemistry in medicine may be expected to make possible a fuller development of the original chair as a centre of scientific research, and the University of Edinburgh is to be congratulated on having given a useful lead in this much-needed reorganisation of the chemistry department.

Arranging under general groups the sums expended during the year 1916–17, and taking into account the change in the allocation for the University of Edinburgh, we find that 43 per cent. was applied towards providing new buildings and permanent equipment in arts, medicine, and science, 36 per cent. towards endowment of professorships and lectureships in these three faculties and for other general purposes, 9 per cent. towards books, etc., for libraries, and 12 per cent. towards the direct endowment of research in science, medicine, and history—where under history are included also archæology, economics, modern languages, and literature. It may be mentioned that fully half the sum was allocated to the history group, so that only 6 per cent. of the grants for the year were used in the encouragement of research in modern progressive science.

It must be recognised that under present war conditions scientific research by young graduates is practically impossible; but the fact remains that in the present quinquennial scheme, which was inaugurated nine months before the outbreak of war, direct endowment of scientific research did not form a very conspicuous feature. On the other hand, it may be argued that it is not an easy matter to supply money directly for research unless the purpose of the research is clearly recognised. Post-graduate work by Carnegie scholars and fellows may or may not yield important gains in increasing or systematising scientific knowledge. A trust like the Carnegie Trust for the Universities of Scotland may have good reasons for believing that the interests of scientific research may be best advanced in the meantime by providing better laboratories, increased equipment, and more efficient teaching, in the hope that other good things will follow in their train. In any case the trust has a grave responsibility, and must see to it that there is no chance of wasteful squandering of the funds it has to administer.

THE RELATIONS OF GEODESY TO GEOLOGY.[1]

THE study of the earth is the aim of both geologists and geodesists, but their methods of investigation differ so widely that their co-operation is sometimes difficult to bring about. While the geologist utilises descriptions and measurements which he has collected at many places widely distributed over the earth's surface, the geodesist deals with a comparatively limited number of observations carried out with the aid of instruments of high precision, and carefully corrected for all ascertainable errors; his material for discussion is provided from data the magnitudes of which are very small, and the weight and relevance of which are not readily appreciated by workers whose advance is along other lines. Still, the co-operation of geology and geodesy is very desirable, and the work that has been done during the past ten or fifteen years in India, where the most extensive collection of high-grade geodetic material in the Empire is available, in bringing together these two lines of investigation may lead, we hope, to further work both there and elsewhere. The reports of the Geodetic Survey of South Africa furnished some similar material, and Dr. W. Bahn, in an article which appeared in the *Beiträge für Geophysik* of 1910, discussed the geodetic results and indicated their bearing on the tectonic geology of the area; but such discussions have been few.

The Himalaya problem is dealt with in the present memoir by Mr. Oldham, who aims at adding to the stock of fundamental facts and so utilising the work of Col. Sir Sidney Burrard, Dr. Hayden, and others that a theory may be built up such as will adequately account for the conditions revealed by geodetic and geological observations.

The following conclusions are quoted as obtaining general acceptance, and as, therefore, providing a starting point for discussion. The elevation of the Himalayas has been accompanied by compression of the rocks of which they are composed; a great main boundary fault lies along the outer edge of the Himalayas, and separates the rocks of the northern area from the Upper Tertiary rocks of the southern area; a series of similar faults is found within the Siwalik area, and these are regarded as marking progressive shifts southwards of the boundary of uplift to the north and deposition to the south.

The discussion is introduced by a chapter which is devoted to an explanation of the nature of the geodetic evidence in which the theories of compensation and isostasy are discussed. A short but useful account of compensation from the work of Archdeacon Pratt and Sir George Airy to the recent studies of Hayford, Bowie, and others leads up to the development of tables of compensation factors for various distances and depths.

The geodesist does not determine the absolute value of the deflection of the plumb-line from the vertical, and selects a station as origin to which he refers the results obtained at other stations. For India the station of Kalianpur has been taken as origin with the assumption that no deflection exists there; but as the existence of a southerly deflection has been established, a correction for the amount of it has to be applied generally before the results at other stations can be employed. Variations in the force of gravity are determined by comparing the period of a free-swinging pendulum at different stations when all the necessary corrections have been applied. These local values have then to be compared with the normal value for that point on the earth's surface, and to do

[1] "The Structure of the Himalayas and of the Gangetic Plain as Elucidated by Geodetic Observations in India." By R. D. Oldham. "Memoirs Geol. Survey of India," vol. xlii., part 2, 1917.

this it is necessary to reduce the local observed value to sea-level. This involves an estimation of the masses of the earth above sea-level, both above and below station-level, in order that their effect may be correctly allowed for.

Mr. Oldham first takes the case of an imaginary mountain range agreeing approximately in its dimensions with the Himalayas, but more regular in form, consisting of a plateau of 15,000 ft. altitude, from which an incline of 100 miles in breadth descends to 5000 ft. by a series of steps, and terminates in another plateau at an altitude of 1500 ft., and 20 miles broad, bounding the Gangetic trough on the north.

Utilising this imaginary range, the effects of various hypotheses of compensation are considered, and the deflections at a series of points on a line crossing the range are computed and tabulated. The attractions of the visible masses, both compensated and uncompensated, are compared, and also the topography of the imaginary range and the actual topography, as determined by Major Crosthwaite, R.E. The Siwalik Hills, with their lower density of about 2·2, as compared with the 2·7 of the Himalayas, are separately taken into account. The case of uniform compensation to different depths is examined and compared with the results given on the assumption of a variable compensation.

Passing from the hill range to the Gangetic trough, reasons are given for taking the value 2·16 for the density of its filling material, and on this assumption the deflections due to such a trough of various depths, breadths, and sectional forms are computed and compared. All this forms a standard of comparison for estimating the value of the observational material, and the geodetic data along lines traversing the Gangetic trough are next examined, the conclusion being reached that the maximum depth of the trough need not exceed 25,000 ft., and can scarcely be less than 20,000 ft., according to the deflection observations. The gravity observations are next discussed and are considered to bear out generally the conclusions which had been reached on the deflection data and to indicate a general upward slope of the floor of the Gangetic trough towards the south. Special cases at Dehra Dun, in the Punjab, etc., are discussed in fuller detail, and near the Siwalik Hills a maximum depth of at least 10,000 ft. for the trough is highly probable.

The next stage in the investigation is a discussion of the support of the Himalayas, and taking the Himalayan geodetic stations, the probable and actual deflections are compared. Local topographical irregularities introduce difficulties in some cases, but there is in all three regions examined an excess of observed over calculated deflection in a northerly direction. Neither alteration in the depth to which compensation extends nor the adoption of a hypothesis of flotation provides an explanation, but the author would attribute it to departures from locally complete compensation. The observations of M. de Filippi's expedition to the Himalayan region should add valuable material for this inquiry, but at present there seems to be a defect of gravity as the hills are entered.

This memoir is a valuable addition to geophysical literature, and a useful contribution to the study of a difficult problem which will be welcomed both by geologists and geodesists. It is to be regretted that the illustrations are poor specimens of such work, for there should be no difficulty in providing more satisfactory blocks. The omission of an indication of the units employed in several of the tables is tiresome to the reader.

H. G. L.

CLIMATOLOGY AND AN ABANDONED FLYING SCHOOL.

THE *Times* of May 20 contains a summary of the third report of the Select Committee on National Expenditure, which gives the material facts about the abortive scheme of the War Office to establish at Loch Doon, Ayrshire, a large school for the training of airmen in gunnery. It is a striking and very expensive example of that incoherence or lack of co-ordination under stress against which the discipline of science as a part of education should be our safeguard. In 1916 the Air Board wanted an aerodrome for special purposes, and found a site at Loch Doon which would fulfil their requirements provided that a peat-bog on the western side of the lake could be drained and certain engineering work carried out on the eastern side. Taken independently, both these conditions could be satisfied, and operations were set on foot. By May, 1917, the estimated cost was 350,000*l.*; afterwards, large further sums were being asked for to complete the scheme; but, though each item had been separately satisfied, the object was not achieved. The climatic conditions were quite unsuitable for a training school, the local "bumps" were a great drawback for the special purpose of the aerodrome, the conditions of the surrounding area placed intolerable restrictions upon its use, and, on account of the increased speed of flight, the engineering works were already out of date. In January, 1918, the Air Council decided to cut the loss and abandon the scheme.

Looking back at the evolution of this fiasco, various points are evident. The air authorities apparently worked by the map, the engineers considered only the questions of draining a bog and constructing certain railways, hangars, etc., not the making of an aerodrome; and the vexatious details of the climate of the British Isles were left to express themselves in their own inexorable way when the mechanical operations had been provided for. The last is, perhaps, the most instructive feature of the situation. Climatology is the science which uses the common experience of past weather to safeguard the future of all operations that depend upon weather. Its basis of fact is merely organised public memory. The Meteorological Committee, in its reports, has frequently urged that, in the public interest, local authorities

should keep suitable records. If this course had been followed in Ayrshire, some 500,000*l.* might have been saved. But our local authorities have not yet acknowledged the duty.

It has been left to the meteorological societies, or the Meteorological Office, or the British Rainfall Organisation to collect such observations of weather as are made for country landowners or by meteorological enthusiasts in various localities; the distribution is naturally haphazard. Moreover, with the possible exception of the water engineer, the people who have to carry out such schemes have no training in the use of the collected information or in how to find it, and without some experience the tables are difficult to use. Much of the information requires re-working in order to answer special questions. For those who know where to look for it, there is a vast mine of information about the climatology of the British Isles, but, for lack of schools devoted to such sciences, it is largely unworked. An authoritative compilation is much needed. The Royal Meteorological Society, in co-operation with the Meteorological Office, began to work the data for a climatological atlas shortly before the war, but has had to discontinue the task for the present. It was thought at the time to be an undertaking of great utility, but that its present worth might run to six figures in a single case was clearly not realised.

NOTES.

THE twelfth annual meeting of the British Science Guild will be held at the Mansion House on Wednesday, June 19, at 4 p.m., the Lord Mayor in the chair. Lord Sydenham, president of the guild, will deliver an address on "Education, Science, and Leadership"; and other speakers will be Sir Algernon Firth, Bart., and Sir Henry Newbolt. Tickets of admission may be obtained from the Secretary, British Science Guild, 199 Piccadilly, London, W.1.

THE Lords Commissioners of H.M. Treasury have approved the proposal of the Meteorological Committee that, in view of the variety and importance of the scientific problems upon which the Meteorological Office is required to advise the fighting forces, Sir Napier Shaw shall, for the period of the war, become scientific adviser to His Majesty's Government in meteorology, and be relieved of the administrative duties of the Meteorological Office, but retain the chairmanship of the Meteorological Committee. Lt.-Col. H. G. Lyons, with the sanction of the War Office, has been appointed acting director of the Meteorological Office for the same period. We most heartily congratulate the Government and Sir Napier Shaw upon this appointment. Meteorology in England has made great progress during the last twenty years, and a large share of the credit for this must be given to Sir Napier's administration of the Meteorological Office and to his lectures and papers on the subject. The value in war of correct forecasts is obvious, but there are many other ways in which an intimate knowledge of meteorology may be of use, and no more suitable man could have been found for the new post.

