THURSDAY, MARCH 24, 1910.

MUSIC.

Music: its Laws and Evolution. By Prof. Jules Combarieu. International Scientific Series. Pp. viii+334. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1910.) Price 5*s*.

THIS important work could only have been written by a musician who was acquainted with the history of music, and also had a considerable knowledge of sciences connected with music, such as mathematics, physics in relation to acoustics, physiology, psychology, and æsthetics. Almost every page shows the versatility of Prof. Combarieu in dealing with the various aspects of the subject, while his power of lucid description is conspicuous. There is also the graceful beauty of style peculiar to a Frenchman, and it has lost little or nothing in translation. The fundamental thesis of the book is that music is the art of thinking in sounds. According to the author, we can never hope to have an adequate conception of music unless we realise that it is a kind of intellectual activity associated with emotional states, but without those concepts that are the material of ordinary intellectual action. The study of acoustics, the study of sensations of tone, as was so fully carried out by Helmholtz in his first work, "Tonempfindungen," the study even of scales and major modes, are only to be regarded as contributions to a fuller understanding of music, although not a few writers, in dealing with these aspects of the subject, have deluded themselves with the notion that in so doing they were explaining the true nature of music. All this may be readily granted; but in justice to the physiologist and psychologist, on whom Prof. Combarieu now and then comes down heavily, almost with scorn ill-concealed, it must be contended that the foundation of music does consist of sensations, varying in kind and quality. The composer thinks in sounds which are related to each other according to laws well known to the composer, and which he often transgresses, and the master musical mind has a kind of instinct that perceives more deeply the hidden meanings of the phenomena of the cosmos and the still more ill-defined region of human thought and feeling.

Prof. Combarieu develops these ideas in a remarkable order. Instead of beginning with what is comparatively simple, the nature of vibrations, the mathematical basis of scales, &c., and the functions of the ear and brain in relation to sensations of tone, and then working onwards to the compositions of such men as Bach, Handel, and Wagner, he proceeds in the reverse order. First, he analyses a melody, showing how much there is in it that cannot be expressed in words, such as sensations of mere pleasure, the expression of emotional states, and the arousing of sentiments, and even trains of thought and of reminiscence, in the mind, and he arrives at the conclusion that music is, as it were, the dynamics of emotional life. He traces the evolution of music, the simple melody, the canon originating in religious feeling, the discovery of counterpoint, the use of rhythm as connected with bodily muscular movements, and the early relation of music to magic. Next he examines the development of music as an expression of the gradually increasing complexity of social life, in this way accounting for the origin of octaves, fifths, thirds, and other intervals, and the development of the major and minor modes. Muscular work requiring cooperation among many individuals taught men rhythm and musical time, and, by slow degrees, the various modes of the Greeks, Lydians, Phrygians, &c., reflected the social life and habits of the Greeks. A confluence of these minor modes has resulted in the minor mode of the present day. In modern music there is a fresher and greater use of the minor mode and of chromatic intervals, and there is less satisfaction merely with consonance, a development quite in keeping with the anarchical state of thought and feeling characteristic of the present day. The development of the orchestra from primitive instruments is one of the most remarkable phenomena in the evolution of music, and modern composers now strive to write something appropriate for each instrument.

Prof. Combarieu makes some excellent observations on Darwin's well-known opinions on the sexual relations of music. It is in most instances the language of love, but a sexual theory will not account for all music. The chapter on the physiology of music is the least satisfactory in this valuable book. We do not think the author does justice to the work of Helmholtz, probably because he fails to grasp the theory of the cochlea and its difficulties. We cannot follow him in his notion that, in some way or other, the cochlea can, in a reflex way, adapt itself to different combinations of tones. Here he merges into metaphysical discussions that are beside the question. The last chapter or section on music and living beings is rather fanciful in describing analogies between well-known physiological phenomena and music. The illustrations he gives are analogies and nothing more.

Prof. Combarieu's book is very suggestive. He takes a noble view of music, an art which does not seem even yet to have reached its climax. Great as are the works of Bach, Handel, Verdi, and Wagner, each reflecting in a subtle way their individual genius, moulded by the circumstances in which they lived and the influences that conspired to make them great musicians, there may yet be in store for the human race even greater works, which, in their turn, will reflect the more complex conditions of civilisation, in even higher planes of non-conceptual thought, and in deeper knowledge and feeling. One may also suppose that in this further evolution the organs of music, the ear and the brain, will become more complicated. The evolutionary process has not ended.

JOHN G. M'KENDRICK.

HYGIENE OF THE NERVOUS SYSTEM.

Why Worry? By Dr. G. L. Walton. Pp. 275. (London: W. Heinemann, 1909.) Price 2*s*. 6*d*. net.

Self-Help for Nervous Women: Familiar Talks of Economy in Nervous Expenditure. By Dr. J. K. Mitchell. Pp. 202. (London: W. Heinemann, 1909.) Price 2*s*. 6*d*. net.

MUCH that a few generations ago it was usual to attribute to disorder of conduct is, by many, now placed in the category of functional nervous disturbance, and concomitantly it has been sought to relieve judicial and ecclesiastical officers of their duties and to devolve them upon the medical profession. In the two small books under review we find, expressed in popular language, that which amounts to a series of short sermons written by medical men, and for the most part addressed to those who are suffering from the effects of a lack of self-control. For one of our authors it is "not his aim to transform the busy man into a philosopher of the indolent and contemplative type," but to enable him to do his work effectively by eliminating undue solicitude. The other defends himself from the possible criticism that his advice is not new. We cannot suppose any such defence will be necessary. The advice proffered is that of Epictetus, Marcus Aurelius, and Seneca, but stops short, we may presume out of respect for the attitude of current science towards current religion, at the plane of these philosophers.

Dr. Mitchell points out how some of the conspicuous and peculiar virtues of women may become sources of trouble. Strong affections and sympathy are apt to lead to emotional excess, and such excess, whether spent in grief, love, hate, or ambition, is the most extravagant form of nervous expenditure, and may eventuate in bankruptcy. A very frequently predisposing cause of nervousness is the too ready yielding to emotional expression, along with the cultivation of an excessive manifestation of emotion in speech and manner. Many women account it an attraction to give way to tears for trifling pains, or to loud complaints expressed in exaggerated language about small annoyances, and it is pointed out to these that to endure the smaller inevitable woes with equanimity is to form a habit which shall be of immense service when the larger troubles arise.

Much useful advice is given upon those physical causes which tend to develop nervous manifestations, or to exaggerate them when they are already present. On one hand there is a large number of persons who attribute many trifling derangements of various organs to their "nerves," and, on the other hand, there are others who fail to recognise their disorders as being nervous in origin until severe mental symptoms arise, and each class will find the information which may be gathered from these books of great help. Due attention, neither too prolonged nor too scanty, to the hygiene of the nervous system will in the future doubtless go as far as prophylactic hygiene has already gone in connection with the other systems, and it must be recognised that the education of the child is in this connection of paramount importance. Something between Spartan severity and the opposite extreme, to which there seems to be a serious danger of our passing, is the educational goal to which we should press, to the development of that degree of self-control which shall avert the nervous weakness which issues in each petty emotion usurping entire control over the body.

For those who are "nervously" disposed we can ask for no better advice than that given in the small volumes before us, and we should certainly feel assured that those who would read the books and would endeavour to act upon the suggestions therein contained were well on the road to recovery. Unfortunately, there is an enormous residue of patients who will listen to no advice, though they pay a man to give it them, and yet another class which, while recognising the advice given to be sound, seems wholly incapable of the amount of self-help requisite to acting upon it.

MYCOLOGICAL WORKS.

(1) *Researches on Fungi.* By Prof. A. H. Reginald Buller. Pp. xi+287. (London: Longmans, Green and Co., 1909.) Price 12*s*. 6*d*. net.

(2) *Die Würzelpilze der Orchideen, ihre Kultur und ihr Leben in der Pflanze.* By Dr. Hans Burgeff. Pp. iv+220; 3 plates, and 38 figs. in text. (Jena: Gustav Fischer, 1909.) Price 6.50 marks.

(3) *Fungi and How to Know Them: an Introduction to Field Mycology.* By E. W. Swanton. Pp. xi+210. (London: Methuen and Co., 1909.) Price 6*s*. net.

(1) DR. BULLER'S investigations, undertaken with the object of throwing light upon the production, liberation, and dispersion of spores in the group of fungi known as the Hymenomycetes, breaks new ground, and, as usual in such instances, will undoubtedly form the starting point of future research on the part of many students. A brief sketch of the components of a typical hymenium or spore-bearing surface are first dealt with. It is pointed out that swollen gill-margins serve to separate the gills, otherwise the spores could not be shed. This may be true in those instances where thickened gill edges exist, but in at least seventy-five per cent. of known agarics the edge of the gills is not in the least thickened.

Under nuclear phenomena it is pointed out that the passage of the nucleus from the basidium through the very narrow sterigma into the spore affords striking evidence of protoplasmic plasticity. This point has been previously emphasised by Wager. The classification of the Agaricineæ according to spore colour is dubbed as a purely artificial arrangement, but no valid reason for this statement is forthcoming. The author does not appear to realise that what the systematist understands by black spores are spores thrown down in the mass; no spores are black, even under the microscope, but they may be opaque, and consequently appear to be black.

In a work devoted to research it is generally assumed that the author is conversant with what has been done previously on the same subject; this, however, does not hold good in the present instance; for example, the occasional sterility of the gills, which consequently remain colourless in species normally producing coloured spores, has already been discussed in more than one text-book, and the conclusion arrived at is identical with that advanced by Dr. Buller. Cystidia are included in the category of hair formations. Probably the definitions as to the origin of hairs are various, but certainly true cystidia—not to be confounded with swollen marginal cells—originate from deep-seated cells.

Coming to the crucial point of research, the liberation of spores, it is at once obvious that the author attempts generalisations on too narrow a basis, as proved by the following quotation :—

"Excepting a few gelatinous species which require further investigation, it is a general rule that in Hymenomycetes the hymenium is situated on the under side of the fruit bodies."

He has ignored, or does not realise, the existence of many hundreds of species included in the Hymenomycetes where the hymenium is on the upper surface of the sporophore, and pointing upwards, as in Corticium, many species of Stereum, Hymenochæte, Poria, &c., yet such species are as numerous and cosmopolitan in distribution as the species with which he is acquainted.

In the Agaricineæ and the Polyporeæ it is considered that the position of the hymenium on the under-surface of the sporophore has been primarily decided as affording the greatest facility for spore dispersion. The spores are very adhesive when fresh, hence to secure successful liberation the gills or tubes must occupy a vertical position, which is secured by the rigidity of the sporophore. Gravity is the principal orienting stimulus acting on the sporophore. The spores on a basidium are discharged successively; each spore is shot out violently to a distance of about $\frac{1}{10}$ mm., and afterwards falls vertically downwards. The horizontal projection of the spores necessitates that gills should be placed at a certain distance apart. The process of spore liberation is treated in detail. Some very ingenious and interesting observations on the rate of fall of spores are furnished, which, subject to modification owing to their size, specific gravity, and process of desiccation, ranges from 0·3 to 6·0 mm. per second. The specific gravity of spores is determined approximately by using heavy fluids contained in a counting apparatus. In the genus Coprinus the gills are usually stated to deliquesce, or melt into a black, inky fluid, and it was generally assumed that the spores were contained in this fluid. According to Buller, however, the spores are shot off and fall as in other Agarics, commencing at the margins, and when a narrow zone of the gill is depleted of spores, the naked portion of the gill is consumed by a process of autodigestion. A most interesting account of the means by which the spores falling from a fruit-body may be seen by the use of a concentrated beam of light is given, but perhaps the most unexpected phenomenon explained is the fact that the sporophores of certain fungi retain their vitality for years in a dried condition, and, after the application of wet cotton-wool, quickly revive and begin to shed their spores, a process which continues for some days.

It is estimated that the giant puff-ball produces 7,000,000,000,000 spores, also that only one spore out of about 20,000,000,000 spores ever succeeds in producing a mushroom capable of reproduction. In addition to the many valuable new discoveries and new theories bearing on subjects previously investigated by other observers, the book abounds with suggestions and sidelights which cannot but prove of immense service to future workers.

Ten plates and numerous excellent figures in the text are of much value in following and grasping clearly the various points raised by the author.

(2) Notwithstanding the extensive researches of Frank, Bernard, and others bearing on the relationship between fungi and the roots of phanerogams, resulting in the structures known respectively as ectotropic and endotropic mycorhiza, much yet remains to be done before we are in a position to formulate the significance of such combinations. Dr. Burgeff has contributed considerably to our knowledge in this respect, and has added many new facts bearing on the nature and life-history of those fungi met with in the roots of orchids. Fifteen different kinds of fungi were isolated and carefully studied from pure cultures. The majority of these produced asexual reproductive bodies, mainly under the form of long chains of minute conidia of the oidium type. No higher form of fruit was observed, hence the systematic position of these root-fungi yet remains to be determined.

Wahrlich's view that certain of the fungi found in the roots of orchids belonged to the genus Nectria has not been corroborated by Burgeff. Sclerotia are sometimes produced. On account of the general resemblance of orchid fungi to those of Rhizoctonia, Bernard placed all the forms he isolated from orchids under the last-named genus. Burgeff, on the other hand, has created a new genus—Orcheomycetes—for the reception of his various forms, which are named specifically after the host from which they were isolated; thus the form isolated from *Ophrys apifera* becomes *Orcheomycetes apiferae*. The wisdom of creating new generic and specific names for admitted form-species is doubtful, more especially as the author states that such names have no systematic importance or significance. The group characters are based on the behaviour and mode of growth of the fungus, as a pure culture, on the substratum. The specific features turn on the nature of the hyphæ, form and size of conidia, some of which are comparatively large, and in some instances there are indications of the formation of pycnidia.

All the described forms are of endotropic origin, truly ectotropic mycorhiza occurring only very seldom in orchids.

The question of nutrition in cultures was investigated, and the important fact noted that no assimilation of free nitrogen took place. All the species are aërobic.

The concluding part of the work deals with the infection of the seed, and the future development of the fungus until the host reaches maturity.

Numerous excellent figures illustrate the different kinds of fungi isolated, also the progress of the fungus from its first entrance into the seed.