THE return to Copenhagen from Greenland, *via* the Faröe Islands, of Mr. Knud Rasmussen, the Danish Arctic explorer, is announced by Reuter's Agency. In 1916 Mr. Rasmussen explored the coasts of Melville Bay between Upernivik and Cape York, as ice prevented his reaching his station at Thule, in North Star Bay. In 1917 he returned to his original programme of exploring the north-west coast of Greenland, with special reference to Eskimo migrations. This was almost the last unexplored part of the Greenland coast. The expedition also planned to carry mails to the American Crocker Land Expedition and its relief expedition, the latter supposed then to be at North Star Bay, south of Smith Sound. The news now to hand through a Reuter message reports that Mr. Rasmussen reached Sherard Osborne Fjord early in May, 1917, and spent the summer in mapping the little-known fjords as far north as De Long Fjord. The difficulties of travelling were accentuated by the absence of game. In the beginning of August the expedition started south again over the ice, and with great difficulty reached Cape Agassiz, 140 miles north of Etah, in three weeks' time, and Etah on September 10. Dr. Wulff, one of the men of science, died of exposure. Mr. Rasmussen apparently wintered at Etah or Thule, and left Greenland this spring. He reports no trace of Eskimo migrations on the north-west coast. Apparently his plans for traversing the Canadian Arctic archipelago from east to west have been deferred.

SCIENCE has lost another distinguished young votary by the death of Capt. James Watson Pryde, who fell in action in East Africa on May 5. Capt. Pryde was a native of Dundee, and received his early education at the Morgan Academy. He then entered the University of St. Andrews, and completed his arts course with distinction in every class. With a strong bent for science, he selected zoology as his main department, and there he gained the highest honours in class and degree examinations, as well as in practical work. Moreover, he at once commenced, as Walker Trust scholar, original work at the Gatty Marine Laboratory, taking up the study of the North Sea Polychæts where another able graduate, Wm. Small, now with the fighting forces in East Africa, had left off, and his published papers show that he did so with conspicuous success. Early in his college career Pryde joined the O.T.C., and at the outbreak of the war was sergeant-major. He volunteered for service at once, and received a commission in the Black Watch, his talents, administrative skill, and agreeable bearing making him very popular. He was then attached to the King's African Rifles, and lately was at Zomba, Nyasaland, pursuing the Germans into Portuguese East Africa, in the region of the Lugenda River. He was looking forward to an early return to continue his researches and the study of medicine. The loss of a zoologist so able and accomplished, and of so gallant a soldier, is grievous.

THE Trustees of the British Museum have published a report on an investigation carried out by Mr. J. Hartley Durrant, of the Natural History Museum, and Col. W. W. O. Beveridge to ascertain how and when the infestation of Army biscuits by flour-moths takes place, and whether any steps can be taken to prevent this. A list is given of eight species of beetles and four Pyralid moths that were actually found in the tins of biscuits examined. But by far the most serious pest was the moth *Ephestia kühniella*, and excellent illustrations and a full description are given both of this species and of *Corcyra cephalonica*. Evidence is adduced indicating that Central America is probably the original home of *E. kühniella*, the so-called Mediterranean flour-moth. The examination of various intact airtight tins showed that the biscuits

contained in them were infested, thus indicating that the moths had gained access to them in the factory prior to packing. By means of a thermo-couple the temperature in the centre of the biscuits during baking was tested, and found to rise to a minimum of just above 100° C. It is considered improbable that insect-eggs, if present in the dough, could survive this temperature. The infestation of the biscuits must take place, therefore, during the cooling and prior to the tins being soldered. The authors suggest that a strong draught of screened cooled air should be passed over the biscuits immediately they have been baked; this would cool them more rapidly, and render it practically impossible for the moths to oviposit on them. Further, the packed tins might be punctured, heated to a lethal temperature, and then soldered up; but against this there are certain technical difficulties, and also the question of expense.

MR. D'ARCY POWER has been appointed Bradshaw lecturer of the Royal College of Surgeons of England for the ensuing year.

THE Royal Society's Croonian lecture will be delivered by Major W. B. Cannon on Thursday, June 20, the subject being "The Physiological Basis of Thirst."

THE Bathgate memorial prize of the Royal College of Surgeons of Edinburgh, consisting of a bronze medal and books, has been awarded to Miss J. A. Sang.

THE medal of the Franklin Institute, Philadelphia, has been awarded to Senator G. Marconi and Dr. T. C. Mendenhall. The presentations were made at the meeting of the institute on May 15.

AT the ordinary scientific meeting of the Chemical Society to be held on Thursday, June 6, Dr. Horace T. Brown will deliver a lecture entitled "The Principles of Diffusion: Their Analogies and Applications."

SIR JAMES DEWAR has been awarded the medal of the Society of Chemical Industry in recognition of the conspicuous services which, by his research work in both pure and applied science, he has rendered to chemical industry.

THE seventieth annual general meeting of the Somersetshire Archæological and Natural History Society will be held in the Municipal Hall, Taunton, on Tuesday, July 23, under the presidency of Prof. F. J. Haverfield, who will deliver a short address on "The Character of the Roman Empire as Seen in West Somerset."

THE eighth geophysical discussion arranged by the British Association Geophysical Committee will be held at the Royal Astronomical Society on Wednesday, June 12, at 5 p.m., Rear-Admiral J. F. Parry, Hydrographer of the Navy, in the chair. The subject will be "The Tides," and the opener will be Prof. H. Lamb, who will be followed by Prof. Love, Mr. Proudman, and others.

THE following officers and new members of council of the Institution of Electrical Engineers have been elected for the ensuing year:—*President:* Mr. C. H. Wordingham. *Vice-Presidents:* Mr. W. A. Chamen, Mr. R. A. Chattock. *Hon. Treasurer:* Mr. J. E. Kingsbury. *Ordinary Members of Council:* Mr. H. W. Clothier, Mr. D. N. Dunlop, Sir R. A. Hadfield, Bart., Prof. E. W. Marchant, Mr. C. C. Paterson, and Mr. J. Sayers.

THE officers of the Linnean Society elected for the ensuing year are:—*President:* Sir David Prain. *Treasurer:* Mr. H. W. Monckton. *Secretaries:* Dr. B. Daydon Jackson, Mr. E. S. Goodrich, Dr. A. B. Rendle. The new members of council are:—Mr. S. Edwards, Prof. J. B. Farmer, Mr. C. C. Lacaita, Mr. R. Innes Pocock, and Miss A. Lorrain Smith.

THE *British Medical Journal* announces the death on March 3, at sixty-six years of age, of Prof. C. Blarez, professor of chemistry in the University of Bordeaux. We learn that Prof. Blarez published more than two hundred memoirs on pure or applied chemistry, and was the author of a course of organic chemistry in three volumes, and of monographs on the urine and on milk. His last publication was a treatise on wines and spirits embodying the results of forty years' work.

A STRONG earthquake visited La Serena, the capital of the province of Coquimbo, in Chile, at 1 p.m. on May 20, but the damage to the town seems, according to the telegram of the *Times* correspondent, to have resulted from fires rather than from the shock itself. The disturbed area was of considerable extent, the shock being felt at Valparaiso, about 210 miles, and Santiago, about 250 miles, to the south of La Serena. As a seismic district the province of Coquimbo is one of the most sensitive in Chile, but there is nothing in the brief account to indicate that the recent earthquake was of unusual severity.

WE regret to learn of the death of Prof. Victor Commont, of the Normal School at Amiens, in his fifty-second year. Prof. Commont was an accomplished geologist and anthropologist who devoted the leisure of a busy life to the detailed study of the river deposits in the valley of the Somme, where Boucher de Perthes first brought Palæolithic implements to the notice of the scientific world. Prof. Commont's researches added precision to the earlier work, and his classic papers on the succession of implement-bearing deposits in the Somme valley form models to be followed wherever similar investigations are undertaken. In the neighbourhood of Amiens he identified deposits of all periods from that of the earliest Palæolithic man to that of the Iron age, and in numerous sections he clearly discovered their relationships. He also devoted much attention to the implements themselves, and had an unrivalled knowledge of the successive types. In 1913 Prof. Commont visited London to examine some of the typical localities in the Thames valley, and to study the newly found collection from Piltdown, Sussex. His premature death is indeed a serious loss to prehistoric research.

IN the Journal of the Royal Anthropological Institute (vol. xlvii., July–December, 1917) Mr. Sidney Ray contributes an elaborate article on "The People and Language of Lifu, Loyalty Islands." Capt. Cook missed the islands of the Loyalty group when he discovered New Caledonia in 1774, as did D'Entrecasteaux in 1793. Missionary work has gone on since 1840 in Maré, and since 1845 in Lifu, but since the annexation of the Loyalty Islands by France in 1864 there has been trouble with missionaries of the Protestant Church, and at present there is only one English missionary in the island. Mr. Ray's paper gives a series of glossaries and notes on the culture of the inhabitants. The use of a ceremonious language employed when addressing or referring to a person of high rank is an interesting and peculiar custom in Lifu and Nengone, but is strangely absent in the neighbouring island of Uvea.

DR. WALTER COLLINGE, in the *Scottish Naturalist* for May, directs attention to the very unsatisfactory methods commonly in use by economic ornithologists for estimating the food contents of the stomach or

crop, as the case may be, in wild birds, for the purpose of determining the usefulness or otherwise of any given species to the farmer or gardener. Briefly, he shows that the volumetric standard adopted by the Biological Survey of the U.S. Department of Agriculture affords the only trustworthy source of information, and should become, indeed, the only recognised test. Each bird requires a certain bulk of food per day, not a certain number of different kinds of insects, seeds, etc., and rightly to estimate the importance of any element in its diet we must first know what proportion the insects, seeds, and so on constitute to the standard requirement. Two very helpful diagrams illustrate the paper.

How little the true nature of museum work is understood, even by many men of science, forms the subject of a very able essay by Dr. F. A. Bather in the *Museum Journal* for May. It seems incredible, for example, that a well-known British zoologist was recently found to believe that the specimens in the public gallery represented the whole collection of fishes in the British Museum of Natural History! After citing instances of the work done by museums in unravelling intricate problems, such as that presented by the attacks of beetle-larvæ on the roots of the sugar-canes in Mauritius, Dr. Bather proceeds to show the imperative need for the most refined, systematic study of living organisms, irrespective of any value they may have in relation to "applied science." This is the most valuable part of his essay, as it was meant to be, though we fear that the day is yet far distant when the general public will realise that science for its own sake is worth pursuing.

THE Geological Survey of Queensland is to be congratulated on the progress it is making in publishing accounts of the fossils of that colony. The two concluding sections of part i. of Mr. A. B. Walkom's memoir on the Mesozoic floras of Queensland are especially interesting for comparison with the Jurassic and Rhætic floras of Europe, which they much resemble. In Publication No. 260 Mr. R. Etheridge, jun., describes some important fossil invertebrata, including Cretaceous crustaceans and a few fragments of the largest known Carboniferous trilobite, which measured about 60 mm. in breadth.

THERE is remarkable uniformity in the anatomy of flesh-eating dinosaurs of Mesozoic times, whether they are early or late, small or gigantic. They all have large hindquarters for bipedal walking, a long tail, very small mobile fore-limbs, and a more or less regular series of sabre-shaped teeth. Mr. Lawrence M. Lambe has just published a well-illustrated description of another genus, Gorgosaurus, from the Cretaceous rocks of Alberta, Canada (Geological Survey of Canada, Memoir 100). Its typical species is about 30 ft. in length, and is specially interesting as one of the latest carnivorous dinosaurs known. There is little new in the skeleton, but the fore-limbs seem to be even more reduced than usual.

THE subject of soil aeration is attracting considerable attention in tropical agriculture, and numerous results are now being obtained, a summary of which was presented by Messrs. A. Howard and R. S. Hole to the Indian Science Congress at Lahore. The effect of adding potsherds or sand to the Pusa soil is shown to increase nitrification and plant growth; in the case of Java indigo the increase was as much as 40 per cent. Flood irrigation, on the other hand, on fine alluvial soils, interferes with their ventilation by rapidly destroying the texture and by forming a compact surface crust impermeable to air. One limiting factor—water—is removed, but another—the need for aeration—is introduced. Thus over-irrigation actually diminishes the yield. This is shown by results obtained at Quetta, where thirteen maunds of wheat were obtained with one irrigation and only eight maunds where three irrigations were given. In any flood irrigation system a practical compromise between the needs of the plant for air and for water must be worked out. This has been accomplished at Quetta by the proper utilisation of the preliminary watering given before sowing. Under this new system the yields are often higher than those obtained with the six or seven waterings usually applied. The Quetta results have been shown by experiment to apply to the Punjab and Sind, where almost half the irrigation water now used could be saved. The economic significance of these results becomes apparent when it is remembered that the annual revenue derived from irrigation works in India is 5,000,000*l.* sterling. It is further shown that aeration probably influences the distribution of plants, and is therefore of importance in ecological studies.

THE Danish Meteorological Institute has published its report for 1917 on the state of the ice in the Arctic seas (Isforholdene i de Arktishe Have). War conditions have made it impossible to obtain as full reports as usual except from the coasts of Greenland, Iceland, Spitsbergen, and the Barents Sea. In Spitsbergen and the Barents Sea the ice conditions were again abnormal and most unfavourable. The winter ice in Spitsbergen fjords broke up a month later than usual, and the autumn ice formed several weeks ahead of the average date. There was pack-ice off the west coast of Spitsbergen throughout the summer months. The coast was most approachable during the first half of August and the second half of September. Throughout the summer it seems, as usual, to have been easier to enter King's Bay than fjords further south, but until late in July the pack on the west coast of Spitsbergen more or less met the pack of the Greenland Sea, and on this account it was not easy to reach the open water north of Prince Charles Foreland. Storfjord seems to have been clear of ice in September, and possibly in August. Reports from the Kara Sea are scanty, but the ice conditions there seem to have been bad. No vessel attempted to make the passage in 1917.

SOME explorations in the previously little-known Tibetsi highlands of the Sahara by Col. Jean Tilho are summarised in an article in *La Géographie*, vol. xxxi., Nos. 6–8. The explorations were part of a long series of journeys between Lake Chad and the Anglo-Egyptian Sudan undertaken in the years 1912–17. Col. Tilho has established that the Tibetsi highlands are not a single range lying north-west and south-east, but consist of four, or perhaps five, ranges radiating between west-north-west and north-east from the Koussi massif. In this massif is the extinct volcano of Emi-Koussi, which rises to a height of 11,155 ft. above sea-level, and marks the summit of the Tibetsi highlands. Emi-Koussi has an enormous crater, eight miles long and about five miles broad, within which are several secondary craters, of which Era Kohor has a diameter of about two miles. In the bottom of this crater is a deposit of sodium carbonate covering about 100 acres and at least 4 ft. in depth. There is clear evidence of the former existence of a lake, but there is now no water. Among other interesting results, Col. Tilho claims to have established definitely that there was never any connection between Lake Chad and the Nile. Material has been obtained in most of the region traversed for a new map, which has been drawn on a scale of 1 to 1,000,000. No map accompanies the article.

THE report on rainfall registration in 1916 in Mysore has just reached us. It includes maps showing the actual rainfall for the year 1916, and the average annual rainfall for the period 1870–1915. On June 25, 1916, more than 16 in. of rain fell during twenty-four hours at Nagar in the Shimoga district; the total rainfall at that place during June was 38 in., nearly 50 per cent. above the normal, although the total fall for 1916 was practically normal at 104 in. The rains during October and November, 1916, were above the normal on account of an exceptional number of cyclonic storms, which originated in the Bay of Bengal. The rains were on the whole but half of the normal during the cool-weather period, January and February, and also during March, the beginning of the hot-weather period. The deficiency was more than made up during the rest of the year, especially in the north-east monsoon period from October to the end of the year. The tables occupy fifty-eight pages, and give the details for the 224 stations under various heads; a notable table is that which gives the distribution in the river valleys.

WEATHER-CONTROLS over the fighting in Mesopotamia, in Palestine, and near the Suez Canal is the subject of an article by Prof. Robert DeC. Ward, of Harvard University, in the *Scientific Monthly* (April). Mesopotamia is characterised as "a country of aridity, of intense summer-heat, of deserts and steppes, of relatively mild winter, and of cold-season rains." The mean temperature at Bagdad for January is given as 48·7° F., and for August 92·5°; the mean maximum is 119·5°, and the mean minimum 21·9°, which are the mean extremes in the year. Winter frosts occur and snow falls locally. The total mean annual rainfall is only about 8 in. or 9 in., and in some years only about half as much. The rain falls between October and May, and the remaining months are practically rainless. February or March is the rainiest month, and the floods come in March and April. The climate of Palestine has been discussed by Exner and Hann, and the article quotes various data. The coast stations have a mean midwinter temperature of between 50° and 55° F., and mean midsummer temperature of 75° to 80°. The hill stations, at elevations of about 1500 ft. to 3000 ft., have mean midwinter temperatures from 45° to 50°, and midsummer means from 70° to a little under 80°. In the Jordan valley the temperatures range from 55° in midwinter to 85° or 90° in midsummer. Jerusalem averages 3·6 days a year with temperature below freezing, and the highest summer temperatures reach 100° to 105°. The annual rainfall at the coast stations ranges from 15 in. to 35 in., and at Jerusalem it is 26 in., no rain falling in June, July, and August. The rainy season extends from the middle of October to early in May. In the district of the Suez Canal the complete absence of rain for months together and the exceptionally small total annual fall in places immensely augments the difficulty of transport. The writer of the article says that winter is the best season for a campaign, both on account of the better water supply and of the lower temperature.

A PRELIMINARY report on the mineral production of Canada during the year 1917 has been issued by the Canadian Department of Mines. Although the total value of this production shows an increase over that for the previous year to the extent of 8·9 per cent., this is due almost entirely to increased values of the products, the quantities showing actual decreases in many cases. Thus the coal output, a little above 14 million tons, shows a decrease of 3·2 per cent.; the production of copper shows a decrease of 7·08 per cent., of lead of 22·71 per cent., of silver of 13 per cent., and of gold of 19·68 per cent. On the other hand, the production of zinc increased by 33·5 per cent., and that of cobalt by 29·62 per cent. There were trifling increases in the production of nickel and of pig-iron, though in the latter case this was due entirely to the production of iron in the electric furnace; furthermore, the pig-iron produced from Canadian ores showed a heavy decline, more imported ore having been smelted in 1917 than in 1916; a large proportion of the latter consists of Wabana ore from Newfoundland. Upon the whole, it may fairly be said that the mineral industry of Canada is holding its own reasonably well under the severe stress of war conditions.

IN the *Elektrotechnische Rundschau* for September 26, 1917, a writer directs special attention to the process of steel hardening by air-blast, owing to shortage of oils in Germany. The hot tool is placed in an attachment capable of rotating freely. It is then exposed to the cold blast forced through a number of tubes in such a way as to rotate the tool. Drills, turning-tools, and other simple pieces may be cooled in the blast from a fan.

ACCELERATION in the deposition of metallic deposits may be obtained by suitable electrolytes, stirring the bath, and applying high temperatures. In this way it has been possible (according to *Elektrotechnik und Maschinenbau*, October 14, 1917) to produce cobalt deposits in three to five minutes with a current density of 29 amps. per dm.^{2} A nickel deposit that previously required 1½ hours can now be made in five minutes by using a solution of 220 grams nickel-sulphate, 21 grams nickel-chloride, and 21 grams boracic acid to one litre of water at 70° C., and using a current density of from 25 to 39 amps. per sq. dm. The action of high temperatures is said to bring about an increase of concentration of the ions. The method is not of universal application, as all solutions do not allow high temperatures to be used.

K. H. GÜLDNER, in the *Zeitschrift des Vereines deutscher Ingenieure* for August 11 and 18, 1917, describes some investigations which he has carried out to determine the lateral deviation of projectiles caused by the spin imparted to them by the rifling of a trench-mortar. The trench-mortar provides a suitable means of carrying out such tests, as the motion of the projectile may be followed by the eye. Rifling with a right-handed twist may cause constant lateral deviation both to the right and left. Right or left deviation is the result of right or left precession, and is visible to the naked eye. Left precession with rifling having a right-handed twist can occur only after the maximum height of the trajectory has been passed if the centre of action of the air-resistance lies behind the centre of gravity of the shell. The precession on the ascending part of the trajectory is always greater than in the descending part.

THE making of accurate screw gauges presents considerable difficulties, as is well known to those who undertook to manufacture these appliances for the Ministry of Munitions. A lathe having many novel features has been designed and made at the request of the Ministry by Messrs. Bryant, Symons, and Co., 320 St. John Street, London, E.C.1, and is described in *Engineering* for May 24. Both centres are dead centres, thus ensuring that work shall be round and not slightly elliptical. The effective pitch of the lead screw can be varied at will, so that it can produce a thread of slightly greater or smaller pitch than the standard; in this way shrinkage during hardening can be provided for in advance. The lead screws of all these lathes are tested separately, and a correction bar

is fitted to compensate for local errors in each lead screw. Each tool, when sold, is accompanied by a certificate from the National Physical Laboratory as to its performance, and the certificate gives the errors found in a screw 8 in. long actually cut in the machine. The design of the machine, so far as can be determined from the drawings and photographs given in the article, is excellent, and the lathe should form a valuable addition to the equipment of gauge shops.