(3) An introduction to field mycology was a desideratum, and, unfortunately, still remains to be written. The present work is practically an imperfect mycological *vade mecum,* attempting to deal with every phase of the subject, instead of being confined to an introduction to field mycology, as stated in the sub-title. The first chapter deals with the general structure and morphology, and has obviously been culled from preceding works of very different dates, as some of the information is up to date, some of historical interest only, and some inaccurate, as the statement that in the Ascomycetes the paraphyses are probably abortive asci. Immediately following this statement it is announced that the paraphyses are a continuation of the vegetative hyphæ, which is a fact, and consequently precludes the possibility of their being abortive asci. Interesting chapters on the dispersal of spores, parasitism, habitats, &c., follow. The remarks anent edible and poisonous species consist of platitudes, and leave the student in doubt. The Jew's ear is not an esteemed esculent in some countries, but *Hirneola polytrichi,* an allied species, is.

Coming to the essential portion of the book, it is at once apparent that the author is one of those who consider that the name of a fungus is a point of primary importance; in fact, there is but little indication that anything else is of any importance. In dealing with the systematic side of a subject, it is universally conceded that the student should be first introduced to the primary groups, and approach by degrees to entities or species. The reverse order, however, is followed in the work under consideration. Families and genera are simply dealt with briefly by a key system, which the beginner cannot possibly grasp, whereas the species are described in detail, the result being that if the species are recognised at all, it will be by a rule-of-thumb method, and his knowledge of affinities will remain at zero. Experience has shown that when a student commences the study of mycology by dealing first with individual species, his knowledge rarely extends beyond recognising a given fungus by name. It is doubtless the same in other branches of science.

The specific descriptions are very uneven, some being technical and beyond the grasp of the beginner; others are altogether inadequate, whereas in the Ascomycetes no mention is made of the asci or spores, the only features of real importance. The statement that *Bulgaria polymorpha,* an ascigerous fungus, is the conidial form of *Ulocolla foliacea* might be regarded as a slip if many other equally glaring mistakes did not suggest lack of knowledge of the subject undertaken. The illustrations are numerous, consisting of sixteen coloured and thirty-two black-and-white plates. Many of the figures are good, some are poor, and some are mere parodies of the object they are intended to represent.

ELEMENTARY CHEMISTRY.

(1) *Elementary Chemistry.* By Hollis Godfrey. Pp. xiv+456. (New York and London: Longmans, Green and Co., 1909.) Price 4*s.* 6*d.* net.

(2) *Systematic Qualitative Analysis.* By Dr. R. M. Caven. Pp. xii+240. (London: Blackie and Son, Ltd., 1909.) Price 3*s.* 6*d.* net.

(1) WE have carefully read a considerable part of Mr. Hollis Godfrey's book, and have reluctantly come to the conclusion that as an elementary text-book it is not a complete success. It is true that the book contains much useful information, which is well arranged, that it is well printed and luxuriously illustrated, and that its general appearance is attractive; but the explanations are slovenly, the similes are childish, the historial references betray a curious ignorance of the original memoirs, and many of the illustrations, excellent though they are as photographs, are peculiarly inept.

We have, for example, a picture of an apple to represent "acids in nature," two views of a rather nondescript landscape to illustrate "earth compounds," a female haymaker looking at her watch with a haycock in the background to explain atmospheric pressure, another party of haymakers looking at a tiny spot in one corner of the picture (a balloon presumably) to indicate the lightness of hydrogen, and so on.

A few extracts will illustrate the other points above mentioned. "Chemistry is a science which explains the every-day things of life" (p. 2). "There are seventy or eighty different atoms" (p. 9), meaning, of course, different kinds of atoms. As a kind of corollary to this the author states that "since masses are made by the union of molecules, there exist only between seventy and eighty perfectly simple substances, &c.," forgetting a previous paragraph in which he defines a hypothesis as a belief, and the more important fact that the elements would continue to exist independently of any atomic hypothesis.

The same kind of loose treatment is extended to volume and weight.

"If we have the same volume, the same size piece, so to speak, we can tell at once whether one substance is heavier or lighter than another. But unless we have the same volumes we can tell very little about it" (p. 23).

Again, on p. 40, it is stated,

"A hot-air balloon rises because the air within the balloon bag heated by the flame, expands, grows less in weight and so pulls the light envelope up."

We have still to learn that dough rises owing to the growth of the yeast cells (p. 281). The relation of oxygen to ozone is compared to a man who disguises himself and assumes another name when engaged in crime. The catalytic action of manganese dioxide on potassium chlorate is compared to a person working in the dark and then in daylight.

"The sun comes out and floods the room with cheerful radiance. The man's hands work faster—swifter and swifter grow his motions, &c."

The references to the history of chemistry may be illustrated by the following extracts. We are told (p. 28), "The explanation of the loss or gain in weight on burning *tasked* the best efforts of the whole scientific world for a couple of hundred years,"

and this is followed by an account of Priestley's discovery of oxygen which even his greatest admirers would scarcely sanction. After stating that Priestley *burned* quicksilver in the air and obtained a red powder, he goes on:—

"The experiment so far was no different from what had been done before, without result, but Priestley, with that brilliant imagination which has so often characterised the great leaders of science, saw a new possibility. If mercury had changed to a red ash by burning, could not the substance which had so changed it be obtained from the red ash in its original form by heating?"

Cavendish's discovery, we are told further on, settled questions which had troubled men of science for two centuries. To the question, "What is water?" Cavendish gave the reply, "It is hydrogen oxide."

Sufficient has been said to illustrate the peculiar defects of the book, and it is not a little surprising that none among the ten ladies and gentlemen named in the preface to whom the MS. and proof were in turn submitted should have directed the author's attention to them.

(2) Although we are deluged with books on qualitative analysis, Dr. Caven's new volume may be regarded as by no means a superfluous addition to the number. He starts on the perfectly correct assumption that qualitative analysis, properly studied, may serve as a foundation for a sound knowledge of practical and theoretical inorganic chemistry, and develops his method along these lines. There is, of course, a great deal about group reagents and tables of separation which are common to most books on the subject, but there is, in addition, a useful general introduction, which is clear and concise, and a final chapter on the systematic examination of inorganic substances. The author does not tell us for what class of student the course is intended, and now that it is becoming the fashion to serve up chemistry to suit the diverse needs of different classes of students, or, as someone expressed it, to sell it in assorted penny packets, we doubt whether any but the embryo professional chemist could give the time necessary to complete it. It is doubtful, too, if it is desirable for any student to postpone quantitative work until so much qualitative analysis has been assimilated.

Experience shows that an early acquaintance with the former is an excellent discipline in careful manipulation and exact observation, and the best antidote to untidy and sloppy habits of work. J. B. C.

OUR BOOK SHELF.

La Vita di Michele Faraday. Narrata da Andrea Naccari. Pp. 370. (Padova: Fratelli Drucker, 1908.) Price 3 lire.

THOUGH there exist four well-known biographies of Faraday in the English language, one only, the brief essay by Tyndall, "Faraday as a Discoverer," has been translated into Italian. Neither, until the appearance of the work now under review, had any Italian biography of Faraday been written. Prof. Naccari, whose position as professor of physics in the University of Turin guarantees his competence in physical science, and who is himself an experimental investigator of some distinction, has now written a life of Faraday which worthily presents the career of our great countryman. He has drawn freely and with due acknowledgment from all the four English biographies, and has had the advantage also of being in possession of the volume of printed correspondence between Faraday and Schönbein, which was published more recently than any of the four. Thus, without being either encumbered with the mass of details of Bence Jones's authoritative memoir, or restrained within the smaller compass of the three smaller biographies, he has been able to produce a work which in certain aspects is the most satisfactory life of Faraday yet compiled. He has not failed to incorporate the newer material while preserving what was of permanent value in the old.

The life-story follows the familiar lines. The author has not been able to add anything to our knowledge of the doings or wanderings of Faraday in Italy as the assistant of Davy in his eighteen months' tour of 1813–15. Neither has he thrown any further light upon the episode of the misunderstanding between Faraday and Nobili and Antinori in 1832 respecting their supposed correction of errors which he had not committed. In the author's preface he states that in his first ten chapters he has considered the man rather than the philosopher, with the intention to make him known and to make him loved. In his eleventh and last chapter, which occupies more than one-third of the book, he treats of Faraday's scientific work. Here he follows conscientiously and skilfully the evolution of Faraday's discoveries in their chronological order, but discusses them in their relation to modern views and discoveries. He lays great stress upon Faraday's electro-optic pioneering discoveries as having been provocative of so much of the later developments of physics. He concludes by citing a characteristic passage from the peroration of one of Faraday's last Royal Institution discourses in 1858.

The book is not illustrated by any cuts. It avoids all mathematical expressions; but it is eminently readable, and is well printed. English men of science owe a debt of gratitude to Prof. Naccari for his faithful presentation of one whose memory they so highly honour.

Botanisch-Mikroskopischer Praktikum für Anfänger, By Prof. Martin Mobius. Zweite Auflage. Pp. xi+123. (Berlin: Gebrüder Bornträger, 1909.) Price 3.20 marks.

THE exercises, sixty-four in number, contained in this little book are designed to make the student familiar with the outlines of plant structure in the chief subdivisions of the vegetable kingdom. The directions for making and mounting the preparations are clear and good, and the text is not overburdened with the details which the student ought to learn from the preparations themselves. The illustrations, which are diagrammatic, may also be found useful, although we think the work would not have been impaired in value had they been omitted. The fact that a second edition has been reached proves that its author has met a need felt for such a book, but it seems odd to discover the statement that the aleurone-containing cells of the castor-oil bean belong to the cotyledons (Keimblätter). We also prefer the style of *Ranunculus acris* instead of *R. acer* (p. 9, &c.). But on the whole the book is useful, well printed, and sensibly bound, and its price is moderate.

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.*]

Fertilising Effect of Soil Sterilisation.

WITH further reference to the work of Messrs. Russell and Hutchinson on soil sterilisation (*Journal of Agricultural Science*, October, 1909), it may be interesting to record some information of which I have recently become possessed.

Some of the large growers of cucumbers, tomatoes, &c., under glass for the London market have for some little time adopted the plan of injecting jets of steam into their soil before planting, not with any view of increasing its fertility, but with the view of destroying slugs, insects, &c. In the experience of some growers the productivity of the soil after steaming has become so greatly increased that, if anything like the usual quantity of stable manure is mixed with the soil, the plants grow with such rank luxuriance as to spoil their bearing capacity, exhibiting all the symptoms that would be expected as the result of a heavy overdose of nitrogen.

This experience has been communicated to me by growers who were previously unaware of the Rothamsted work. At the moment they were feeling in somewhat of a dilemma: if they did not steam the soil they suffered from insect pests; if they did steam it they were obliged to curtail the supply of stable manure, at the expense of lowering the subsequent soil temperature, which is normally maintained at a high level by the fermentation of the manure. No doubt means may be found of adjusting the various conditions satisfactorily, but meantime the observation appears to afford striking independent confirmation on a practical scale of the indirect fertilising effect of partial sterilisation in killing off the phagocytes or protozoa which normally keep down the numbers of those bacteria the task of which is to turn organic nitrogen into plant food. BERNARD DYER.

17 Great Tower Street, London, E.C., March 15.

Certain Reactions of Albino Hair.

IN a note in the *Journal of Physiology* (vol. xxxviii.) on the chemical nature of albinism, Mr. Mudge describes some interesting observations which he made upon rats' skins. Starting with the presumption, based upon the work of Miss Durham and Cuénot, that an albino carries a chromogen and lacks the ferment necessary to produce pigment from it, and supposing that fermentation is a process of oxidation or reduction, Mr. Mudge argued that it might be possible to produce pigment artificially by means of an oxidising or reducing agent. He found by experiment that immersion of albino rat skins in a solution of 10 per cent. formalin and 70 per cent. alcohol in equal volumes resulted in a "vivid yellow colour" in the hairs; he further states that these coats, when washed in water and immersed in H_2O_2 (20 vols.), become changed in colour from vivid yellow to a "brownish tint" in about twenty-four hours. He adduces arguments to show that the coloration is due to the presence of a specific body in the hairs diffused through the keratin, and not to mere reaction between the keratin and the formalin.

I have repeated these experiments with various skins. In the case of the single albino rat skin which I used, the vivid yellow was obtained immediately on immersion in the formalin mixture. The change to brown in H_2O_2 was not obtained, but complete decoloration resulted from immersion in this reagent. Prolonged immersion in the formalin mixture also produced almost complete decoloration.

With guinea-pig albinos carrying, respectively, black, chocolate, and red, negative results were obtained, as they were also with a single mouse skin.

What struck me as particularly interesting in connection with the yellow colour produced by the formalin mixture in the coat of the albino rat is the fact that it is a peculiar canary-yellow, which I remember to have seen elsewhere among mammals only in members of the stoat family when the winter whitening is incomplete. A piece of pale yellow stoat fur acquired a much more intense yellow colour as a result of twenty-four hours' immersion in the formalin mixture; a similar piece was decolorised by H_2O_2. There can thus be little doubt that the yellow body produced artificially in the fur of the albino rat is a substance similar to the yellow pigment of the stoat's winter coat, and therefore probably represents a stage in the reduction of the pigment to the condition in which it exists in the white hairs.

Miss Durham tells me that it is a well-known fact that albino rats do not remain pure white if they are exposed to the action of light. Just as darkness is necessary for the production of a pure white coat in the rat, so a certain degree of cold seems necessary in the case of the stoat tribe, though in their case a change to a warmer climate does not at first prevent the usual colour-change in winter. Thus Eric Parker, in "The Book of the Zoo," points out, concerning a certain foreign pine-marten, that "the first winter he spent in the Garden his fur turned almost white to match the snows he would naturally have expected. The last two winters it remained brown, though it has lightened considerably towards yellow." This repetition of a periodic act without the usual stimulus recalls certain phenomena in plants, which Mr. F. Darwin attributes to memory. IGERNA B. J. SOLLAS.

Nitrogen-fixing Bacteria and Non-leguminous Plants.

MAY I be allowed to direct attention to two errors in Mr. Hall's letter in NATURE of December 23, 1909?

Mr. Hall states that "Pseudomonas and Azotobacter together (1·24) are less effective than when grown separately (0·91+0·56)." This comparison is incorrect. The fixation of free nitrogen by bacteria is estimated in terms of milligrams of nitrogen *per unit of carbohydrate* in the culture solution. Pseudomonas and Azotobacter together give 1·24 N for *one* unit of carbohydrate. Pseudomonas and Azotobacter grown separately give 1·47 N for *two* units of carbohydrate, hence the correct comparison is:—

	Per unit
Pseudomonas and Azotobacter together	$= 1{\cdot}240$ N
Pseudomonas and Azotobacter separately	$= \frac{1{\cdot}47}{2} = 0{\cdot}735$ N.

Hence my conclusion that Pseudomonas and Azotobacter together are *more* effective than when grown separately is, I think, justified.

The second error has reference to a mean experimental error of ±10 per cent. Mr. Hall writes:—"By an error which the context rendered sufficiently obvious, I wrote "oats" instead of barley when dealing with Prof. Bottomley's first-quoted experiment with soil." May I point out that oats were the only plants mentioned in the "first-quoted experiment with soil"? Even if the increase of barley (13·6 per cent.) be taken, one fails to see how it is "sufficiently obvious" that a mean error of ±10 per cent. *more* than covers an increase (the lowest of the results quoted) of 13·6 per cent. W. B. BOTTOMLEY.

King's College, Strand, W.C., February 16.

A Sample of Spurious Correlation.

THOUGH regretfully unable to do justice to the mathematical reasoning of Dr. G. T. Walker in NATURE of January 6, I may, perhaps, be allowed to say that it is of the essence of the method that those dots (each expressing a comparison of two sums of thirty items) tend to arrangement in a straight band, or strip, with fairly defined borders. It is expected that future dots will generally come within those limits; but to affirm this in a given case, to say, *e.g.*, that the next dot will not be below a certain level, is it not, necessarily, to say something quite definite as to the character of the coming season, as that its rainfall, frost days, or other feature considered, will not be below a certain numerical value? If the one statement is warranted, so (by the nature of the case) is the other. Thus the essential point seems to me to be whether the past distribution of those dots affords a reasonable clue to their future distribution, and I do not see that my critic throws doubt on this.

I think (with all deference) that anyone who will give the method a full trial will find it distinctly helpful in a number of cases (I do not say in all).

ALEX. B. MACDOWALL.

8 Marine Crescent, Folkestone, January 14.

IN my former letter in NATURE of January 6 I attempted to prove that the arrangements of dots in a band would occur even if the numbers of which the sums were taken were entirely independent of one another, in which case a forecast regarding one of the numbers could not possibly be made from knowledge of the remainder. A forecast could only be made if it were shown that the width of the band were smaller than would be expected on the hypothesis of pure chance, and this vital point has received no consideration.

The situation may be made clearer by reference to the original letter in NATURE of September 16, 1909. The essence of the method is that, if we were forecasting for 1910, the dot the two rectangular coordinates of which are the sums of data for thirty years up to 1909 and 1910, respectively, will lie near to a line through the origin at an angle of 45° with the axes. Thus the sum of the data from 1880 to 1909 will be *nearly* equal to the sum of the data from 1881 to 1910, or the data for 1880 and 1910 will be *nearly* equal. If the *nearness* to equality has any value at all for forecasting, this is equivalent to asserting that the data in question tend to be repeated after thirty years, or have a thirty years' period; but as the same result could be reached if 25 or 35, or any other comparable number, had been substituted for 30, it will be seen that the reasoning cannot be free from error.

That the nearness to equality is inadequate is clear from the diagram in the original letter. The edges of the band there intercept a length representing about thirty-six days along any vertical ordinate. Hence all that can be inferred in forecasting for 1910 is that the number of hot days will probably not differ by more than ± 18 from the number of hot days in 1880; and as the average number of hot days in a year is stated as fifteen, it appears that a forecast so entirely vague could be made without any analysis whatever.

GILBERT T. WALKER.

Kodaikanal, February 21.

SOME SCIENTIFIC CENTRES.

No. XV.—THE MOUNT WILSON SOLAR OBSERVATORY OF THE CARNEGIE INSTITUTION OF WASHINGTON.

MOUNT WILSON rises 6000 feet, almost abruptly, from the plain in which lie the twin cities of Los Angeles and Pasadena. From the mountain top these cities appear at night as glittering star clusters; by day they are seen through a haze of dust which the ascent of the mountain has put below our feet. Beyond is the vast Pacific; above our heads the glorious sky of California; around us the buildings of perhaps the best equipped observatory in the world.

These words are written by anticipation. Prof. Hale has invited the International Union for Solar Research to hold its next meeting on Mount Wilson on August 29, 1910, and astronomers and physicists from all parts of the world are eagerly looking forward to the occasion. The present writer is not, however, altogether a stranger to the scene; he was on Mount Wilson in 1904; but at that time the observatory was in its infancy. It had not even been decided on what scale it was to be designed. Prof. Hale had realised the magnificent opportunities offered by the climate and site, and he had made urgent application to the Carnegie Institution for funds adequate to deal with the serious difficulties to be overcome; but he had also resolved that, if his application was not granted, there should still be a solar observatory on Mount Wilson, for which he would himself provide the funds, so that he had already commenced building operations. Nevertheless, the utmost provision which he and his courageous wife could afford to make would naturally fall far short of what was needed for a suitable observatory, and he was therefore anxiously awaiting the answer of the Carnegie Trustees. Fortunately for astronomy, it was favourable; and since it was received one marvel has followed another in rapid succession. The visitors will be drawn to Mount Wilson as to the main focus of astronomical enterprise and success at the present moment.

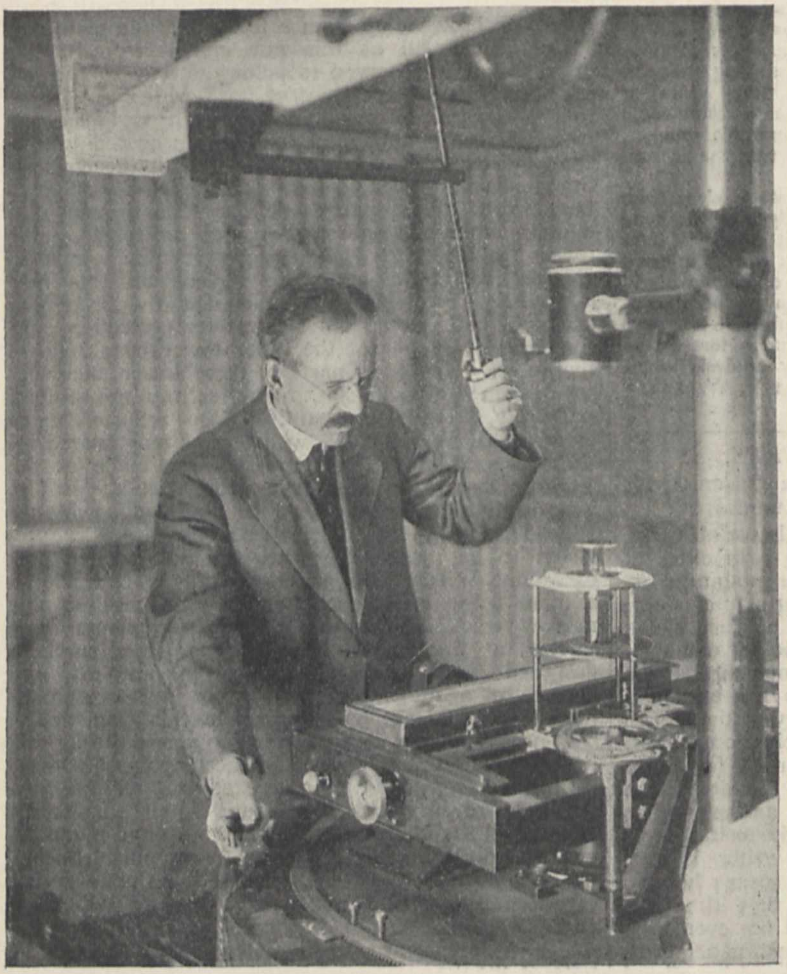
The first of the principal instruments to be completed was the great horizontal Snow telescope, originally constructed at the Yerkes Observatory, with the aid of funds given by Miss Snow, of Chicago. The concave mirror, of 24 inches aperture and 60 feet focus, is fed by a cœlostat with plane mirrors of 30 inches and 24 inches, the beam of light being sheltered by a house specially designed to guard against temperature effects. To this telescope can be attached a spectrograph of 18-feet focus, or a 5-foot spectroheliograph. The heavy parts of the apparatus are mounted on massive stone piers, built with great labour, since it was found that the stone in the neighbourhood was unsuitable, and that materials had to be brought up from a lower altitude by mules.

But, successful as this powerful instrument has been, it has also served to point the way to possible improvements. Experience of its working suggested that a *vertical* telescope might be in various ways better than a horizontal one; and accordingly a "tower" telescope was constructed, with the cœlostat mounted on a tower 60 feet high, built as a skeleton framework. This experiment was so successful that a more ambitious one was at once projected, and a tower 150 feet high is under construction. As wind pressure will be much more serious on this new structure, Prof. Hale has adopted the ingenious device of building an outer tower for protection, surrounding every bar of the inner tower by a tube of the outer. The lower parts of these tower telescopes are contained in wells sunk many feet into the ground.

Thirdly, there is the beautiful 5-foot reflector, made by Prof. G. W. Ritchey, who has already proved his skill in such work. The mirror was made at the Yerkes Observatory some years ago, but has had to wait until a mounting could be provided on Mount Wilson; and, indeed, there was a still earlier provision to be made; the track up the greater part of Mount Wilson was originally only 3 feet wide—a mere ledge in a precipitous descent—and up this narrow track the materials and instruments were carried, at first on mule back, later in a specially designed carriage, with steering fore and aft, and drawn by a mule. But the 5-foot mirror and its mounting could not be taken up in this way, and it was necessary to widen the track to 5 feet throughout its whole length. This was not accomplished without serious delays, owing to severe storms, which sometimes destroyed weeks of labour; but it was finally completed, the instrument was taken up and mounted, and at the meeting of the Royal Astronomical Society on December 10, 1909, were shown some photographs of Mars taken with this great telescope which far surpassed anything of the kind yet seen, and for which the president was requested to convey a special vote of thanks.

A still larger telescope, with a mirror 100 inches in diameter, is to be attempted on Mount Wilson, but is not yet within sight of completion. Round the existing three great instruments are grouped a number of other buildings; first and foremost a physical laboratory, so indispensable now in astrophysical work; also an astrophysical museum, and a variometer house; and then such necessary accompaniments as a power-house, a pump-house, storage-houses, and dwellings. The establishment is not adapted for ladies and children, and the chief residence is called the "Monastery." Distressing news reached us recently that the "Monastery" had been burnt down, owing to the carelessness of a temporary servant. Fortunately it contained no original photographs or records, and most of the books had been taken down to Pasadena, but many were burnt. The building and contents were insured, but re-building cannot be commenced until after the close of the rainy season in the spring, so that the observers will be put to some inconvenience during the next few months, though there are now so many residences on the mountain that they can find temporary quarters.

In Pasadena, 6000 feet below, are the instrument shop, office, physical laboratory, &c. Here also dwell the wives and families of the observers. There is, of course, communication constantly by telephone and frequently by personal visit between the two departments of the observatory. Much practice has made the observers expert and rapid climbers.



Prof. G. E. Hale at the 30-foot spectrograph of the 60-foot tower telescope, arranged for photographing the spectrum of a sun-spot with rhomb and Nicol prism.

Our thoughts naturally turn from the contemplation of so magnificent an installation to the man who designed it, and has brought it to such perfection of efficiency in the short space of six years. It is, of course, not the first achievement of Prof. Hale. Just six years ago it fell to the lot of the present writer to review his work on the occasion of the award to him of the gold medal of the Royal Astronomical Society. That work already comprised the successful inception of the spectroheliograph and its use in depicting the "flocculi" at various "levels" in the solar atmosphere (the connotations of the terms in inverted commas having been suggested by the medallist only a few weeks before); also a considerable piece of work on the spectra of fourth-type stars; also the foundation and equipment, not only of the private observatory at Kenwood (Chicago), but of the great Yerkes Observatory, with its giant telescope and other magnificent resources for the study of astrophysics; also the establishment of the *Astrophysical Journal* as an indispensable aid to workers. Such a record might well have contented an ambitious man at the end of a long life, but it is not too much to say that Hale has in the intervening six years eclipsed these achievements, together and separately, by new ones. The workers who had been put in communication by his Journal have been drawn into closer companionship by the International Union for Solar Research, which he inaugurated at St. Louis in 1904, and which he has invited, after meetings at Oxford (1905) and Meudon (1907), to meet at Mount Wilson this year, as above stated. His record of work now includes the photographic mapping of the sun-spot spectrum (a long-standing problem solved) and the discovery of magnetic vortices in the sun—a truly sensational discovery, and one which is certain to lead to others; and his work in founding the Yerkes Observatory has been treated as preliminary to the real business of adapting the splendid Mount Wilson Observatory, point by point, to the pressing needs of solar physics.

We should lose a valuable lesson if we did not note the steady progression in enterprise which has built up the success. Prof. Hale has several times publicly insisted upon the value of work with modest apparatus, such as he began with himself. During a visit to England in 1907, he gave an address to the Royal Astronomical Society on "Some Opportunities for Astronomical Work with Inexpensive Apparatus" (Mon. Not. R.A.S., lxviii., p. 64), which not only emphasised the value of such work, but gave a number of concrete suggestions to intending workers. The difficulties of making a beginning are well known; but those who earnestly consult this lecture will find most of them removed. It is, of course, assumed that there is a desire to work; Hale addressed himself to "the amateur," defining him as "the man who works in astronomy because he cannot help it, because he would rather do such work than anything else in the world, and who therefore cares little for hampering traditions or for difficulties of any kind." These noble words are not only a stimulus; they also clearly reflect the character of the man who uttered them, and go far towards explaining his success. For the rest, we may accept his own estimate of the importance of beginning with small means, and of the value (several times emphasised in letters to the present writer) of the encouragement of his father. His father bought him a telescope (an excellent 4-inch Clark), but not until he had first made one himself; his father also bought him the spectroscope with which he first photographed a spectrum, to his huge delight, but this was not until he had first worked with home-made apparatus; his father built the Kenwood Observatory, but not until his son had matured his plans by work at Harvard and elsewhere. "His policy always was," writes the son in one of his letters, "to induce me to construct my first apparatus, and then to give me a good instrument if my early experiments were successful." On the death of this wise and kind father, his children established, in pious and affectionate memory of him, the "William E. Hale Fund" for the encouragement of research, which has already aided, in an unobtrusive but none the less efficient manner, several scientific projects of different kinds. His lessons are so deeply impressed on the mind of his son that in the address above referred to he said, "with all seriousness, that it is a fair question whether large observatories, with powerful instrumental equipment, should be established, if they tend to keep back the man who is pursuing the subject with less expensive appliances, and is introducing, through his careful consideration of the possibilities of research, the new methods which in the process of time will take the place of the old ones."