THE May issue of the Transactions of the Optical Society is devoted almost entirely to papers on the methods of design of telescopic objectives. Mr. P. F. Everitt sets out clearly in order of importance the six conditions which it is desirable that an objective, so far as is practicable, should fulfil. He then shows how, by the help of tables such as those of Smith and Cheshire, the approximate radii of the surfaces of the objective are found, and corrected by tracing the paths of an axial and an edge ray through the system. Mr. T. Smith gives an account of the methods in use at the National Physical Laboratory which have furnished the tables just mentioned, and Mr. S. D. Chalmers gives an alternative method of making the calculation. In the discussion of the three papers Prof. Cheshire emphasised the importance of accurate computation of the properties of an objective before the manufacturer put tool to glass. We cannot in modern times wait for a sample to be made and tested before producing instruments in quantity. Mr. Conrady and Mr. Hasselkus contended that an objective should be designed to compensate the errors of the common eye-pieces, while Mr. Everitt declined to saddle the objective with this task.

MR. C. TURNBULL read a paper to the Institution of Electrical Engineers on May 9 in which he urged the necessity of having a "national proving house" for testing British engineering apparatus and materials. Although most of the speakers agreed with Mr. Turnbull, no one advanced any real proof that there was any urgent necessity for a commercial laboratory of this kind. We are not aware that there is any appreciable quantity of inferior apparatus or shoddy electrical materials in the market. The president, Mr. C. H. Wordingham, in opening the discussion, gave a summary of a report of the committee of the council which had been considering the subject. He began by saying that the proving house would not enter into competition with existing institutions, but it will be difficult to avoid doing so. It will be remembered that when the National Physical Laboratory was started this consideration caused considerable friction. As a proving house will have to be largely, if not altogether, self-supporting, little research work can be undertaken. Sir Richard Glazebrook welcomed the suggestion that the proving house should work in conjunction with the National Physical Laboratory. The experience of the working of the National Board of Fire Underwriters of the U.S.A., which has what is practically an electrical proving house, shows, however, that the main problems it is forced to consider are political, commercial, and international rather than scientific. Hence it may be advisable to leave the problems of a British national proving house to the engineers' and manufacturers' associations, as they are free to deal with such questions. Unless a much stronger case can be made out for it, the whole proposal will probably fall through.

IN the Kjeldahl method for the estimation of nitrogen in organic compounds the substance is usually—in fact, almost invariably—digested with the sulphuric acid until a clear, transparent liquid is obtained. With some substances, *e.g.* indiarubber, a very prolonged period of digestion is thereby rendered necessary. Mr. Matthew Howie finds, however (Journal of the Society of Chemical Industry, March 30), that the whole of the nitrogen present in rubber is converted into ammonia in less time than is required to effect the complete dissolution of the substance. Using samples of plantation sheet and of Manihot rubber, it was found that 80 per cent. to 94 per cent. of the nitrogen was converted into ammonia after one hour's digestion, whilst three to four hours' digestion gave as high a nitrogen value as the six hours necessary for complete clarification of the solution. It is possible that in the case of other highly resistant nitrogenous substances the Kjeldahl estimation might be similarly shortened.

OUR ASTRONOMICAL COLUMN.

MAY METEORS.—Between May 17 and 24 meteors have occasionally been abundant and given evidence of several well-defined showers. Whether or not this period is worthy of special note cannot be absolutely affirmed, though the evidence strongly suggests that it needs further investigation. This year some fine meteors were observed at Bristol on the mornings of May 18 and 19, and proved that several of the various systems which mark this epoch returned with tolerable strength.

In 1866, May 18, several of the assistants of the Royal Observatory, Greenwich, remarked a striking prevalence of bright meteors, and Mr. Denning found on projecting the roughly observed paths that the radiant was placed at 247°+32° near ζ Herculis. This shower was observed at Bristol in 1903, 1911, and a few other years, and from a general investigation of all the meteor tracks recorded at the latter station since 1875 during the period May 17–24 the following radiants seem well defined:—

° °	° °	° °	° °
194+57	245+62	280−13	312+61
223+41	248+29	280+31	316+31
227− 6	254−21	290+60	331+50
230+33	263+37	291+52	332+71
231+27	270+47	294± 0	334+58
241+48	273+22	311+80	354+40

Many periods of the year appear to be more noteworthy for the large number of streams visible than for the special richness of one or two.

DISTANCE OF THE PLEIADES.—Prof. W. H. Pickering has made a further application of the statistical method to the determination of the distance of the Pleiades (Harvard Circular, No. 206). Absolute magnitudes were calculated by Russell's formula $M=0{\cdot}6+2{\cdot}1(T-2)$, where M is the absolute magnitude and T the type of spectrum, counting B as 1, A as 2, F as 3, G as 4, and K as 5. The eighty-two stars considered range in type from B5 to A9, and, omitting the six brightest stars as being possible "super-giants," the average difference between apparent and absolute magnitudes is 6·46. This corresponds with a distance of 201 parsecs, or 656 light-years, the parallax being $0{\cdot}0050'' \pm 0{\cdot}0008''$. It thus appears that the Pleiades are about five times as remote as the Hyades, while the distance between the two farthest apart of the bright stars (63′) is 12 light-years. The brightness of Alcyone is estimated to be 2100 times that of the sun, while the other five bright stars average about 800 times as bright as the sun.

By the same method Prof. Pickering finds 301 light-years, or a parallax of $0{\cdot}0109'' \pm 0{\cdot}0026''$, for the Coma Berenices cluster.

THE SPECTROSCOPIC BINARY 42 CAPRICORNI.—The variable radial velocity of this star was shown in

two photographs taken by Dr. Lunt at the Cape Observatory in October of last year, and data for the computation of a provisional orbit were provided by fifteen plates taken later (*Astrophysical Journal*, vol. xlvii., p. 134). The magnitude of the star is 5·28, and the spectrum of type K. The semi-amplitude of the velocity curve is 22·75 km./sec., and the system is approaching with a velocity of 3·0 km./sec. relatively to the sun, or receding at 7·3 km./sec. when the component of the solar motion is eliminated. The star is of special interest, inasmuch as the period is only 13·25 days, whereas Campbell found no spectroscopic binaries of the later types G, K, and M having periods less than twenty days.

THE TOTAL SOLAR ECLIPSE OF JUNE 8, 1918.

THE "Eclipse Number" of *Popular Astronomy* (vol. xxvi., No. 5, May) gives special prominence to a number of articles on the approaching total eclipse of the sun visible in the United States. Prof. H. C. Wilson gives a general account of eclipse phenomena and of the circumstances of the eclipse of June 8, to which is appended a series of letters indicating the plans of leading astronomers for observing the eclipse. The shadow first strikes the earth in the Pacific south of Japan, then passes north-westward, and reaches its highest latitude about 500 miles south of the Alaskan coast in long. 152° W.; on its landward course it passes from the western coast of Washington by way of Denver to Florida, the duration of totality on the central line gradually diminishing from 121 to 50 sec. Quite a large number of American astronomers are too fully occupied with war-work to undertake observations, but several well-equipped parties will occupy stations along the track. Ample provision appears to have been made for direct photographs of the corona on large and small scales, as well as for spectroscopic observations, and some of the observers will make special efforts to obtain photographs suitable for testing the deflection of rays of light from stars near the sun which is predicted by Einstein's theory of relativity. Prof. Hale will be in Wyoming with a party from the Mt. Wilson Observatory, and will attempt to determine the rotation of the corona from displacements of the green coronal line, besides obtaining photographs for studies of the chromospheric spectrum at different levels. Prof. Campbell's programme is somewhat restricted by the delay in the return of the instruments employed by him in Russia in 1914, but some instruments are available for photographs of the corona and of its spectrum.

The observations proposed by Prof. Abbot include measures of the brightness of the sky and of the outgoing radiation before, during, and after the eclipse. Prof. Stebbins will endeavour to secure photometric measures of the corona by means of potassium and rubidium photo-electric cells. A large party from the U.S. Naval Observatory will be located at Baker, Oregon, and in addition to many other observations, will attempt to extend the spectroscopic observations into the extreme red by the use of plates stained with dicyanin. Profs. Frost and Barnard have also prepared an extensive programme of photographs of the corona and its spectrum at Green River, Wyoming. In a separate article Prof. Frost directs attention to the valuable observations of the chromospheric spectrum which are possible at places within 200 miles of the eclipse track, as indicated by Newall and Fowler in 1912.

On account of the war, it is not expected that there will be any expeditions from foreign countries to observe this eclipse.

DIURNAL VARIATION OF ATMOSPHERIC PRESSURE.

THE effect of geographical latitude on the semi-diurnal wave of atmospheric pressure is fairly regular and well marked, but the variation of the diurnal wave has attracted less attention since Angot in 1887, and also Hann, showed conclusively its dependence on secondary local conditions. Three Japanese investigators from the Geophysical Seminary of the Physical Institute, Tokyo, contribute an account[1] of a preliminary attempt to trace more definitely the mechanism of these local influences, one of the most obvious of which, under the name of "continentality," has recently been attracting the attention of Mr. C. E. P. Brooks in this country in connection with climate, and with a purely geographical theory of the Ice age.

The elementary definition of continentality as the percentage of land in a circle of definite size (say 10° radius) surrounding the station is clearly insufficient, so much depending upon the orientation and shape of the coast line or lines that the form of the function is bound to be complicated. The Japanese authors soon come to the conclusion that it is not linear, and are constrained to make a series of simplifying assumptions in order to reach a workable hypothesis. The assumptions are no more probable than those of the early days of the theory of tides, with which the present problem has obvious analogies.

With these limitations the authors appear to account for such features as the variation with longitude, the inversion of phase near the poles, and the minimum amplitude near the coast, but a general solution of the problem has evidently not yet been reached. They indicate the lines on which they propose to continue the investigation, and conclude with a representative set of daily variation curves for ten British observatories, showing considerable dissimilarity, those of Oxford and Aberdeen, for instance, being almost the converse of each other. A systematic series of stations within the Empire, chosen with special reference to the elucidation of this problem, may well form part of the programme of co-ordinated British Empire meteorology so strongly advocated by Major Lyons in his presidential address to the Royal Meteorological Society.

The barometric variations dealt with in the above paper, as generally studied, are naturally to be regarded as vertical oscillations of the free atmosphere, though there is a possible difficulty in the differentiation between statical and dynamical pressure, when an ascending or descending current is in question. But there is also a very decided horizontal oscillation or motion of the free atmosphere, and this has begun to attract attention since the use of pilot balloons has provided more information about the direction of the wind at different heights than can be inferred from the motion of clouds. A paper from Batavia[2] has appeared in the Proceedings of the Royal Academy of Amsterdam dealing with the semi-diurnal variation of this motion.