A few facts and dates may be given here. George Ellery Hale was born in Chicago on June 29, 1868 (a few months before the classical observations of prominences without an eclipse, on which he was to build his main work), the son of William E. and Mary S. Hale; he married in 1890 Miss Evelina S. Conklin, of Brooklyn, N.Y., and has a daughter and a son. He entered the Massachusetts Institute of Technology (Boston) in 1886, taking the course in pure science, and graduating S.B. in 1890. He spent some time at the University of Berlin in 1893–4. While in Boston he was enabled, by the kindness of Prof. E. C. Pickering, to spend his spare time at the Harvard Observatory, doing any work assigned to him. The principle of the spectroheliograph occurred to him in the summer of 1899, but experiments were not then successful. He first photographed the prominences in the spring of 1891, within a week or two of similar successes by C. A. Young and Deslandres; but this achievement must be carefully distinguished[1] from the construction of the first successful spectroheliograph, in which Hale had a clear lead of all other workers. It was completed in January, 1892, and from that time regularly recorded, at the Kenwood Observatory, prominences and faculæ. Before the end of 1892 the project for the great Yerkes Observatory was already on foot, and was completed in the autumn of 1897. We may note in passing two incidents of that early history; first, that the project originated in a chance conversation with Alvan G. Clark at the Rochester meeting of the American Association for the Advancement of Science. Hale then learnt of the existence of two discs of glass available for a large telescope, and immediately began the search for a Mæcenas. Such incidental results of scientific gatherings are sometimes forgotten in estimating their value. Secondly, after several applications had failed, when ultimately the matter was laid before the late Mr. C. T. Yerkes, he replied at once, inviting President Harper and Mr. Hale to call upon him, and telegraphed for Mr. Clark as a result of the interview. His rapidity in decision seems to have been noteworthy, even in Chicago.

It would unduly extend this brief notice to follow the history of the Yerkes Observatory during the years from its completion in 1897 until Hale handed over the directorship in 1904 to Prof. E. B. Frost, in order to devote himself to the Mount Wilson Observatory. One is sometimes tempted to peer into the future; from Kenwood to Yerkes, from Yerkes to Mount Wilson, from Mount Wilson to ——? Does a fourth term of the series ever occur to Prof. Hale in his dreams? Series are treacherous to deal with; "it is most unpleasant," once remarked an eminent mathematician who has devoted part of his life to them, "to dream that you are expanded in an infinite series, and that it will not converge." There is a notable divergence in the series of observatories with which Prof. Hale might identify himself; but then it may not be infinite. Indeed, we expect to find —recurring to the attitude of anticipation with which this notice began—we confidently expect to find in August next excellent reasons why the series should stop short at its third term. It is difficult to imagine how conditions for work could be bettered. Mount Wilson has great instruments and a fine climate; it has the financial backing of the wealthy Carnegie Institution; it is within easy reach of Pasadena, and in telegraphic communication with the whole world; and last, but by no means least, it has already an able staff of workers, including men like Adams, Ellerman, and Ritchey, whose names are famous wherever there is an astronomer. Those who have visited the mountain are enthusiastic in praise of the conditions for work. A notable visit was paid by Prof. Barnard, who found the times of exposure required for his photographs considerably less than at the Yerkes Observatory.

The main purpose of the Mount Wilson Observatory is solar research, but a wide interpretation must be given to the term. Prof. Hale has often emphasised the representative character of the sun—it is the one star near enough to be examined in detail; but it is nevertheless a star, and to understand it we must study it alongside other stars; we cannot do justice to the sun by working at the sun alone. Hence he has insisted on an adequate equipment for stellar work at Mount Wilson. The method of attacking scientific problems along more than one line is a characteristic feature of Hale's work generally, and has been an important factor in his success. To give a recent and striking instance. Along one line he was developing the spectroheliograph to the point where good photographs could be obtained in red light (Hα), and this led to the discovery of the solar vortices; along another line, which might have seemed irrelevant to the former, he was working at the photography of sun-spot spectra, and at last succeeded in getting good images of double and triple lines. Forthwith the two researches met and flowed in the same stream; to test the magnetic hypothesis of the vortices he could examine the spot spectra polariscopically. Had either of these two lines of work been neglected, the other would have remained unfruitful. No doubt there was an element of luck in the simultaneity with which the two became available; but luck proverbially attends on energy and enterprise.

H. H. TURNER.

[1] It does not seem to the present writer that the late Miss A. M. Clerke has been sufficiently careful to distinguish these two distinct steps in her otherwise admirable writings (see, *e.g.*, "Problems in Astrophysics," pp. 18 and 98.

THE BRITISH SCIENCE GUILD.

THE fourth annual meeting of the British Science Guild was held at the Mansion House on March 18, when the fourth annual report upon the work of the past year was presented. The Lord Mayor occupied the chair, and an address was delivered by Mr. Haldane, president of the Guild. Sir John Cockburn, K.C.M.G., gave a summary of the report, the adoption of which was moved by Lord Strathcona, and seconded by Sir Alfred Keogh, K.C.B. Sir George Darwin, K.C.B., and Sir Ernest

Shackleton also spoke. We propose to print the main parts of these speeches later, and here limit ourselves to the mention of a few points of wide interest included in the report.

The following gentlemen were elected as new vice-presidents:—Sir William White, K.C.B., F.R.S., Sir Clifford Allbutt, K.C.B., F.R.S., Sir George Darwin, K.C.B., F.R.S., Surgeon-General Sir A. Keogh, K.C.B., Right Hon. Sir George Reid, K.C.M.G. The following new members of the executive committee were also elected:—Sir David Gill, K.C.B., F.R.S., Sir William White, K.C.B., F.R.S., the Rt. Hon. the Earl of Chichester, Sir A. Keogh, K.C.B., Mr. A. Mosely, C.M.G., Sir Boverton Redwood, Colonel Sir John Young, C.V.O.

The executive committee proposes to offer two prizes for an essay on "The best way of carrying on the struggle for existence and securing the survival of the fittest in national affairs." The essay should state the main points to which attention must be directed; the following, in which the practice of modern nations differs, may be touched upon:—

(1) The training of the citizen to secure national efficiency in peace, and national defence in war.

(2) State organisations for securing the same objects.

(3) The State endowment of the higher teaching and research in universities and elsewhere.

(4) Whether a system of party government alone is sufficient to secure all the best interests of the State in those directions in which brain-power and special knowledge are needed, or whether a body free from the influence of party politics and on which the most important national activities are represented by the most distinguished persons is desirable.

(5) Whether it is of advantage that the nation's greatest men in science, learning and industry on whom, in peace, the prestige and progress of the nation chiefly depend should be in touch with the head of the State.

(6) How discoveries and applications of science can be best and soonest utilised for State purposes both in peace and war.

Formation of Colonial Branches.

In the last annual report reference was made to the proposed formation of branches of the Guild in Australia and Canada. During the year further progress has been made, and inaugural meetings have been held in Winnipeg (Canada) and Sydney (New South Wales). A branch is also being formed in South Australia.

In Canada an organising committee has been formed, consisting of the leading educational, scientific, and business men. By forming such a committee, it was considered that not the least of the advantages would be the keeping in touch with the scientific methods throughout the Empire, and it was hoped that the Canadian committee might thus be the means of obtaining accurately for the British Guild information on Canadian matters.

The inaugural meeting of the New South Wales branch was held on October 13, 1909, at the Royal Society's House, Sydney, the Governor of New South Wales, Lord Chelmsford, occupying the chair. In the course of an address Lord Chelmsford said that what is wanted to-day, and what he thought the Guild intends to try to do, is to get a scientific spirit to permeate the public at large. Science is an end in itself; but the general public should be convinced that in giving money for scientific purposes they are giving it for a good cause, and also that scientific knowledge is worth something in pounds, shillings, and pence. He hoped in that way to get the public alive to the importance of scientific knowledge in everyday life. Departments of public instruction may bring forward schemes of coordination and the like, but until the parents have been convinced that education is of value to them, all the schemes in the world are not going to make them alive to education. In Germany and in America parents in the homes are alive to the importance of education, and they are determined to undergo any personal sacrifices if they can only give their sons and daughters the best possible education.

In the case of agriculture, we have to convince the farming community as a whole that there is something in scientific knowledge that is going to be of value to them. This is very hard to do. It is to be hoped that by its methods the Guild will be able to press home, not only upon men in authority—he believed men in authority are fully alive to the value of scientific knowledge—but also upon the men in the street, that scientific knowledge is not a mere abstraction, and that if devoted to commerce, trade, and everyday life, it will sweeten and enrich the lives of all and help the well-being of the community at large.

Speaking of the objects of the Guild, Dr. F. A. Bennet said that Germany spends more money on the University of Berlin alone than does England upon the whole of her universities put together. "It is not the German Dreadnoughts we have to be afraid of, but the German schoolmaster," observed Sir James Graham. "He is the man who is doing the damage."

In South Australia, the Governor, Sir Day Hort Bosanquet, is acting as patron of the branch. In a circular, issued by the secretary, the ideals of the Guild are stated as:—

"To give one kind of education only to the people of the Empire—*the best* (both practical and theoretical)—and to secure its economic application to the wants of mankind.

"To help us to keep our Empire the greatest factor in the world and retain our immense commerce. To do this we must teach the people the necessity of applying the methods of science to all branches of human effort. It must be observed that practical and scientific knowledge combined, and its application to useful purposes, is the secret of all human mental influence and power. It reduces labour, increases pleasure, and gives health and contentment.

"Scientific straight-thinking is just as good for us as a navy is for Germany. *Brains lie at the root of all things.*"

The Want of National Organisation.

The president of the Guild in his address last year remarked:—"The exertions of our people as a united people are necessary if we are to hold our own in the stress of the competition of nations." These remarks have led the executive committee to consider how best the suggested changes can be brought about. The committee points out that in the case of the armed forces of the country, following the example of Germany, a general staff for army purposes is already in being, and the Government has announced that a similar organisation is being established for naval purposes. The view that the peace purposes of the nation could be well served by an organisation dealing similarly with peace requirements, and indeed that they cannot be best served without it, is rapidly gaining ground, all the more because it is becoming fully recognised that party politics deal more with the temporary success of a party than with the permanent welfare of the State. A body composed of men selected from among the most eminent representatives of science, education, industry, commerce, and finance, associated with the technical heads of the Government institutions dealing specially with such matters, would provide such a general staff fully competent to deal with questions in which united action would be conducive to the nation's welfare and progress.

In university organisation there has been steady growth of opinion in two directions. First, the necessity for the fullest consideration of research in connection with all the higher teaching; and, secondly, the national loss which results from the exclusion of the universities from the Government view of education as represented by its Board.

In giving a statement of some scientific researches which have recently been aided by the State, the executive committee remarks that the present Government has shown itself more anxious to promote scientific inquiry than any of its predecessors.

Work of Committees.

New committees have been formed for dealing with the conservation of natural sources of energy, and to consider the question of technical education and its position in regard to universities. In addition to these, there are committees dealing with education, inexpensive instruments in science teaching, agriculture, synchronisation of clocks, naming and numbering of streets (executive committee), and the coordination of charitable effort.

The medical committee has been increased in numbers in order to take up specially the consideration of medical research. In its report this committee emphasises the very great importance of post-graduate medical study, and points out the very wide field and the great materials for such work which exist in London, and that owing to the absence of organised effort relatively little use is being made of this immense field. It is further considered that the ideal to be worked for is the establishment of a central medical school in connection with the London University, which should be devoted to post-graduate teaching and research. Such central school might be associated with all the London hospitals in connection with the London University for the purpose of post-graduate medical study, and should have affiliated to it other medical institutions and hospitals for the treatment of special types of disease (such as hospitals for epilepsy and diseases of the nervous systems, the Royal Ophthalmic Hospital at Moorfields, Brompton Hospital for Consumptives, &c.). Professors appointed by the Central London University School would be deputed to work at any of the appointed institutions, where special facilities might exist for research and post-graduate teaching in the subject dealt with by each professor. The committee is strongly of the opinion that much greater facilities should be given for medical research than exist at the present time, and that large funds should be furnished from public and private sources for such purposes. One of the objects on which expenditure is urgently required is in the endowment by the Central London University School of arrangements for pathological research at the medical schools.

The committee on the conservation of natural sources of energy, of which Sir William Ramsay is chairman, has decided to draw up reports on (1) coal, particularly in connection with its employment for smelting and other industrial purposes; (2) internal-combustion engines and oil engines; (3) atomic and interatomic energy; (4) the availability and quantity of natural oil and natural gas; (5) the heat of the earth; (6) availability of water-power; (7) forestry; (8) carburisation of coal at high and low temperatures; (9) solar power.

THE PROPOSED SCOTTISH NATIONAL ANTARCTIC EXPEDITION OF 1911.

A LARGE and enthusiastic meeting, organised by the Royal Scottish Geographical Society, was held in the Synod Hall, Edinburgh, on Thursday evening, March 17, to hear the plans of Dr. Bruce for his second Antarctic expedition. Prof. J. Geikie, F.R.S., president of the society, was in the chair, and was supported by a number of representatives of Scottish scientific bodies and others. The keynote of the meeting was that the aim of the expedition was to be throughout scientific. This was emphasised first of all by the chairman, who on that ground disclaimed the idea against which a needless protest had been put forth by the president of the Geographical Society of Berlin, that Antarctic exploration should be in any way reserved for any particular nation, and, in view of the immense field for scientific investigation in Antarctica, welcomed the friendly rivalry of all nations in carrying out that work.

Dr. Bruce then addressed the meeting, and before giving an account of his present plans, gave a brief sketch of the history of Antarctic exploration, laying special stress on the part that Scotsmen had borne in that work since Weddell set sail from Leith in 1823. It is hoped that the expedition now planned will leave Scotland about May 1, 1911, and reach Buenos Aires about June 20 of that year. About ten days later it will sail for Cape Town, pursuing a zigzag course, for the most part, between the parallels of 40° and 50° S., but including a visit to the Sandwich group in about 57° S., as well as to Gough Island. The purpose of this navigation will be to supplement the bathymetrical survey of the South Atlantic Ocean begun by the *Scotia* in 1902–4, and it is not expected that Cape Town will be reached before September 1. After refitting and coaling, the ship will sail once more for the Sandwich group, and thence to Coats Land, and seek for a place on or near that coast where it may be possible to land and erect a house, although from the experience of the previous expedition it is thought possible that it may be necessary to go so far east as Cape Ann in Enderby Land for that purpose. At some point in Coats Land, however, it is intended that a sledge-party of three, under the leadership of Dr. Bruce, shall land with the view of crossing to the Ross Sea by way of the South Pole. The ship, after landing a party of ten or twelve persons at whatever point they find suitable for the erection of a house, will proceed, by a route in as high a latitude as possible, to winter at Melbourne, taking soundings and carrying on deep-sea research all the way.

In the following spring the ship will leave Melbourne and push southward to McMurdo Strait, Victoria Land, in order to send a sledge party to meet, and furnish with fresh supplies, the previously landed sledge-party under Dr. Bruce. It is expected that the two parties will meet near the Beardmore Glacier, and, after meeting, the combined party will proceed to the ship and sail for New Zealand. Further oceanographical work will afterwards be carried on between New Zealand and the Falkland Islands in as high a latitude as the winter season will permit, and in the following spring the ship will sail southwards to relieve the wintering party, which by that time will have been engaged for two years in surveying the coast-line of Antarctica east and west of the station, and in taking meteorological, magnetic, and other observations. The total cost of the expedition is estimated at about 50,000*l*. Dr. Bruce, it may be mentioned, is in cordial correspondence, not merely with Captain Scott, but also with the promoters of the German expedition, and there is good reason to hope that if funds are raised both for his and the German expedition, there will be no useless overlapping of work. As regards the McMurdo Strait, which Captain Scott has chosen for his special sphere of work, Dr. Bruce expressly announces that the Scottish expedition will make no special investigations in that region.

The meeting was then addressed by Dr. John Horne, F.R.S., director of the Geological Survey of Scotland, who, as representing the Royal Society of Edinburgh, first referred to the high value of the publications already issued giving the scientific results of Dr. Bruce's previous Antarctic expedition, including upwards of twenty papers published by the society he represented, and expressed the hope that the Government would see its way to furnish the necessary funds for the publication of the remaining results, which were eagerly looked for by all interested in Antarctic exploration in every part of the world. He stated that he was commissioned by the council of the society to give to Dr. Bruce's new scheme the most cordial recommendation to the Scottish public for financial assistance.

Prof. J. Graham Kerr, F.R.S., professor of zoology in the University of Glasgow, then spoke as representative of the Royal Philosophical Society of Glasgow, expressing that society's cordial sympathy with Dr. Bruce's project, and especially because they felt that they had in him a splendid example of the type of explorer who, while ready to take any adventures that came his way, recognised that his real object was to do honest scientific work. The Earl of Cassilis, representing the St. Andrew Society, dwelt more particularly on the contrast presented by the large grants that had been made by Government to other Antarctic expeditions, and the entire lack of recognition, so far, of the work of proved value that had been done by Dr. Bruce.

Prof. J. Cossar Ewart, F.R.S., professor of zoology in the University of Edinburgh, then commented on the zoological value of Dr. Bruce's expeditions, which had been the means of adding dozens of new species to scientific knowledge, and on that account gave his cordial support to the carrying out of this second Scottish Antarctic Expedition. In an eloquent speech Prof. D'Arcy W. Thompson, C.B., of the Scottish Fishery Board, professor of zoology in University College, Dundee, expressed warm appreciation of the work that Dr. Bruce had already done in his previous expeditions. Mr. Chisholm, lecturer on geography, Edinburgh University, recommended Dr. Bruce's plans to the support of the meeting, among other grounds, on account of the fact that Dr. Bruce had shown his qualifications as a leader by the attachment and devotion which he inspired in his followers, and this point was immediately enforced by Dr. R. N. Rudmose Brown, lecturer on geography in the University of Sheffield, who had accompanied him in expedition after expedition.

At the close of the meeting, on the motion of Mr. W. G. Burn-Murdoch, a resolution asking the meeting, as a representative Scottish gathering, to express their hearty desire to have Dr. Bruce's plans carried out, was unanimously approved. It should be added that, while the opinion that it was the duty of the Government to contribute to the publication of the results of the *Scotia* expedition was very freely expressed at the meeting, the appeal for funds to carry out the present projected expedition is not made, in the first instance at least, to the Government, but to "the enthusiasm and patriotism of Scots at home and abroad."

PROF. J. CAMPBELL BROWN.

As recorded with regret last week, Prof. James Campbell Brown, professor of general chemistry at the University of Liverpool, died very suddenly from heart failure on Monday, March 14. Prof. Campbell Brown, who was the son of the late Mr. George Brown, a chemical manufacturer with a business in London, was born in Aberdeenshire in 1843. He studied at the University of Aberdeen, and afterwards at the Royal College of Chemistry and the Royal School of Mines, London. He was a D.Sc. of London University, and LL.D. (*honoris causa*) of the University of Aberdeen. His connection with Liverpool began in 1867, when he was appointed lecturer in chemistry and toxicology at the Royal Infirmary School of Medicine. He became public analyst for Liverpool in 1872, for Cheshire and the Isle of Man in 1873, and for Lancashire in 1875. In 1877, being then chairman of the Royal Infirmary School of Medicine, he took a prominent part in the movement for the foundation of a university college in Liverpool, and from 1878 to 1884 was one of the secretaries of the special committee which afterwards became the council of the new college. Prof. Campbell Brown may, therefore, rightly be said to have been one of the prominent founders of the present University of Liverpool. In 1881 he was appointed to the chair of chemistry endowed by Mr. Grant, of Rock Ferry. When death overtook him he was still the active occupant of this chair.

For more than forty years Prof. Campbell Brown exercised an important and beneficial influence on higher education, and especially higher scientific education, in this country. In Liverpool in particular he developed a flourishing department of chemistry, and was very successful in enlisting the sympathy and obtaining the aid of the chemical manufacturers of Lancashire and Cheshire. As a public analyst of experience and repute he did much for the improvement of our methods of suppressing the falsification and adulteration of foods and drugs.

In 1874 he published a report on the chemistry of tea cultivation in India, and made important recommendations which proved of great value to that industry.

He contributed a very considerable number of papers to the scientific journals, and was awarded two gold medals by the Franco-British Exhibition. In this connection his excellent work on the latent heats of evaporation of liquids deserves special mention. Quite recently he contributed a paper to the Chemical Society dealing with double and triple ferricyanides.

In 1908 he was elected a vice-president of the Chemical Society. A man of genial, kindly, and unselfish nature, his heart was entirely in the work to which his life was devoted. He lived to see his labours crowned with a well-deserved success. The University of Liverpool owes him a debt of gratitude which few can appraise, and it stands to-day a memorial of his wisdom and foresight, his marvellous power of organisation, and his profound belief in the value of the investigation and dissemination of knowledge and truth. F. G. D.

NOTES.

SIR WILLIAM RAMSAY, K.C.B., has been nominated "Membre d'Honneur"—honorary member—of the Chemical Society of France.

SIR THOMAS BARLOW, F.R.S., has been elected president of the Royal College of Physicians, London, in succession to Sir Richard D. Powell.

THE Aldred lecture of the Royal Society of Arts will be delivered by Prof. H. H. Turner, F.R.S., on Wednesday, May 4. The title of the lecture is "Halley and his Comet."

THE death is announced, in his seventy-second year, of Dr. Otto Hermes, founder of the Berlin Aquarium. Dr. Hermes was appointed director of the aquarium in 1871, and was known by his writings on zoological subjects.

AMONG the latest developments of Germany's airship movement we notice the fund raised by Prince Henry of Prussia for the building of a dock at Hamburg capable of housing at least two Zeppelins. Of the 50,000*l.* required, 20,000*l.* was raised almost immediately.

A YOUNG horn of *Cervus megaceros* has been dug up recently from a depth of 2 or 3 feet below the surface of Martin Mere, near Southport, in Lancashire. It is the property of the Rev. Mr. Bulpit of that town, by whom the specimen has been submitted for determination to the director of the Liverpool Museums.

THE following awards of the Royal medals and other honours have been made by the council of the Royal Geographical Society:—Royal gold medals: founder's medal, Colonel H. H. Godwin Austen, C.M.G., F.R.S.; patron's medal, Dr. W. S. Bruce; Murchison grant, Dr. Carl Skottsberg; Gill memorial, Mr. D. Carruthers, for his journey in north central Arabia; Cuthbert Peek grant, Lieut. C. E. Fishbourne, R.E.; Back bequest, Mr. H. Vischer. A special medal has been awarded to Rear-Admiral Peary for his attainment of the North Pole.

BY the death of Prof. J. Edmund Wright, of Bryn Mawr College, a young mathematician of great promise has been lost. Prof. Wright graduated at Trinity College, Cambridge, being senior wrangler in 1900, subsequently taking a first in "part two" and obtaining a Smith's prize. He was in 1903 appointed associate professor in Bryn Mawr College, in succession to Prof. Harkness. He was the author of a "Cambridge Tract" on "Invariants of Quadratic Differential Forms," and he also wrote on theory of groups, differential geometry of space, and Abelian functions.

SIR FREDERICK MAPPIN, BART., whose death at the age of eighty-nine years took place on March 19, was an active friend of higher education in Sheffield. He took a very prominent part in founding the Sheffield Technical School, which later formed an important part of the University College, and is now merged in the University of Sheffield. He contributed generously towards the support of these institutions, and at the time of the foundation of the University gave 15,000*l*. to its fund. He was one of the first two Pro-Chancellors of the University, and was also chairman of its department of applied science.

AN International Hygiene Exhibition is to be held in Dresden next year. At a meeting of members of the British executive committee of the exhibition, held on March 16 at the Hotel Cecil, Prof. Pannwitz, the deputed representative of the scientific department, delivered an address. He explained the aims and objects of the exhibition, the support which is being extended by the German Imperial and State Governments, the efforts which many civilised countries are making to secure an effective representation, and he concluded by expressing his full confidence that the British representation will be in every respect worthy of the country which is the acknowledged birthplace of sanitary science. Offices are to be opened in Victoria Street, S.W., for the accommodation of the British executive and for the general working of the undertaking in this country.

THE sixty-third annual meeting of the Palæontographical Society was held at Burlington House on Friday, March 18, Dr. Henry Woodward, F.R.S., president, in the chair. The report of the council referred to the progress of the monographs on Pleistocene Mammalia, Cretaceous and Carboniferous fishes, and Cretaceous Lamellibranchia, and recorded the gift of a series of plates of Carboniferous fishes by the Carnegie Trust for the universities of Scotland. It lamented the death of two members of council during the past year, the Rev. G. F. Whidborne and Mr. C. Fox-Strangways. Miss M. S. Johnston, the Rev. R. Ashington Bullen, Dr. F. L. Kitchin, and Mr. A. W. Oke were elected new members of council. Dr. Henry Woodward, Dr. G. J. Hinde, and Dr. A. Smith Woodward were re-elected president, treasurer, and secretary respectively.

FROM the *Deutsche Zeitschrift für Luftschiffahrt* we learn with deep regret of the death of the founder and editor of that journal, Lieut.-General H. W. L. Moedebeck. The name of Moedebeck figures prominently in the annals of German aëronautics, and even the published records which reach this country afford evidence of the powerful influence of his personality in stimulating aëronautical enterprise. He is described as a man possessing ideas, not only for the requirements of the day, but for developments of the future. Before airships were thought of he devised methods of preventing explosions in motors, and his geographical surveys were also initiated, in the face of considerable opposition, before the demand for them had arisen in connection with aërial navigation. In 1884 he was first appointed by the German Government to develop the balloon for military purposes. He has published a handbook and a pocket-book of aëronautics, of which the latter is now well known in this country. His works on "Airships: their Past and Future," and on flying men, have done much to popularise aëronautics; but perhaps the two things which stand out most prominently as his life-work have been the *Deutsche Zeitschrift* and the aëronautical map brought out in connection with the above-mentioned survey. The part which Moedebeck played in developing the "Zeppelin movement," especially at a time when the Count had few supporters, is also worthy of note.

NEARLY thirty years ago, the sanction of Parliament was given to a scheme to obtain an adequate water supply for Liverpool from the Welsh hills. This undertaking was completed on March 16, when the Prince of Wales visited Lake Vyrnwy and turned on into the great artificial lake there the water collected from the Marchnant River. The complete scheme for the water supply of Liverpool outlined by Messrs. G. F. Deacon and T. Hawksley comprised the impounding of the rivers Vyrnwy, Marchnant, and Afon Cownwy. The two latter are higher than the former, and the work in connection with them was carried out after the Vyrnwy scheme was finished. In the cases of Afon Cownwy and Marchnant the rivers were dammed, and tunnels cut through the intervening hills so that the impounded water could empty itself into the Vyrnwy. The Afon Cownwy tunnel was 7 feet in diameter and 6723 feet in length, and the Marchnant tunnel 7 feet in diameter and 7345 feet in length, and it was at the latter one that the Prince of Wales opened the valve which allowed the water to flow through the tunnel into the Vyrnwy lake, thus completing the whole scheme. The completed scheme as it now stands has a gathering ground of 22,742 acres, and the capacity of Vyrnwy lake is 12,131 million gallons; its greatest depth is 84 feet; the area of its surface is 1121 acres, and its length $4\frac{3}{4}$ miles. The surface-level of the lake above the sea is 825·89 feet Ordnance datum, and the level of the highest point in the watershed is 2050 feet Ordnance datum. The water engineer of Liverpool, Mr. Joseph Parry, has been entirely responsible for the work in connection with the Marchnant and Afon Cownwy rivers.