There is a good deal of uncertainty about the investigation, even in a favourable place like Batavia, where atmospheric conditions are as a rule very quiet and steady. Observations were made not only at Batavia, but also at a neighbouring mountain station of 3000 metres elevation, as well as from a small coral island, to eliminate the land-effect. Single observations are

1 "On Diurnal Variation of Barometric Pressure." By T. Terada, M. Kiuti, and J. Tukamoto. Journal of the College of Science, Imperial University of Tokyo, vol. xli., art. 1 (November 20, 1917).

2 "The Semi-diurnal Horizontal Oscillation of the Free Atmosphere up to 10 km. above Sea-level Deduced from Pilot-Balloon Observations at Batavia." By W. van Bemmelen and J. Boerema. Proceedings Royal Acad. Amsterdam, vol. xx., pp. 119–35+plate.

included, especially at times of the day when convection currents are not in evidence in the lower atmosphere, otherwise double observations by day and by night were obtained with different base-lines of approximately half a mile, one mile, and one and a half miles in length. Some hundreds of ascents were observed, of which a fair proportion reached a height between 9 and 11 km., only 30 per cent. failing to reach the 4-km. level.

The data are admittedly insufficient to determine a diurnal oscillation, but Dr. van Bemmelen is fairly satisfied with the result for the semi-diurnal one. The east and north components are treated separately, and it is found that the former has a greater amplitude than the latter, and also a better determined phase. Gold's theoretical results for the lower layers are confirmed (*Phil. Mag.*, vol. xix.). The phase of the east component diminishes up to 4 km., and probably increases above that height, showing a fairly close analogy with the vertical oscillations. W. W. B.

RECONSTRUCTION IN FRANCE.

THE issue of the *Revue Scientifique* for April 13 contains evidence that our French neighbours are discussing the problems of reconstruction on much the same lines as we are. In an article on agriculture in 1917, M. Albin Haller, president of the Académie d'Agriculture, deals with the present effects of the war on agriculture and the outlook after the war, particularly in regard to the supply of artificial manures. He points out that war conditions have led to a diversion of the supply of nitrogenous manures to the manufacture of explosives, and that after the war it will be necessary to make up for the lost fertility of the soil by State efforts in the direction of stimulating the home supply of nitrogenous fertilisers from such sources as the by-products of gas- and coke-making, or even from special plants devoted to nitrogen fixation. In regard to the latter, he rightly points out that the feasibility may depend upon the harnessing of the waterfalls of the country—a point that we might well take to heart when we consider the immense possibilities of the Highlands of Scotland in this direction. M. Haller also throws out suggestions in regard to the future supply of phosphatic fertilisers, again touching a problem which is engaging attention here. The fact that the State now controls the production of sulphuric acid, and that, owing to its command over Australian zinc "concentrates," it may be able to market the acid as a waste product, inevitably suggests State enterprise in the future production of fertilisers as an adjunct to its food-production campaign.

An article in the same issue by M. Brucker, Principal of the Lycée de Cherbourg, entitled "L'Education de l'esprit scientifique," may be paralleled by the Report of the Committee appointed by the Prime Minister to inquire into the position of natural science in the educational system of Great Britain. It is perhaps characteristic of the two nations that, whereas the former is largely devoted to a discussion of the abstract and logical principles of scientific education—whether, for example, the methods should be synthetic or analytic—the latter concerns itself largely with the concrete problems of curricula, supply and training of teachers, etc. One rarely reads the writings of an educated Frenchman without having some cause to envy his possession of a language which is such an elegant vehicle for the picturesque, and, at the same time, precise expression of ideas. Such an instance can be cited in M. Brucker's characterisation of scientific definition as "une lutte contre le psittacisme," or, when quoting another writer, he speaks of "battant la paille des mots pour en faire tomber le grain des choses." May we commend the latter operation to our politicians? B.

RADIATION AND THE ELECTRON.[1]

II.

IN spite of the credentials which have just been presented for Einstein's equation, we are confronted with the extraordinary situation that the semi-corpuscular theory out of which Einstein got his equation seems to be wholly untenable, and has, in fact, been pretty generally abandoned, though Sir J. J. Thomson[2] and a few others[3] seem still to adhere to some form of æther-string theory—that is, to some form of theory in which the energy remains localised in space instead of spreading over the entire wave front.

Two very potent objections, however, may be urged against all forms of æther-string theory, of which Einstein's is a particular modification. The first is that no one has ever yet been able to show that such a theory can predict any one of the facts of interference. The second is that there is direct positive evidence against the view that the æther possesses a fibrous structure. For if a static electrical field has a fibrous structure, as postulated by any form of æther-string theory, "each unit of positive electricity being the origin, and each unit of negative electricity the termination, of a Faraday tube,"[4] then the force acting on one single electron between the plates of an air condenser cannot possibly vary *continuously* with the potential difference between the plates. Now in the oil-drop experiments (*Phys. Rev.*, vol. ii.[1913], p. 109) we actually study the behaviour in such an electric field of one single, isolated electron, and we find, over the widest limits, exact proportionality between the field strength and the force acting on the electron as measured by the velocity with which the oil drop to which it is attached is dragged through the air.

When we maintain the field constant and vary the charge on the drop, the granular structure of electricity is proved by the discontinuous changes in the velocity, but when we maintain the charge constant and vary the field the lack of discontinuous change in the velocity disproves the contention of a fibrous structure in the field, unless the assumption be made that there are an enormous number of æther strings ending in one electron. Such an assumption takes all the virtue out of an æther-string theory.

Despite, then, the apparently complete success of the Einstein equation, the physical theory of which it was designed to be the symbolic expression is found so untenable that Einstein himself, I believe, no longer holds to it, and we are in the position of having built a very perfect structure and then knocked out entirely the underpinning without causing the building to fall. It stands complete and apparently well tested, but without any visible means of support. These supports must obviously exist, and the most fascinating problem of modern physics is to find them. Experiment has outrun theory, or, better, guided by erroneous theory, it has discovered relationships which seem to be of the greatest interest and importance, but the reasons for them are as yet not at all understood.

It is possible, however, to go a certain distance towards a solution and to indicate some conditions which must be satisfied by the solution when it is found. For the energy $h\nu$ with which the electron is found by experiment to escape from the atom must have come either from the energy stored up inside the atom or else from the light. There is no third possibility.

[1] Address to the Section of Physics and Chemistry of the Franklin Institute, Philadelphia, on January 4, 1917, by Prof. R. A. Millikan, professor of physics in the University of Chicago. The substance of this lecture has since been incorporated into a book recently issued by the University of Chicago Press, entitled "The Electron." Continued from p. 237.

[2] Proc. Phys. Soc. of London, vol. xxvii. (December 15, 1914), p. 105.

[3] "Modern Electrical Theory" (Cambridge University Press, 1913), p. 248.

[4] J. J. Thomson, "Electricity and Matter," p. 9.

Now the fact that the energy of emission is the same, whether the body from which it is emitted is held within an inch of the source, where the light is very intense, or a mile away, where it is very weak, would seem to indicate that the light simply pulls a trigger in the atom, which itself furnishes all the energy with which the electron escapes, as was originally suggested by Lenard in 1902 (*Ann. d. Phys.* [4], vol. viii. [1902], p. 149), or else, if the light furnishes the energy, that light itself must consist of bundles of energy which keep together as they travel through space, as suggested in the Thomson-Einstein theory.

Yet the fact that the energy of emission is directly proportional to the frequency ν of the incident light spoils Lenard's form of trigger theory, since, if the atom furnishes the energy, it ought to make no difference what kind of wave-length pulls the trigger, while it ought to make a difference what kind of gun—that is, what kind of atom—is shot off. But both these expectations are the exact opposite of the observed facts. *The energy of the escaping corpuscle must come then, in some way or other, from the incident light.*

When, however, we attempt to compute on the basis of a spreading-wave theory how much energy a corpuscle can receive from a given source of light, we find it difficult to find anything more than a very minute fraction of the amount which the corpuscle actually acquires.

Thus, the total luminous energy falling per second from a standard candle on a square centimetre at a distance of 3 m. is 1 erg.[5] Hence the amount falling per second on a body of the size of an atom, *i.e.* of cross-section 10^{-15} cm., is 10^{-15} ergs, but the energy $h\nu$ with which a corpuscle is ejected by light of wave-length 500 $\mu\mu$ (millionths millimetre) is 4×10^{-12} ergs, or 4000 times as much. Since not a third of the incident energy is in wave-lengths shorter than 500 $\mu\mu$, a surface of sodium or lithium which is sensitive up to 500 $\mu\mu$ should require, even if all this energy were in one wave-length—which it is not—at least 12,000 seconds, or four hours, of illumination by a candle 3 m. away before any of its atoms could have received, all told, enough energy to discharge a corpuscle. Yet the corpuscle is observed to shoot out the instant the light is turned on. It is true that Lord Rayleigh has recently shown (*Phil. Mag.*, vol. xxxii. [1916], p. 188) that an atom may conceivably absorb wave-energy from a region of the order of magnitude of the square of a wave-length of the incident light rather than of the order of its own cross-section. This in no way weakens, however, the cogency of the type of argument just presented, for it is only necessary to apply the same sort of analysis to the case of γ rays, the wave-length of which is of the order of magnitude of an atomic diameter (10^{-8} cm.), and the difficulty is found still more pronounced. Thus Rutherford[6] estimates that the total γ-ray energy radiated per second by one gram of radium cannot possibly be more than $4{\cdot}7\times10^{4}$ ergs. Hence at a distance of 100 m., where the γ rays from a gram of radium would be easily detectable, the total γ-ray energy falling per second on a square millimetre of surface, the area of which is ten-thousand billion times greater than that either of an atom or of a disc the radius of which is a wave-length, would be $4{\cdot}7\times10^{4}\div4\pi\times10^{10}=4\times10^{-7}$ ergs. This is very close to the energy with which β rays are actually observed to be ejected by these γ rays, the velocity of ejection being about nine-tenths that of light. Although, then, it should take ten thousand billion seconds for the atom to gather in this much energy from the γ rays, on the basis of classical theory the β ray is observed to be ejected with this energy as soon as the radium is put in place. This shows that if we are going to abandon the Thomson-Einstein hypothesis of localised energy, which is, of course, competent to satisfy these energy relations, there is no alternative but to assume that at some previous time the corpuscle had absorbed and stored up from light of this or other wave-length enough energy so that it needed only a minute addition at the time of the experiment to be able to be ejected from the atom with the energy $h\nu$.

Now the corpuscle which is thus ejected by the light cannot possibly be one of the free corpuscles of the metal, for such a corpuscle, when set in motion within a metal, constitutes an electric current, and we know that such a current at once dissipates its energy into heat. In other words, a *free* corpuscle can have no mechanism for storing up energy and then *jerking* itself up "by its boot straps" until it has the huge speed of emission observed.