THE last Bulletin, that for March 10, of the Institution of Mining and Metallurgy contains the annual report of the council, which deals with the work of the year 1909. The gold medal of the institution has been awarded to Prof. William Gowland, F.R.S., in recognition of his services in the advancement of metallurgical science and education during a long and distinguished career. "The Consolidated Gold Fields of South Africa, Ltd.," gold medal has been awarded to Mr. W. A. Caldecott, in recognition of his work in the investigation of methods of reduction and treatment of gold ores and of his contributions to the literature of the subject. "The Consolidated Gold Fields of South Africa, Ltd.," premium of forty guineas has been awarded conjointly to Messrs. C. O. Bannister and W. N. Stanley, for their work in the investigation of the thermal properties of cupels and for their joint paper on "Cupellation Experiments—the Thermal Properties of Cupels." Four post-graduate scholarships, each of 50*l*. in value, have been awarded. The total membership of the institution at the end of the year under review was 1902, which represents an actual increase of 277 in two years.

German geology has sustained a serious loss by the death of Dr. Emil Philippi, extraordinary professor of geology at Jena, who is best known as the geologist with the German Antarctic Expedition under Prof. von Drygalski. He had been from 1901 to 1906, except during his absence with that expedition, a privat-docent in Berlin. In 1906 he was called to Jena to succeed Prof. J. Walther as assistant to Prof. Lenck. Dr. Philippi will be best remembered by his contributions to the geology of the Gaussberg, beside which the *Gauss* wintered in the Antarctic; they and his memoir on the islands visited on the voyage have been reviewed in Nature. His other contributions are mainly on problems connected with glacial geology. He was especially interested in facetted stones, which he discovered both in the drifts of north Germany and in Antarctic icebergs. He seemed disposed to regard facetted stones in general as due to ice work. He published in 1908 a short memoir on the Upper Palæozoic glaciation of southern Africa and Australia, for which he accepted a Permian date. He accompanied the Geological Congress in its excursion to Mexico in 1906, and subsequently wrote an account of the tectonic effects of the intrusion of the syenite porphyry of Cerro Muleros. His premature death in Egypt has cut short a career of great promise.

The Premier (Transvaal) Diamond Mining Company recently presented to the British Museum (Natural History) an interesting series of specimens from the Premier Mine, near Pretoria. The examples of diamondiferous rock which come from different depths, ranging from 15 to 160 feet below the surface, exhibit very clearly the change that takes place in the colour and texture as the depth increases; the specimen, orange in colour and powdery in character, which came from the shallowest depth, is in marked contrast with that, bluish and hard, which was taken from the lowest depth. The series of rough diamonds, eighteen in number, and nearly 9 grams, or 29 carats, altogether in weight, gives an idea of the variation possible in the form, transparency, and colour of the stones found in the mine; thus there are a clear white octahedron and a black opaque boart, a tetrakis-octahedron, nearly spherical in shape, and a flat, triangular twin, and yellow, pink, and brown stones. Examination in polarised light shows that most of the diamonds are in a state of strain. A specimen of "blue ground" out of which emerges a diamond is of especial interest, because it so rarely happens that the rock is split just where a diamond chances to be. The series includes also specimens of the associated minerals, pyrites, calcite, and "Cape-ruby" (pyrope-garnet).

Great efforts are being made by the committee, of which Lord Desborough is chairman and Mr. C. E. Fagan secretary, to render the British big-game section at the forthcoming Vienna Sports Exhibition a success. His Majesty the King, who has given directions that the skeleton of his famous thoroughbred Persimmon should be sent, is taking great personal interest in the matter; and the trustees of the British Museum have placed the services of a portion of the staff of the Natural History Branch at South Kensington at the disposal of the committee. One of the special objects of this section is to exhibit a representative series of trophies of the big-game animals found in the British Empire (inclusive of protected States). The number of such species, according to a provisional list drawn up for the committee by Mr. Lydekker, is about 165, but many of these are represented by two or more local races. A number of sportsmen and other owners of trophies of this nature have been asked to lend specimens, especially those approaching or representing the "record," and the replies have been, on the whole, of an encouraging nature, the names of those who have promised to lend specimens including the King, the Prince of Wales, the Duke of Westminster, Lord Lansdowne, Mr. Chas. Lucas, and a number of well-known big-game sportsmen. It is also intended to exhibit specimens of the game mammals, birds, and fishes of the British Isles. A photograph of the picturesque building intended for the reception of the British trophies appears in the *Field* of March 19, accompanying a letter from Lord Desborough. The main difficulty is the shortness of the time available, the exhibition opening in May.

When the Aërial League was founded, an excellent opportunity was afforded to the British public to retrieve the reputation implied in the words "England's Neglect of Science"; but in an article in the *Standard* (March 14) Captain Cave Browne Cave draws a striking comparison between the support which this movement has obtained and the reception accorded to similar efforts abroad. He says:—"In Germany up to last year the public had subscribed 330,000*l*. towards the building of an aërial fleet. The Government has made grants amounting to 250,000*l*. The Aërial League, founded in 1908, has attained a vast membership; a practical school of aëronautics has been founded at Friedrichshafen, and a chair of aëronautics at Göttingen University; the wharves, docks, aluminium foundry, hydrogen factory, and large construction yards which have been built at Friedrichshafen are capable of turning out six complete Zeppelins annually, while the output of Gross, Parseval, and other equally successful types of military dirigibles is practically unlimited. In France Government lands have been placed at the disposal of pioneers of flight; great public subscriptions have been raised. Prominent men like Messrs. Deutsch, de la Meurthe, Basil, Zaharoff, and Archdeacon have come forward from time to time with munificent gifts, aggregating over 100,000*l*., for the foundation of aërotechnical institutions, for scientific research work and tuition in aëronautics, for special prizes and the encouragement of inventors. A college of advanced aëronautics has been inaugurated at Paris for the theoretical and practical training of aviators. The French Aërial League, with a membership well over 10,000, has courses of study and practical work at its Juvisy flying ground. In England the Aërial League has been formed, but the appeal to the British people has produced little result."

We regret to record the death, on March 6, of Mr. Charles Fox-Strangways. Born in 1844 at Rewe, near Exeter, where his father, a grandson of the first Earl of Ilchester, was rector, Mr. Fox-Strangways was educated at Eton and afterwards at Göttingen, where he studied mineralogy, chemistry, and physics. In 1867 he was appointed an assistant geologist on the Geological Survey under Murchison, and was engaged for some years in mapping parts of the Yorkshire coal-field, the country around Harrogate, and a large area extending across the Vale of York to the Jurassic and Cretaceous rocks of the east Yorkshire moorlands, and the coast near Scarborough. He was author, or part author, of several memoirs, notably one on the geology of Harrogate, of which a second edition was published in 1908. His chief publication was a general memoir on the Jurassic rocks of Yorkshire, published in two volumes, 1892. In 1889 Mr. Fox-Strangways was transferred to the Midland district, residing for many years at Leicester while engaged in surveying the Leicestershire coal-field and bordering areas. He was author of memoirs on that coal-field, and on the country around Derby, Burton-on-Trent, Atherstone, Charnwood Forest, and Leicester. In 1901 he was promoted to be district geologist, but retired from the public service in 1904, as a weakness of the heart, which ultimately proved fatal, rendered it necessary to give up the arduous work of a field-geologist. His geological labours, represented by official maps, sections and memoirs, and by papers communicated to scientific societies, bear evidence of the most painstaking care and accuracy. While at Leicester Mr. Fox-Strangways did much to promote local interest in geology, especially by conducting field-excursions, which were highly appreciated.

ACCORDING to a telegram from Paris in the *Times* of March 13, an International Congress for the Study of Cancer will be held in that city, under the patronage of the President of the Republic, in the first week of October. The assemblage will not be a congress in the true sense; its official title is "Second International Conference for Cancer Research," the first meeting of the kind having been held in Heidelberg in 1906, as the outcome of which a sort of international association has developed. From this association, however, British investigators have hitherto held aloof, notwithstanding efforts that have been made from Berlin to induce the Imperial Cancer Research Fund—which is the national and representative body in this country—to join. These efforts have taken the form of questions addressed to the Prime Minister in the House of Commons, and even went so far as the presentation of a petition to the King during his visit to Berlin in February, 1909. The German organisers of the so-called international association have used their best efforts to have the first International Congress on Cancer held in London in 1910; but this proposal was discountenanced by the director of the Imperial Cancer Research Fund, Dr. E. F. Bashford, and the executive committee, on the ground that the time for such a congress had not yet arrived. It was felt that such a congress held in London under the auspices of the Imperial Cancer Research Fund, backed as it is by the support of various Government departments, the Royal Society, the Royal Colleges of Physicians and Surgeons, and other public bodies, would arouse too great expectations on the part of the public. The programme for the forthcoming meeting in Paris covers a wide range of subjects, but in the absence of the names of those contributing papers it is too early to decide what importance will attach to the assembly. The list of office bearers given in the *Times* exhibits the remarkable feature of not including a single name of an active worker in those fields of cancer research which are the direct contributors to the success attending the investigations of the past ten years. However distinguished some of these names are in the realms of practical medicine and surgery, they add little, if any, weight to the purely scientific side of an assembly called together to study so recondite a problem as cancer.

DR. LUIGI PERNIER, under the title of "Vestigia di una Citta Ellenica arcaica in Creta," has issued, through the Istituto Lombardo di Scienza e Lettere, an account of a summary examination of an early Greek city in Crete. It is surrounded by walls of cyclopean masonry, now partially ruined. Some inscribed stones and terra-cottas were discovered, the most interesting find being a stele representing a standing figure facing to the right, clad in a tightly folded robe, and holding in the left hand something resembling the Egyptian Ankh. The figure possibly shows the influence of Minoan traditions, and the site clearly deserves further detailed examination.

MAJOR LAMB, I.M.S., and Captain McKendrick, I.M.S., detail certain observations on rabies in the Scientific Memoirs of the Government of India (No. 36). They find that when the "natural" virus is passed through dogs a "fixed" virus is obtained just as with rabbits, and that the structures known as "Negri bodies," while easily demonstrable in the natural virus, cannot be found in the fixed virus. In several cases, both in dogs and in rabbits, a chronic form of rabies was observed, the chief symptom of which was progressive emaciation. It is comparatively easy to infect guinea-pigs and monkeys by subcutaneous inoculation of the virus. As in monkeys the incubation period is much prolonged when the inoculation is subcutaneous, attempts were made to immunise these animals with a single subcutaneous inoculation with a fixed virus, but without success. No bacteriolytic properties towards the virus could be detected in the serum of patients who had undergone the anti-rabic treatment.

FISHERIES, IRELAND, SCI. INVEST., 1908, iv. (1910), is devoted to an account, by Messrs. E. W. L. Holt and L. W. Byrne, of the chimæroid fishes of the Atlantic slope off the west coast of Ireland. The most interesting of these is *Rhinochimaera atlantica*, a long-beaked species known by a single adult male captured at a depth of between 670 and 770 fathoms, and certain egg-capsules attributed to the same species, which was first named by its describers in 1909. *R. atlantica* belongs to a genus otherwise represented by *R. pacifica*, distinguished by the relative shortness of the base of the second dorsal fin. The only Atlantic chimæroid with which *R. atlantica* could be confounded is *Harriotta raleighana* of the western Atlantic; the largest of the four known specimens of the latter is, however, not more than half the size of the type of the former, which, in turn, is decidedly smaller than its Pacific representative. Harriotta is also otherwise distinguished.

IN the thirteenth quarterly report on the scientific work of the Lancashire and Western Sea-fisheries, Mr. J. Johnstone refers to experiments carried out at Conway in regard to the cleansing of mussels from sewage-pollution. By transplanting the mussels to pure water, about 90 per cent. of the sewage-bacteria was eliminated, from which it appears that it will be possible to render the polluted molluscs of the Conway estuary fit for human consumption at a comparatively small cost. In the fourteenth report Mr. Johnstone dwells on the measurements of plaice which have been made during the last two years, these relating to something like 100,000 individual fish. These lead to the provisional conclusion that, in spite of the enormous numbers of under-sized fish taken by this method, the 6-inch trawl-mesh is not harmful to the plaice-fishery. "The plaice are small and below the normal in 'condition' because they are so abundant. If they could be 'thinned out' by transplantation it might be of advantage to the fisheries in general to enforce the 7-inch mesh; but so long as they cannot be transplanted I do not think that the use of the larger mesh would lead to any improvement, and it would certainly diminish the takings of the inshore fishermen."

VARIOUS attempts have been made from time to time to interpret the phenomena of sex-determination in accordance with Mendelian principles. The problem is again attacked by Mr. Geoffrey Smith in the first of his "Studies in the Experimental Analysis of Sex," published in the *Quarterly Journal of Microscopical Science* for February. Some years ago this investigator was led to formulate a Mendelian interpretation of sex-inheritance as a result of his remarkable observations on the parasitic castration of the crab Inachus by the degenerate barnacle Sacculina. Male crabs when infected by the parasite develop the secondary sexual characters of the female, and in certain circumstances ova may actually appear in the gonad. Female crabs in like case, however, do not develop male characteristics. Hence it was concluded that the male crab is a potential hermaphrodite, in other words, a heterozygote in which, under normal conditions, maleness is dominant. The female crabs, on the other hand, were regarded as pure recessives in respect of their femaleness. On these facts, amongst others, the author bases his "half-hybrid" theory of sex-inheritance, in accordance with which one sex is a heterozygote showing dominance of maleness or femaleness, while the other is a pure recessive homozygote. It appears that Prof. Bateson and Mr. Punnett two years later arrived independently at the same result in endeavouring to interpret Doncaster's remarkable breeding experiments on the currant moth, but in this case the female is the heterozygote and the male the homozygote. Mr. Smith also deals with the correlation between primary and secondary sexual characters, again largely as a result of his own observations on the parasitic castration of Inachus. He concludes that the development of the secondary sexual characters is not primarily dependent on the gonad, but that the development of both is dependent upon a common factor, which is supposed to be a hypothetical "sexual formative substance," an internal secretion, occurring in two varieties, male and female. The theory, however, is somewhat complicated by the necessity of taking into consideration the well-known effect produced by the gonad on the development of the secondary sexual characters, as shown by castration. Mr. Smith's views on the question approximate closely to those of Mr. Walter Heape.