The ejected corpuscle must then have come *from the inside of the atom,* in which case it is necessary to assume, if the Thomson-Einstein theory is rejected, that within the atom there exists some mechanism which will permit a corpuscle continually to absorb and load itself up with energy of a given frequency until a value at least as large as $h\nu$ is reached. What sort of a mechanism this is we have at present no idea. Further, if the absorption is due to resonance—and we have as yet no other way in which to conceive it—it is difficult to see how there can be, in the atoms of a solid body, corpuscles having all kinds of natural frequencies so that some are always found to absorb and ultimately to be rejected by impressed light of any particular frequency. But apart from these difficulties, the thing itself is impossible if these absorbing corpuscles, when not exposed to radiation, are emitting any energy at all; for if they did so, they would in time lose all their store, and we should be able, by keeping bodies in the dark, to put them into a condition in which they should show no emission of corpuscles whatever until after hours, or years, of illumination with a given wave-length. Since this is contrary to experiment, we are forced, even when we discard the Thomson-Einstein theory of localised energy, to postulate electronic absorbers which, during the process of absorbing, do not radiate at all until the absorbed energy has reached a certain critical value when explosive emission occurs.

However, then, we may interpret the phenomenon of the emission of corpuscles under the influence of æther waves, whether upon the basis of the Thomson-Einstein assumption of bundles of localised energy travelling through the æther, or upon the basis of a peculiar property of the inside of an atom which enables it to absorb continuously incident energy and emit only explosively, *the observed characteristics of the effect seem to furnish proof that the emission of energy by an atom is a discontinuous or explosive process.* This was the fundamental assumption of Planck's so-called quantum theory of radiation. The Thomson-Einstein theory makes both the absorption and the emission sudden or explosive, while the loading theory, first suggested by Planck, though from another viewpoint, makes the absorption continuous and only the emission explosive.

The h determined above with not more than one-half of 1 per cent. of uncertainty is the explosive constant, *i.e.* it is the unchanging ratio between the energy of emission and the frequency of the incident light. It is a constant the existence of which was first discovered by Planck by an analysis of the facts of black-body radiation, though the physical assumptions underlying Planck's analysis do not seem to be tenable any longer. For the American physicists Duane and Hunt (*Phys. Rev.*, vol. vi. [1915], p. 166) and Hull (*ibid.*,

[5] Drude, "Lehrbuch der Optik" (1906), p. 472.
[6] "Radioactive Substances and their Radiations," p. 288.

vol. vii. [1916], p 157) have recently shown that the same quantity h appears in connection with the impact of corpuscles against any kind of target, the observation here being that the highest frequency in the general or white-light X-radiation emitted when corpuscles impinge upon a target is found by dividing the kinetic energy of the impinging corpuscle by h. Since exhibited in De Broglie's photographs here shown (Figs. 6 and 7).[7] It will be seen from these photographs that *the atoms of each particular substance transmit the general X-radiation up to a certain critical frequency and then absorb all radiations of higher frequency than this critical value.* The extraordinary significance of this discovery lies in the fact that it indicates that there is a type of absorption which is not due either to resonance or to free electrons. But these are the only types of absorption which are recognised in the structure of modern optics. We have as yet no way of conceiving of this new type of absorption in terms of a mechanical model.

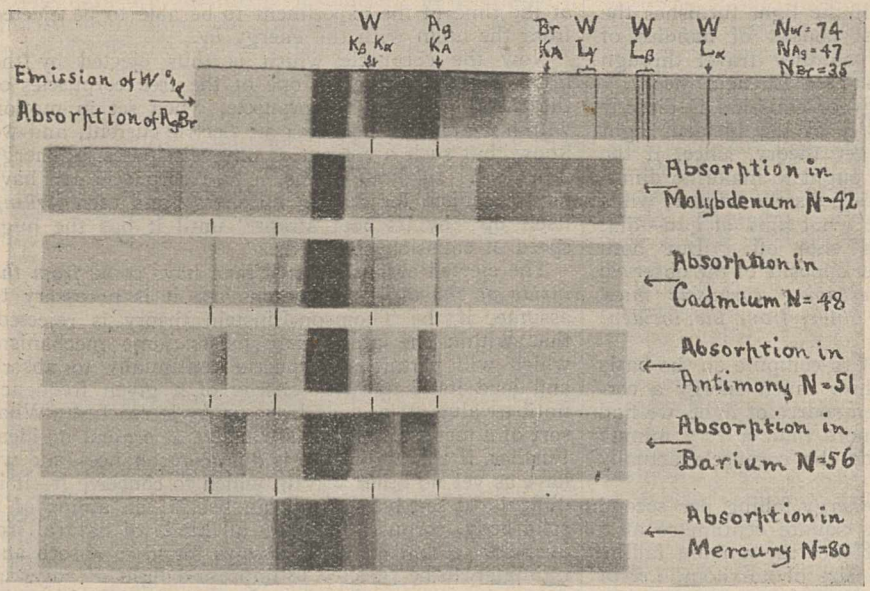

FIG. 6.—Absorption of certain substances in region of K-radiations.

There is one result, however, which seems to be definitely established by all this experimental work. Whether the radiation is produced by the stopping of a free electron as in Duane and Hunt's experiment, and presumably also in black-body experiments, or by the absorption and re-emission of energy by bound electrons, as in photo-electric and spectroscopic work, Planck's h seems to be always tied up in some way with the emission and absorption of energy by the electron. *h may, therefore, be considered as one of the properties of the electron.*

The new facts in the field of radiation which have been discovered through the study of the properties of the electron seem, then, to require in any case a fundamental revision or extension of classical theories of absorption and emission of radiant energy. The black-body radiation is presumably due to the impact of the *free* corpuscles within a metal upon the atoms, it is probable that the appearance of h in black-body radiation and in general X-radiation is due to the same cause, so that, contrary to Planck's assumption, there need not be, in either of these cases, any coincidence between natural and impressed periods at all. The $h\nu$ which here appears is not a characteristic of the atom, but merely a property of the æther pulse which is generated by the stopping of a moving electron. Why this æther pulse should be resolvable into a continuous or white-light spectrum, which, however, has the peculiar property of being chopped off sharply at a particular limiting frequency given by $h\nu = \mathrm{PD} \times e$ is thus far a complete mystery. All that we can say is that experiment seems to demand a sufficient modification of the æther-pulse theory of white-light and of general X-radiation to take this experimental fact into account.

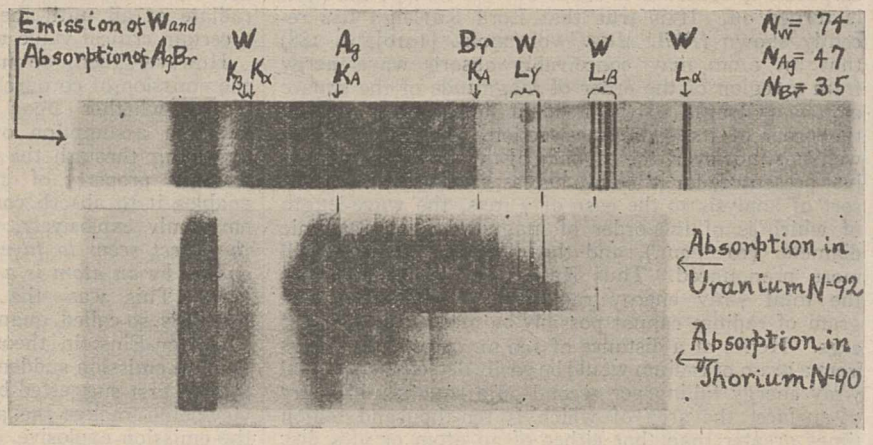

FIG. 7.—Absorption of uranium and thorium in region of L-radiations.

On the other hand, the appearance of h in connection with the absorption and emission of *monochromatic* light (photo-electric effect and Bohr atom) seems to demand some hitherto unknown type of absorbing and emitting mechanism within the atom. This demand is strikingly emphasised by the remarkable absorbing property of matter for X-rays discovered by Barkla (*Phil. Mag.*, vol. xvii. [1909], p. 749) and beautifully Thomson-Einstein theory throws the whole burden of accounting for the new facts upon the unknown nature of the æther and makes radical assumptions about its structure. The loading theory leaves the æther as it

[7] These photographs will be found also in the August, 1917, number of the *Physical Review* (see presidential address of the president of the Physical Society).

was and puts the burden of an explanation upon the unknown conditions and laws which exist inside the atom. I have already given reasons for discrediting the first type of theory. The second type, though as yet very incomplete, seems to me to be the only possible one, and it has already met with some notable successes, as in the case of the Bohr atom. Yet the theory is at present woefully incomplete and hazy. About all that we can say now is that we seem to be driven by newly discovered relations in the field of radiation either to the Thomson-Einstein semi-corpuscular theory, or else to a theory which is equally subversive of the established order of things in physics. For either one of these alternatives brings us to a revolutionary quantum theory of radiation—that is, a theory which calls for an explosive emission of energy in units and has therefore something akin to atomism about it. To be living in a period which faces such a complete reconstruction of our notions as to the way in which æther waves are absorbed and emitted by matter is an inspiring prospect. The atomic and electronic worlds have revealed themselves with beautiful definiteness and wonderful consistency to the eye of the modern physicist, but their relation to the world of æther waves is still to him a profound mystery for which the coming generation has the incomparable opportunity of finding a solution.

GEOLOGICAL STRUCTURE IN RELATION TO MAGNETIC DISTURBANCE.

A LECTURE on the relationship between geological structure and magnetic disturbance, with especial reference to Leicestershire and the concealed coalfield of Nottinghamshire, was delivered before the Geological Society on May 1 by Dr. A. Hubert Cox.

Before the lecture, at the request of the president, Dr. A. Strahan, director of the Geological Survey, briefly outlined the circumstances that had led to an investigation into a possible connection between geological structure and magnetic disturbances. The magnetic surveys conducted by Rücker and Thorpe in 1886 and 1891 had proved the existence of certain lines and centres of disturbance, but those authors observed that "the magnetic indications appear to be quite independent of the disposition of the newer strata," and Dr. Strahan had not been able to detect any obvious connection with the form and structure of the Palæozoic rocks below. In 1914–15 a new magnetic survey was made by Mr. G. W. Walker, who confirmed the existence of certain areas of disturbance. It was suggested that the effects might be due to concealed masses of iron ore, and the matter was referred to the Conjoint Board of Scientific Societies, which appointed an Iron Ores Committee to consider what further steps should be taken. The committee recommended that attention should be concentrated on certain areas of marked magnetic disturbance, and that a more detailed magnetic survey of these areas, accompanied by a petrological survey and an examination of the magnetic properties of the rocks of the neighbourhood, should be made. Dr. Strahan had been approached with a view to the petrological work being undertaken by the Geological Survey, and it had been arranged by the Board of Education, with the consent of H.M. Treasury, that a geologist should be temporarily appointed as a member of the staff for the purposes of the investigation. Dr. Cox had received the appointment, and his lecture would show that results of great significance had been obtained by him. The new magnetic observations had been made by Mr. Walker, and the examination of the specimens collected, in regard to their magnetic susceptibility, had been conducted by Prof. Ernest Wilson.

Dr. Cox then described the selected areas, which lay on Lias and Keuper Marl between Melton Mowbray and Nottingham, and in the neighbourhood of Irthlingborough, where the Northampton Sands are being worked as iron ores. The Middle Lias iron ores, consisting essentially of limonite, which crop out near Melton Mowbray, have been proved incapable, by reason of their low magnetic susceptibility, of causing disturbances of the magnitudes observed, while the distribution of the disturbances showed no correspondence with the outcrop of the iron ores. Nor was any other formation among the Secondary rocks found capable of exerting any appreciable influence. It appeared, therefore, that the origin of the magnetic disturbances must be deep-seated.

Investigation showed that the disturbances were arranged along the lines of a system of faults ranging in direction from north-west to nearly west. The faults near Melton Mowbray have not been proved in the Palæozoic rocks, and, so far as their effects on the Secondary rocks are concerned, they would appear to be only minor dislocations. But farther north, near Nottingham, faults which take a parallel course, and probably belong to the same system of faulting as those near Melton Mowbray, are known from evidence obtained in underground workings to have a much greater throw in the Coal Measures than in the Permian and Triassic rocks at the surface. It appears, therefore, that movement took place along the same lines at more than one period, the earlier and more powerful movement being of post-Carboniferous but pre-Permian age, the later movement being post-Triassic. Accordingly, it is probable that the small dislocations in the Mesozoic rocks indicate the presence of important faults in the underlying Palæozoic.

The faults can give rise to magnetic disturbances only if they are associated with rocks of high magnetic susceptibility. It is known from deep borings that the concealed coalfield of Nottinghamshire extends into Leicestershire, but how far is not known. Deep borings have proved that intrusions of dolerite occur in the Coal Measures at several localities in the south-eastern portion of the concealed coalfield, and always, so far as observed, in the immediate vicinity of faults. It has been established that dolerites may exert a considerable magnetic effect; and the susceptibility of those that occur in the Coal Measures is above the general average. Further, no other rocks that are known to occur, or are likely to occur under the area, have susceptibilities so high as the dolerites found in the Coal Measures. These facts suggest the possibility of the occurrence of dolerites intrusive into Coal Measures beneath the Mesozoic rocks of the Melton Mowbray district.

The distribution of the dolerites actually proved, and of those the presence of which is suspected by reason of the magnetic disturbances, appears to be controlled by the faulting. Moreover, whereas the character of the magnetic disturbances is such that it would not be explained by a sill or laccolite faulted down to the north, in the manner demanded by the observed throw of the principal fault, it would be explained by an intrusion that had arisen along the fault-plane. The faulting itself is connected with a change of strike in the concealed Coal Measures, and the incoming of doleritic intrusions in the concealed coalfield, in contrast with their absence from the exposed coalfield, appears to depend upon the changed tectonic features. The change of strike is apparent, but to a less degree, in the Mesozoic rocks, which, in the neighbourhood of Melton Mowbray, have suffered

a local twist due to the development of an east-and-west anticlinal structure.

In view of the evidence that later movements have, in this district, followed the lines of earlier and more powerful movements, it appears possible, and even probable, that this post-Jurassic (probably post-Cretaceous) anticline is situated along the line of a more pronounced post-Carboniferous but pre-Permian anticline. In this connection the isolated position of Charnwood Forest has a considerable significance. The forest is situated on the prolongation of the east-and-west line of uplift, and just at the point where this uplift crosses the line of the more powerful north-westerly and south-easterly (Charnian) uplift. Where the two lines of uplift cross, the elevation attains its maximum, and the oldest rocks appear.

The main line of faulting and of magnetic disturbance is parallel with and on the northern side of the east-and-west anticline, and the faulting is of such a nature that it serves to relieve the folding while accentuating the anticlinal structure. It is possible that this belt of magnetic and geological disturbance marks the southern limit of the concealed coalfield. The results obtained by joint magnetic and geological work have thus served to emphasise the real importance of a structure which, when judged merely from its effects on the surface-rocks, appears to be of only minor importance.

A further series of observations was carried out on the Jurassic iron ores of the Irthlingborough district of Northamptonshire. The ores occur in the form of a nearly horizontal sheet of weakly susceptible ferrous carbonate partly oxidised to hydrated oxides. They give rise to small magnetic disturbances which are quite capable of detection, and these may be of use in determining the boundaries of the sheets in areas not affected by larger disturbances of deep-seated origin.

The results obtained by the joint magnetic and geological work in the two areas show that this method of investigation may be used to extend our knowledge of the underground structure. It appears also that an extension of the method to other parts of the country would yield information of considerable scientific and economic importance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The University has gratefully accepted a gift by Mr. W Denison Roebuck of a unique collection of microscopic slides and a library of books upon the subject of fresh-water Algæ, as the nucleus of a specialist library and collection of Algæ in general. These were the property of Mr. W. B. Turner, who died twelve months ago, and who, since his coming to Leeds in 1877, had been one of the most active scientific workers in the city until laid aside by a serious illness. The value of the gift is enhanced by the fact that many of the books are illustrated by coloured drawings done by Mr. Turner himself, he having been a talented natural history draughtsman. The collections will be known as the "Barwell Turner Memorial," and will be available for the use of students of algological science.

OXFORD.—The annual Halley lecture was delivered on May 28 by Sir Napier Shaw, director of the Meteorological Office. The subject was "The First Chapter in the Story of the Winds." The lecture, which was illustrated by lantern-slides, dealt with Halley as the first framer of a physical explanation of trade winds and monsoons. His views still in part hold good, but the phenomena are more complicated than Halley thought. Contrary to what was once surmised, observation has shown that the horizontal circulation of the air is explicable, the vertical circulation being at present too complex for exact determination, though progress may be hoped for in this direction.

The report for the past year of the visitors of the University Observatory mentions the appointment of Miss Bellamy to assist in the provisional seismological service undertaken by Prof. H. H. Turner on the death of Prof. Milne. Dr. J. K. Fotheringham has received a temporary appointment in connection with his work in the region where astronomy and chronology overlap. Lectures have been delivered by Prof. Turner to military audiences, including some in France, and also others of a popular character. Vol. iii. of the Vatican Zones has been printed and distributed. The work for other of the Vatican Zones has been partly completed, and some Santiago plates have been dealt with, with the aid of a grant from the Royal Society. The counts of stars for the Astrographic Catalogue and the analysis of weather statistics have been continued.

On May 28 the preamble of a statute establishing a definite school of agriculture and forestry was laid before Congregation by the Warden of All Souls'. The statute was supported by Profs. Somerville, Sir W. Schlich, Bourne, and Spenser Wilkinson, and by the Warden of Wadham. It was opposed by Mr. Walker, fellow of Queen's, and on a division the preamble was carried by 53 to 11.

The Romanes lecture will be given by the Right Hon. H. H. Asquith, M.P., on Saturday, June 8, at 3.30 p.m., in the Sheldonian Theatre, on "Some Aspects of the Victorian Age."

THE appointment to the George Henry Lewes studentship for research in physiology at Cambridge University will shortly be made. The studentship is of the annual value of 200*l*., and is open to women. Applications should be made by June 20 to Prof. Langley, Physiology School, Cambridge.

THE Toronto correspondent of the *Times* reports that a movement has been begun at Winnipeg by Sir J. A. Maikins, Lieutenant-Governor of Manitoba, Archbishop Matheson, Primate of All Canada, Sir Augustus Nanton, Prof. W. F. Osborne, of Manitoba University, and others for a conference at which prominent educationists of Canada, Great Britain, and the United States will discuss the best methods to promote ideals of national citizenship and character. The correspondent states that the conference is expected to result in the formation of an unofficial permanent National Board of Education, which will act as a clearing-house for educational ideals and an advisory body for the direction of new methods in education. One particular object of the movement is to improve text-books.

THE meeting of the Physical Society to be held on Friday, June 14, at the Imperial College of Science, will be devoted to a discussion on "The Teaching of Physics in Schools," to be introduced by Sir Oliver Lodge. Contributions to the discussion are expected from Mr. C. E. Ashford, headmaster, R.N. College, Dartmouth; Dr. T. J. Baker, King Edward's High School, Birmingham; Mr. C. L. Bryant, Harrow School; Mr. G. F. Daniell, Educational Department, London County Council; Prof. R. A. Gregory, chairman of the British Association Committee on Science in Secondary Schools; Mr. J. Nicol, Northern Polytechnic, Holloway; Prof. T. P. Nunn, London Day Training College; Mr. F. W. Sanderson, headmaster, Oundle School; Mr. A. T. Simmons, Inspector of Secondary Schools, University of London; Mr. E. Smith, Leyton Secondary School; and Prof. F. Womack, Bedford College. Visitors are invited to attend this meeting of the society.

SOCIETIES AND ACADEMIES.

LONDON.

Optical Society, May 9.—Mr. S. D. Chalmers in the chair.—T. Y. **Baker** and Major L. N. G. **Filon**: Spherical aberration. The authors had considered the subject from the point of view of an optical design for a system of co-axial thin lenses (separated by air) in which the focal lengths and separations of lenses are determined from general consideration of the functions that the instrument has to perform, and from the necessity for correcting for colour. A design carried out in this manner leaves available for the correction of spherical aberration the *forms* of the various lenses. For a thin lens of definite focal length made of a definite variety of glass the difference of curvature of the two faces of the lens is fixed, but the mean of these two curvatures is arbitrary. When aberrations of the second order have to be included, the semi-cubical parabola is no longer a sufficiently close approximation to the caustic, which, in general, develops two new cusps off the axis. The general appearance of such a caustic was examined, as well as the possibility of deriving the two parameters from trigonometrically calculated rays. The authors urged that the full import of the higher-order aberrations could best be understood by an actual construction of the caustic in the several media, from which the trained optical calculator would be able to tell from the shapes of the successive curves how the aberrations of different orders would affect the final image formation, and also to form an idea as to which lenses were having most serious effect, and how changes in the forms of the lenses would enable him to diminish the spherical aberration of the final image.

PARIS.