A CURIOUS abnormality in a batch of crocus specimens is described in the *Gardeners' Chronicle* (February 26). Some of the thin scale leaves that envelop the bud had developed into white fleshy leaves, which grew nearly as high as a normal flower, while the enclosed foliage leaves and flowers were stunted. It is suggested that the sap had been diverted to the scale leaves as a result of forcing treatment.

THE treatment of felled trees with the view of reproduction by coppice shoots forms the subject of an article in the *Indian Forester* (December, 1909). In Europe it is usual to cut the stumps flush with the ground. When this method has been followed in India, at any rate in the case of the well-known sál tree, *Shorea robusta*, coppice shoots are in many cases not formed at all; it appears that, owing to contraction, the wood and bark separate, and the dormant buds are not rejuvenated; but if a few inches of the stump are left, coppice shoots are abundantly produced.

WITH regard to the ultimate reasons for the injurious effects produced in plants by frost, an instructive article appears as an editorial in the *Gardeners' Chronicle* (February 19). It has been shown that ice is first formed in the interspaces between the cells, with the result that water is withdrawn from the cell sap; continued formation of ice causes disruption of the tissues; but ice-formation is not regarded as the chief cause of injury. A new theory receiving the approval of competent authorities has been advanced by the Swedish botanist Lidfors. He examined a number of plants such as Cerastium and Viola, which, without any apparent means of protection, survive the severe winters of Sweden, and found that during winter the starch in the leaves was replaced by sugar. He then falls back on experiments connected with the maintenance of proteins in the cell sap and protoplasm, by which it has been shown that if water be extracted from the cell the proteins pass out of solution, causing destruction of the cell; but if sugar is present the proteins will remain in solution until a much lower temperature is reached. This theory also affords a logical explanation of the disastrous effects of spring frosts.

THE official forecast for the wheat crop of South Australia is now published in the *Journal of Agriculture* for that colony, and is put at 11½ bushels per acre. If this is realised it will be the second highest yield during the last twenty years. The average yield in 1893 was 7·5 bushels per acre; it fell steadily until 1896, when it was only 1·4 bushels, but then it rose slowly to 11·3 bushels in 1905 and has remained round about this figure since. The 1908 crop of 11·45 bushels was the highest on record. The yield for the United Kingdom in 1908 was 32·3 bushels.

IT occasionally happens that milk which has stood at low temperature for twelve to twenty-four hours becomes so viscid that it can be drawn out into strings. The trouble is caused by a micro-organism, but as it is not very common no large number of investigations have yet been made. A case that arose in Rhode Island was fully investigated by Messrs. Cole and Hadley, the results being published as Bulletin 136 of the Rhode Island Agricultural Experiment Station. From the details given it appears that the organism resembles the *Bacillus lactis viscosus* described by Adametz and A. R. Ward, and belongs to the same group.

MR. H. T. FERRAR contributes further notes on the movements of subsoil waters in Egypt to the December (1909) number of the *Cairo Scientific Journal*. These deal specially with the variations of level observed in a number of experimental tube-wells specially set up in the province of Gharbia, in Lower Egypt, which indicate that the conditions in Lower Egypt are almost the reverse of those which obtain in Upper Egypt, the minor factors in the latter becoming the controlling factors in the former. A series of diagrams shows the relation of the Nile flood to the movements of water-table, with the modifications produced by such factors as the nature of the soil, seepage, and irrigation.

CAPTAIN TIXIER, of the Siam Indo-China Boundary Commission, contributes to *La Géographie* (xx., No. 6, p. 337) a valuable note on the orography of French Indo-China. The region may be described generally as a vast sandy plateau, uplifted towards the east and enclosed by four folds in parallel pairs perpendicular to each other. On the north the Tonkin and northern Annam fold runs north-west and south-east, with a parallel member, much less important, to the south, in the Cardamom range. At right angles to these, in a direction N. 25° E., are the Cape Varela-Poulo Condore chain and the great fold which appears to have rested its whole weight on the sand plateau, causing it to sink, and in balancing to rise to the east, the movement being accompanied by fracture in two directions parallel to the enclosing chains. The Gulf of Siam, with its almost uniform depth of 45 metres, is apparently a plain similar to that of Grand Lac and the Semoun.

WE have recently received an excerpt from the Bulletin of the Society of Historical and Natural Sciences of the Yonne (2 Semestre, 1908), consisting of a very useful and laborious compilation by M. Ernest Blin of *Remarques météorologiques* made in various districts of that department between the fifteenth and eighteenth centuries. The notices are taken from the archives of various institutions and from provincial publications, and are arranged in chronological order, with references to the sources of origin, and furnish much information on the general character of the seasons and on conspicuous meteorological occurrences, floods, &c. Some interesting references are also made to the former practice of ringing church bells with the idea of dispersing hail and thunderstorms; this practice was still in vogue at Quarré-les-Tombes until the middle of the nineteenth century. The publication of this summary is due to a suggestion by M. E. Lauda, of the Austro-Hungarian Hydrographical Service, and recommended by the Meteorological Conference at Innsbruck in 1905, that all available historical documents of different States regarding abnormal weather phenomena should be collected and published.

IN November last Mr. J. W. Giltay and Prof. M. de Haas communicated to the Koninklijke Akademie van Wetenschappen te Amsterdam an interesting paper, a copy of which has just reached us, on the motion of the bridge of the violin. Various statements as to the nature of the movement have been made by writers on acoustics, such as Helmholtz, van Schaik, Apian-Bennewitz, Barton, Garret, and Pentzner, but, by ingenious experiments, Giltay and de Haas have conclusively proved that the motion of the bridge is in two directions, namely, (1) in its own plane about one of the feet and at right angles to the strings, and (2) at right angles to its plane, or transversely, that is, in the same direction as the strings. The sound of a violin must be attributed to three causes:—(*a*) a vibration imparted to the air by the string; (*b*) a vibration which the roof of the violin receives from the parallel swing of the bridge; and (*c*) a vibration communicated to the roof by the transverse vibration of the bridge. The (*a*) movement may be left out of account as being very weak, and the intensity and timbre of the note is determined by the parallel and transverse motions, and more especially by the latter. Each of these motions has its fundamental tone and associated partials, and the quality of the tone is modified when the intensity of one of the motions alters its partials, while it may leave the other motion unchanged or slightly changed. A "mute" damps the transverse motion of the bridge to a higher degree than the parallel motion, and the use of the mute does not weaken intensity so much as to alter quality.

THE February number of the Johns Hopkins University Circular consists mainly of notes from the physical laboratory of the University, edited by Prof. J. A. Ames. One of the most interesting of the notes is that of Mr. J. A. Anderson, on a method of testing screws intended for the most accurate work, such as the ruling of diffraction gratings. A nut which fits the screw accurately is cut in two by a plane through its centre perpendicular to its axis, and the two parts rotated through an angle of 180°, for example, with respect to each other. One of the plates of a Fabry and Perot interferometer is mounted on each half of the nut, and the motion of the interference fringes observed as the screw is rotated by hand at a convenient speed, the two parts of the nut being prevented from rotating with respect to each other. The method is more sensitive than that of the late Prof. Rowland, which consisted in ruling two sets of grating lines at a small angle to each other and observing the loci of the intersections of the two series of lines.

THE *Electrician* for March 4 contains a short article by Dr. W. H. Eccles on the radiation from directive aërials in wireless telegraphy, in which the problem is treated by the exponential method, which has done so much to shorten the mathematical work in modern treatises on light. If the disturbance at the point of observation due to an aërial at a distance x is represented by $re^{i(u+a)}$, where u is a linear function of x and of the time, that from another aërial at a distance d from the former in a direction which makes an angle ϕ with the line joining the point of observation to the first aërial can be represented by a similar expression, with r and a omitted and u decreased by $2\pi d.\cos\phi./\lambda$. The total disturbance at the point of observation due to the two aërials can then be represented by $e^{iu}(re^{ia}+e^{-i2\pi d.\cos\phi/\lambda})$. The energy received is the square of the modulus of this, that is,

$$r^2+1+2r\cos(a+2\pi d.\cos\phi./\lambda).$$

This expression, plotted as a function of ϕ, gives the polar diagram of the directive system, the form of which depends greatly on the value of $2\pi d/\lambda$. The directions in which the radiation from the aërials is a maximum for a given value of a, the relative phase, are independent of r, the ratio of the amplitudes of the oscillations in the two aërials.

ALTHOUGH users of glass apparatus are familiar with the general appearance of the breaks which sometimes occur, no one has hitherto made a scientific study of their forms in relation to their causes. In the *Physikalische Zeitschrift* for February 15 there is a paper by Dr. L. Gabelli which remedies this omission. Breaks are classified as due either to external or to internal causes. The external causes may be localised, as in the case of a blow struck on the surface of the glass with a pointed or blunt object, or be distributed over the surface, as in the case of hydrostatic pressure. The author shows by means of numerous figures that in each case the break has characteristics which enable the cause to be assigned, and in the case of hollow vessels there is a difference between the effects due to the same cause applied within or without. Of breaks due to causes within the material, those which fall under unequal heating are most common, and, like the previous ones, have their own characteristics, which depend greatly on the distance of the heated point from the edge of the material. The author hopes that the technical importance of the subject will lead others to continue these investigations.

WE learn from a note in *Engineering* for March 18 that the Bureau Veritas International Register of Shipping will shortly issue a new edition of its rules. The new publication will be very comprehensive. No change has been made in the method of determining the scantling numerals, which remain as formerly, the basis being the sum of the breadth and depth, and the product of the length, breadth, and depth. For thickness of material, one-fiftieth of an inch has been adopted as a unit, instead of one-thirty-second as formerly. This will admit of ready comparison with the British standard decimal system on the one hand and with the metric system on the other.

MESSRS. WILLIAMS AND NORGATE will issue very shortly, in conjunction with Messrs. B. G. Teubner, of Leipzig, a volume compiled and edited by Yokshio Mikami, entitled "Mathematical Papers from the Far East."

MESSRS. WATTS AND CO. have issued for the Rationalist Press Association, Ltd., a cheap reprint of "The Nature and Origin of Living Matter," by Dr. H. Charlton Bastian, F.R.S. This edition has been revised and slightly abbreviated, and its price in paper covers is 6*d*., or in cloth, with Dr. Bastian's portrait as frontispiece, 1*s*. net.

A CATALOGUE of rare and valuable books and autograph documents and letters has been issued by Mr. Bernard Quaritch, of Grafton Street, London, W. The catalogue runs to 336 pages, and contains full sections dealing with works on astronomy, mathematics and physics, topography, and other subjects likely to appeal to scientific readers.

A SEVENTH edition of "A Treatise on Ore and Stone Mining," by Sir Clement Le Neve Foster, F.R.S., has been published by Messrs. Charles Griffin and Co., Ltd. The work appeared first in 1894, when it was reviewed at length in NATURE (vol. l., p. 543) by the late Mr. Bennett H. Brough, who was afterwards responsible for the sixth edition, issued in 1905, and reviewed in NATURE of January 4, 1906 (vol. lxxiii., p. 220). The present issue has been revised by Prof. S. Herbert Cox, who has adhered to the original general scheme of the book. The price of the treatise is 28*s*. net.

THE issue of the *British Journal of Photography* for March 18 is the third of the special "colonial" numbers, in which that journal addresses itself specially to photographers and photographic dealers abroad. The enlarged text pages contain contributions on studio matters, including the first of a series of articles for the young professional portraitist on securing different effects of lighting. Mr. Edgar Clifton writes on the care of lenses in the tropics, Mr. Welborne Piper on the adjustments of the enlarging lantern, whilst a large proportion of the letterpress deals with recent introductions by photographic manufacturers.

OUR ASTRONOMICAL COLUMN.

THE SOLAR ECLIPSE OF 1912 APRIL 17.—In an article published in the *Revue générale des Sciences* for February 15, M. D. Savitch discusses at full length the circumstances of the solar eclipse of 1912 April 17.

The central line passes through Portugal, the Bay of Biscay, and across France to Belgium, its direction being north-east. It passes within ten miles of Paris. Only about three times a century is an eclipse total in France.

The magnitude of the eclipse along its central line is continually diminishing, and the character of the eclipse changes from total to annular. The point, however, where this change takes place can hardly be assigned with certainty, for it is largely displaced by a small change in the adopted semi-diameter of the moon; the difference of 1·18″ between the values used by the Nautical Almanac and the Connaissance des Temps is sufficient to displace it by some hundred miles from a position out at sea to the neighbourhood of Paris.

In any case, totality is too short for the eclipse to be of much value in the usual way. Nor is there much reason to expect better results than usual from observations to determine the moon's position. No eclipse since 1715 plays a prominent part in determining the position of the moon, and the eclipse of 1715 and its predecessors are important because they are ancient rather than because they were accurately observed in the modern sense of the word accurate.

M. Savitch's article is clear, and illustrated by an excellent map.

THE COMETS (1910*a* AND HALLEY'S).—A large number of observations of comet 1910*a* are published in No. 4392 of the *Astronomische Nachrichten*, including those made at Kodaikanal, Cambridge, Helwan, and Greenwich. Mr. Michie Smith reports a number of positions, several of which, it is interesting to note, are referred to positions of a sun-spot. On January 31 Mr. Evershed traced the tail to a distance of 27° from the head.

Herr Konkoly reports the presence of the three hydrocarbon bands, in the spectrum of the comet, on January 26, and states that the continuous spectrum was faint, whilst a fourth band was suspected.

Dr. Kobold has carried his ephemeris back to the beginning of November, and shows that, although the comet was probably brighter than the sixth magnitude as early as December 1, it was apparently so near the sun as to render its discovery improbable. The ephemeris published in No. 4393 of the *Astronomische Nachrichten* indicates that the comet may become observable again about the first week in April as a morning star, but it will be faint and difficult. A note in the *Observatory* for March emphasises the necessity for such observations being made, if possible, because of their value in determining more rigidly the exact form of the orbit.

Dr. F. J. Allen kindly sends us a beautiful drawing of the comet depicting its form as he saw it on January 30 from the Mendip Hills; the observations were recorded in our article of February 10 (NATURE, No. 2102, p. 441). He directs especial attention to the pronounced curve of the tail towards its extremity, the direction beyond α Pegasi, the uppermost star shown, being nearly horizontal, and states that the comet as here shown is, relatively to the stars, too bright, while the head is perhaps

Comet 1910*a*. From a drawing by Dr. F. J. Allen.

a little too large; but the form and extent of the tail are as he saw it.