Academy of Sciences, May 13.—M. Léon Guignard in the chair.—G. **Humbert**: The indefinite quadratic forms of Hermite.—J. **Boussinesq**: Further studies on the rupture of a sandy *terre-plein*.—H. **Le Chatelier** and B. **Bogitch**: The action of oxide of iron on silica. An experimental study of the penetration of silica bricks by oxide of iron. The iron penetrates more easily in a reducing atmosphere, the portions reached by the iron oxide contain less lime than the original brick, whereas the part of the brick not attacked by the iron oxide contains more lime than originally, the lime being expelled by the ferrous silicate and driven into the upper part of the brick. Four reproductions of photomicrographs are given, showing the condition of various zones of silica brick impregnated by oxide of iron.—G. **Julia**: Limiting values of Poisson's integral relating to the sphere and a point of discontinuity of the data.—E. **Belot**: The *rôle* of the forces dominating the attraction in the architecture of the earth and other worlds. Mechanical model of the formation of the solar system.—M. **Bied**: The function of the oxide of iron and lime employed as agglomerants in the manufacture of silica bricks. In studying the effect of different agglomerating materials in the manufacture of silica bricks an unexpected fact was elicited that appreciable quantities of oxide of iron, even in the presence of lime, do not appreciably lower the melting point of the brick. Further experiments on this question are now given in confirmation. In one case the addition of 3 per cent. of oxide of iron and 1 per cent. of lime lowered the fusion point only by 5° C., an amount not exceeding the experimental error.—E. **Rengade**: The composition of silica bricks taken from a Martin furnace.—Ed. **Chauvenet** and Mlle. L. **Nicolle**: The neutral zirconyl nitrate. There is no evidence of the existence of anhydrous or hydrated neutral zirconium nitrate. The hydrated zirconyl nitrate, $ZrO(NO_3)_2,2H_2O$, can be obtained as a crystalline product, but the anhydrous zirconyl nitrate could not be prepared from this.—M. **de Chardonnet**: Treatment of the wash waters in the manufacture of artificial silk. There are about 4 cubic metres of washing water (containing sulphuric and nitric acids, lime, and sulphur) per kilogram of silk produced, and it is necessary to neutralise this liquid before it can be run into drains or rivers. An arrangement is described for neutralisation with lime and removal of the precipitated sulphur. The liquors after neutralisation have marked manurial properties.—M. M. **Yélénko**: Results of studies on the earthquake of August and September, 1912, on the Sea of Marmora.—C. **Sauvageau**: The plantules of *Phyllaria reniformis*.—E. **Voisenet**: Is the Adamkiewicz reaction due to glyoxylic acid or to formaldehyde? Hopkins and Cole showed that the use of acetic acid in the Adamkiewicz reaction introduced a substance necessary to the production of the violet colour, and considered this to be glyoxylic acid. They considered the possibility of formaldehyde as the necessary reagent and rejected it. The author takes the opposite view, and regards formaldehyde, and not glyoxylic acid, as the essential reagent.

CALCUTTA.

Asiatic Society of Bengal, April 3.—Dr. T. **Kaburaki**: Zoological results of a tour in the Far East. Brackish-water Polyclads. The Polyclads described in this paper were obtained in brackish water in the north-eastern part of the Malay Peninsula. They belong to the genus Shelfordia, which has hitherto been known only from Borneo. It is the only genus of Polyclads that has been found in fresh water. Two new species are described.—Dr. N. **Annandale**: Zoological results of a tour in the Far East. Mollusca of the Tai-Hu. The Tai-Hu is a large, shallow body of fresh water occupying a depression in the alluvium of the Yangtse delta. Seventeen species of molluscs, of which three (all belonging to the family Hydrobiidæ) are now described as new, are recorded from it. One of the new forms belongs to the genus Hypsobia, Heude (which has recently been re-described by Robson under the name Katayama), another to Stenothyra, Benson, and a third to a remarkable new genus hitherto apparently confused with Vivipara, though actually belonging to a different family. The Tai-Hu molluscan fauna as a whole is remarkable for the small size of the individual and for the existence of an estuarine element in its composition.—Dr. N. **Annandale**: Zoological results of a tour in the Far East. Sponges. (1) Two marine sponges (*Reniera implexa* and a new variety of *Amorphinopsis excavans*) were found on the piers of a landing-stage some distance up a creek on the coast of Perak. They lived in very muddy water, and were exposed daily at the fall of the tide. The structural peculiarities which enabled them to exist in these conditions are discussed in detail. (2) Specimens of fresh-water sponges collected in Japan, China, and the Malay Peninsula are discussed and described. They include new species of Spongilla and Trochospongilla.—Capt. F. **de Mello** and Dr. J. F. St. A. **Fernandes**: Révision des champignons appartenant au genre Nocardia. In this paper the authors give a synoptical account of the numerous species of parasitic fungi belonging to the genus Nocardia. Our knowledge of these forms is at present in an extremely chaotic state, and the authors have attempted to introduce order and precision into the classification.—C. **Fischer**: Preliminary note on the flora of the Anaimalais. (i) General description of the tract; (ii) faunistic notes; (iii) jungle tribes and their cultivations; (iv) division of the vegetation into five

types, description and characteristic species; (v) general conclusions and synopsis.—A. **McKerral**: The Burmese sesamum varieties. Notes on their variation and growth. After discussing the literature dealing with this crop and the importance of sesamum to Burmese agriculture, the author proceeds to describe the different varieties grown in Burma and their variations, using as a basis material collected from the principal sesamum districts and grown at the Talkon Agricultural Station. The description is followed by a tentative classification of the Burmese sesamums based on the branching habit, vegetative period, and colour of the seed, and by a discussion of the abnormalities which occur. In conclusion, the author discusses the possibilities of improvement, especially through single-plant selection.

VICTORIA.

Royal Society, March 14.—Mr. J. A. Kershaw, president, in the chair.—Prof. O. **Nordstedt**: Australasian Characeæ. This synopsis includes about fifty species of Chara and Nitella, one of Talypella, and one of Lychnothamnus, and was communicated by A. D. Hardy, who incidentally remarked on the overproduction and subsequent decay of the species of Nitella in some Victorian reservoirs.—A. D. **Hardy**: Note on pentamery in Narcissus. The author described an inflorescence of "Soleil d'Or" (*N. tazetta*) in which five flowers were normal, the sixth having the floral formula of $K_5 C_5 A_5+_5 G_5$. Careful search amongst many thousands of flowers of this species during the season failed to discover a similar specimen. The only other case of a similar kind known to the author was that of Crocus ($K_5 C_5 A_5 G_5$), quoted by Worsdell in "Principles of Plant Teratology."

BOOKS RECEIVED.

The Invertebrate Fauna of Nottinghamshire. By Prof. J. W. Carr. Pp. viii+618. (Nottingham: J. and H. Bell, Ltd.)

Manuale di Fisica ad uso delle Scuole Secondaire e Superiori. By Prof. B. Dessau. Vol. iii. Pp. vii+760. (Milano: Società Editrice Libraria). 23 lire.

A Handbook of Briquetting. By Prof. G. Franke. Translated by F. C. A. H. Lantsberry. Vol. ii. Pp. xi+214. (London: C. Griffin and Co., Ltd.) 15*s*. net.

"Inasmuch": Some Thoughts concerning the Wreckage of the War. By J. Oxenham. Pp. 26. (London: Methuen and Co., Ltd.) 6*d*. net.

Aids in the Commercial Analysis of Oils, Fats, and their Commercial Products. By G. F. Pickering. Pp. viii+133. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*. net.

Tropical Wild Life in British Guiana: Zoological Contributions from the Tropical Research Station of the New York Zoological Society. By W. Beebe. Vol. i. Pp. 504. (New York: Zoological Society; London: Witherby and Co.) 12*s*. 6*d*. net.

Practical Organic and Bio-Chemistry. By R. H. A. Plimmer. New edition. Pp. xii+636. (London: Longmans and Co.) 18*s*. net.

Tychonis Brahe Opera Omnia. Tomi Quarti. Fasc. Prior. Pp. 376. (København K.)

The Problem of Man's Ancestry. By Prof. F. Wood-Jones. Pp. 48. (London: S.P.C.K.) 7*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 30.

ROYAL SOCIETY, at 4.30.—A Method of Avoiding Collision at Sea: Prof. J. Joly.—A Statistical Survey of Colour Vision: Dr. R. A. Houstoun.—The Production of Anthocyanins and Anthocyanidins. III.: Dr. A. E. Everest.

ROYAL INSTITUTION, at 3.—The Abode of Snow; its Appearance, Inhabitants, and History: Sir F. Younghusband.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

ROYAL SOCIETY OF ARTS, at 4.30.—The Cotton-mill Industry of India: Hon. Sir Dinshaw E. Wacha.

SATURDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—Problems in Bird-migration: Prof. C. J. Patten.

MONDAY, JUNE 3.

ROYAL GEOGRAPHICAL SOCIETY, at 5.

SOCIETY OF CHEMICAL INDUSTRY, at 7.30.—A Cadmium-vapour Arc Lamp: Dr. H. J. S. Sand.—The Estimation of Tin in High-grade Wolfram Ores and the Use of Lead as a Reducing Agent in Pearce's Assay: A. R. Powell.

VICTORIA INSTITUTE, at 4.30.—Germanism: Rev. Chancellor Lias.

WEDNESDAY, JUNE 5.

GEOLOGICAL SOCIETY, at 5.30.

ENTOMOLOGICAL SOCIETY, at 8.—Studies in Rhynchophora. IV. A Preliminary Note on the Male Genitalia: D. Sharp.

SOCIETY OF PUBLIC ANALYSTS, at 5.—A Method for the Colorimetric Estimation of Cobalt: E. G. Jones.—Nucleic Acid and its Analytical Examination: A. C. Chapman.—(1) Opium Wax. (2) Estimation of Morphine in Opium by Polarimeter: Jitendra Nath Rakshit.—The Application of the Valenta Turbidity Test to Mineral Oils: P. J. Fryer.—The Valenta and Crismer Tests: J. H. Johnston and Dr. A. W. Stewart.—A New Method of Identifying Starches: A. W. Blyth.—Two Plant Products from Colombia, S.A.: A. L. Bacharach.

THURSDAY, JUNE 6.

ROYAL INSTITUTION, at 3.—The Abode of Snow; Its Appearance, Inhabitants, and History: Sir F. Younghusband.

LINNEAN SOCIETY, at 4.30.—A Revision of Some Critical Species of Echium [Viper's Bugloss], as Exemplified in the Linnean and other Herbaria, with a Description of *Echium judaicum*, a New Species from Palestine: C. C. Lacaita.—Experiments with Cyclamen: Capt. A. W. Hill.—The Relationship between the Symbionts in a Lichen: R. Paulson and S. Hastings.—Abnormal Apple-blossoms and Fruit: W. C. Worsdell.

FRIDAY, JUNE 7.

ROYAL INSTITUTION, at 5.30.—The Romance of Petroleum: Sir B. Redwood.

SATURDAY, JUNE 8.

ROYAL INSTITUTION, at 3.—Problems in Bird-migration: Prof. C. J. Patten.

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MACMILLAN AND CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.