Dr. Allen, referring to the passage of the earth through the tail of Halley's comet on May 18, suggests that a well organised attempt should be made to collect some of the cometary dust which may then enter our atmosphere. It will be remembered that Prof. Turner, in his recent Royal Institution lecture, suggested that some such attempt should be made, by "bottling" some large quantities of the atmosphere. It is obvious that to have any hope of success the "bottling" would have to be done on a very large scale and under the most favourable and rigid conditions. Dr. Allen suggests a large chamber, carefully prepared and situated in a position where the air is usually very free from contamination, through which immense quantities of the atmosphere could be drawn and filtered. The filtering should be carried on before, during, and after May 18, in order that differential tests might be applied to determine the extra-terrestrial origin of the collected dust. As the cometary dust, and gas, may take days, or weeks, to diffuse sufficiently to reach the earth's surface, the experiment should be continued for some time after the critical date, thus affording opportunity to detect any differences in the collected matter.

In No. 5 of the *Revue générale des Sciences* (March 15, p. 177) M. G. Renaudot makes the interesting suggestion that the periodicity of comets, or of Halley's comet especially, was known and recognised by the ancient Hebrews. He bases this suggestion on a passage in the Talmud, where one of two voyagers explains that he has laid in a stock of flour, rather than bread, because "*There is a very bright star which appears every seventy years* and which deceives navigators. Thinking that she may surprise us during this voyage, and so prolong our journey, I have provided the flour." M. Renaudot gives reasons why the expected object should be considered as a comet, rather than as a long-period variable, for instance, explains that 70 instead of 75 is in accordance with the habit of giving round numbers, and states that the existence of the two important personages between whom the dialogue took place is well attested historically.

A second edition of Prof. Turner's British Association address on "Halley's Comet" has just been issued by the Clarendon Press at the price of 1*s*. net.

EPHEMERIS FOR EROS, 1910.—To facilitate observations of Eros during the coming opposition, Prof. Wendell has computed an ephemeris, which is published in Circular No. 153 of the Harvard College Observatory. Unfortunately, the planet will not be observable in these latitudes, its declination at opposition (May 23) being 46° 31′ S., but, as its orbit and light-variations are so peculiar, it is hoped that a number of observations will be secured at southern observatories.

PROF. DOBERCK'S DOUBLE-STAR OBSERVATIONS.—In continuation of a list which appeared in Nos. 4327–8 of the *Astronomische Nachrichten*, Prof. W. Doberck now publishes his observations of a great number of doubles, at Sutton during 1909, in Nos. 4394–5 of the same journal. Each observation is recorded separately, and the position-angle and distance of each pair are given for the mean epoch of observation.

DANIEL'S COMET, 1909*e*.—A photograph of Daniel's comet (1909*e*) was secured by Dr. Wolf on February 28, when the comet's magnitude was 15·0. It now appears that this comet belongs to the Jupiter, and not to the Uranus, family of comets, as was at first suspected.

THE NATIONAL PHYSICAL LABORATORY IN 1909.

THE general board of the National Physical Laboratory held their annual meeting at the laboratory on Friday last, March 18, when the report of the work done during 1909 was presented, and the programme of work proposed for the year 1910 was approved. The chair was taken by Sir Archibald Geikie, as president of the Royal Society, and Lord Rayleigh, chairman of the executive committee, was also present. A large number of guests were invited to inspect the various departments of the laboratory.

Two new branches of the work claim attention this year. The first of these is the national experimental tank for experiments on ship models, which is being constructed at a cost of about 20,000*l*., provided by the generosity of Mr. A. F. Yarrow. A maintenance fund for carrying on the work of the tank for the first ten years has also been provided with the aid of the Institution of Naval Architects. With regard to the details of the working of the tank, assistance will be given, under a scheme printed in the laboratory report, by an advisory committee composed of members nominated by the Institution of Naval Architects and by the executive committee of the laboratory.

The tank itself, and the office buildings and workshops required, are now nearly completed. The length of the tank is 500 feet at the full depth of 12½ feet, and the width 30 feet. At the north end are docks for receiving the models, while at the south end is a shallow "beach" for breaking the waves. As was shown by Dr. Glazebrook in a report presented in March, 1909, to the Institution of Naval Architects, models up to 20 feet in length and 3 feet in breadth can be tested in a tank of the width stated without any appreciable effect on the results due to the sides.

The models will be towed along by a carriage, electrically driven, spanning the tank and running on rails on either side. This carriage carries the observers and dynamometers. The models will usually be made of paraffin wax, and the equipment will include special model-cutting machinery. None of this apparatus, however, is yet installed, and we hope, at a later date, to give a more detailed account of the tank and of the special apparatus employed.

The second large development of the work during 1909 is the formation of a division for research in aëronautics. This work has been undertaken in accordance with the announcement made by the Prime Minister in the House of Commons on May 5, 1909, and is under the general superintendence of the Advisory Committee for Aëronautics then appointed. Rapid progress has been made during the year with the provision of the necessary equipment for the experimental work at present planned. This includes an air channel 4 feet square in section by 20 feet long for general work in aërodynamics, a whirling table 60 feet in diameter for propeller testing, in a special building 80 feet square; dynamometers for motor testing, with arrangements for an air blast for air cooling; and two wind towers for work on a large scale in the open. All this apparatus has been erected, and experiments have been for some time in progress. The division is under the charge of Dr. Stanton as superintendent of the engineering department, and his great experience on the subject of wind pressure will be especially valuable. To provide the increased accommodation necessary, two more bays have been added to the engineering building.

The testing of balloon fabrics also constitutes an important branch of the work. Tensile and bursting tests have been carried out in the engineering department, while in the chemical department a special apparatus has been devised for the determination of the permeability to hydrogen. We may, perhaps, be able on another occasion to give further particulars of the aëronautical equipment.

Turning now to the physics department, in the electrical standards division good progress has been made with the erection of the Lorenz apparatus for the determination of the ohm in absolute measure, and this is now nearly complete. The coils, wound on marble cylinders, have been made in the laboratory; the main part of the machine, by the kindness of Sir Andrew Noble, has been constructed at Elswick. The determinations to be made with this will be the chief work in this division during the current year. With regard to standard cells, a research has been in progress to determine the limits of temperature between which cadmium amalgams of various concentration can be usefully employed, the results of which were communicated to the Physical Society by Mr. F. E. Smith in a recent paper. The general conclusion arrived at is that an amalgam containing 12½ per cent. of cadmium cannot safely be used below 12° C., and the substitution of a 10 per cent. amalgam is recommended. This can be relied upon to give constant results at a definite temperature for all temperatures between 0° and 51° C.

We have previously made reference to the new order in council lately issued relative to the electrical units, the outcome of the work of the International Conference in London in 1908. To complete the work of the conference, representatives from the chief standardising laboratories are to meet at Washington shortly to continue jointly the researches necessary to decide on a definite value for the E.M.F. of the Weston cell.

Another matter in which international cooperation is being arranged is the question of the methods of measuring hysteresis and eddy loss in steel sheet. A modification of the Epstein method has recently been devised by the Bureau of Standards which appears to give accurate results, and investigations relative to this question have been in progress at the laboratory.

In the electrotechnics division much attention has been given to perfecting the equipment for alternating-current measurements. Features of special interest are the non-inductive water-cooled tube resistances, described in a paper communicated to the Institution of Electrical Engineers, and the quadrant electrometer for use as an alternating-current wattmeter. The 100,000-volt transformer equipment has been completed, and has been employed in an investigation into the properties of different varieties of ebonite, while a research on insulating materials is in progress. In the photometry section a considerable amount of work has been done towards setting up sub-standards for use in measurements of metallic filament lamps. The determination of the candle-power of these in terms of the pentane standard involves a comparison between lights of different colour, and in the process of stepping up as many observers as possible must be employed to obtain a representative mean.

Early in the past year an agreement was arrived at between the authorities in America, France, and this country as to a common light unit, the American unit being altered by 1·6 per cent. to bring it into agreement with the British unit expressed in terms of the 10-candle Harcourt pentane lamp.

In the thermometry division the work has consisted in great measure of improvements in the equipment, especially with the view of the extension of the work on the fundamental gas scale to higher temperatures. It is hoped that a useful material for gas-tight vessels has been obtained, but further progress required power for heating larger furnaces, which has now been provided.

In the metrology division an interesting experiment is being tried in the use of silica as a material for standards of length. The advantages are a low coefficient of expansion and small thermal hysteresis, *i.e.* the temporary change in length due to a cycle of temperature change is small. A standard has been constructed with flat and parallel end slabs fused into a hollow cylindrical rod, the slabs being platinised to receive the divisions. The study of this standard will be continued during the present year.

Important additions have been made to the sets of standard screw gauges in the possession of the laboratory. These now comprise complete series of British standard Whitworth threads, British standard fine threads, British standard electrical conduit gauges, and B.A. threads. They have been constructed by Armstrong, Whitworth and Co. to the dimensions laid down by the Engineering Standards Committee. Two large machines for pitch and diameter measurements are also being constructed at Openshaw.

The 50-metre mural base for verification of surveying tapes has been completed. The length of this base is stepped out against a 4-metre standard bar, itself determined against the standard metre. Another important piece of work has been the re-erection of the Blythswood ruling machine for ruling diffraction gratings. By shifting the periodic error connecting cam from one end of the screw to the other, the length of grating which can be ruled has been increased from 5 to 8 inches. The exact setting of the periodic error cam alone remains to be done to enable the ruling of gratings to be commenced.

A useful piece of work in the optics division has been the devising of a new apparatus for testing photographic shutters. The method is essentially that of Sir Wm. Abney, with the use of a vibration galvanometer in place of a siren as a time recorder.

In the engineering department a large number of researches are in progress. Dr. Stanton is continuing his wind-pressure work, as well as the research on the resistance of materials to alternating stresses of high frequency. Some very interesting results have been obtained with regard to the heat transmission and friction of air currents in pipes, and a paper on the resistance of plates and models in a uniform current of water was communicated to the Institution of Naval Architects. The water channel used for these experiments has been utilised also for work in connection with aëronautics, and gives results closely comparable with those obtained in an air channel, allowance, of course, being made for the difference in density. A valuable paper by Mr. Bairstow on the elastic limits of material under alternating stress has been published in the Philosophical Transactions, and contains interesting experimental conclusions relative to the theory of fatigue. Another research of importance which is in progress relates to the strength and efficiency of welded joints, from which the preliminary conclusions have been reached that the material at a welded joint is often in a dangerously brittle state, and that a long weld is essential to secure even moderately good results.

In the department of metallurgy and metallurgical chemistry, the work done for the Alloys Research Committee of the Institution of Mechanical Engineers was embodied in the ninth report, on some alloys of copper, aluminium, and manganese, presented to the institution early in 1909. Further work on the light alloys of aluminium is in progress. The eutectics research, on which a first communication appeared in 1908 in the Philosophical Transactions, has been continued, attention being especially directed to the mode of solidification of eutectic alloys. A preliminary account of an investigation into the effects of strain at high temperatures, recently published in the Proceedings of the Royal Society, presents features of interest. It was established that deformation by intra-crystalline slip occurs at temperatures up to 1100° C., while the three allotropic modifications of iron known as α, β, and γ iron showed marked differences in the effects of strain. A number of cases of failure in practice have been investigated, and in connection with these a systematic study is being made of the modes of fracture of steel.

The work of the observatory departments of the laboratory, at Kew and Eskdalemuir, is of a distinct character, and need not be referred to now in detail. Mention must, however, be made of the admirable piece of work completed by Dr. Chree, in the discussion of the magnetic curves of the National Antarctic Expedition of 1902–4, printed in the volume of "Magnetic Observations" issued by the Royal Society early last year.

INSTITUTION OF NAVAL ARCHITECTS.

THE spring meetings of the Institution of Naval Architects commenced on Wednesday, March 16, in the rooms of the Royal Society of Arts. The institution has now completed its first fifty years of existence, and proposes to celebrate its jubilee by special meetings commencing on July 4. The council also recommended that the present time is favourable for applying for incorporation under a Royal charter, an opinion which was endorsed by the members at the Thursday meeting. A presidential address was delivered by Earl Cawdor, and premiums were awarded to Dr. T. E. Stanton and Mr. H. C. Anstey for papers, respectively, on the resistance of thin plates and models in a current of water, and on the application of internal-combustion engines for marine propulsion. Thirteen papers in all were presented at the meetings, abstracts from some of which we give below.

A systematic series of experiments on wake and thrust deduction has been carried out recently at the experimental tank of Messrs. John Brown and Company's establishment at Clydebank, and form the subject of a paper contributed by Mr. W. J. Luke. Experiments were made with twin and with single screws, and in all cases where twin screws were run the experiments were made in both directions of rotation. The work involved the carrying out of at least 2000 experiments. The effective horse-power may be expressed as the product of the thrust horse-power and the hull efficiency, the latter quantity being the product $(1+w)(1-t)$, where w is the wake fraction and t is the fraction of the total thrust by which the tow-rope resistance is less than the thrust exerted by the screw when propelling the ship. The experiments were directed towards determining the variations in w and t when (*a*) speed, (*b*) diameter, and (*c*) pitch ratio were varied. With naked models a decrease in wake fraction is evident with an increase of speed; changes which appeared for variations in diameter might be as much owing to alterations in clearance; variation in pitch had little or no effect on either of the hull-efficiency elements.

Prof. B. Hopkinson, in his paper on the measurement of shaft horse-power by torsion-meters, directed attention to the need for further experimental work on full-sized shafts with the view of ascertaining whether twist may be produced by means of a longitudinal push or pull. Such would imply, if no torque be applied, a peculiar structure of the shaft, which might be described as a helical arrangement of the fibres. Mr. C. E. Stromeyer gave results of his observations of the brittleness of mild steel due to nitrogen. It has not yet been possible to combine nitrogen with steel by merely heating the two together, but this may be effected by heating steel in an atmosphere of ammonia. Ammonia may be present in blast furnaces if the coking of the fuel has not entirely removed the nitrogen which was present in the coal. It also seems that, when nitrogen has once entered pig-iron in the blast-furnace, it cannot be removed by subsequent heating. It seems desirable to ascertain more definitely by further experiments how titanium acts in practice in the removal of nitrogen from steel.

A very important paper was presented by the Hon. C. A. Parsons on the application of the marine steam turbine and mechanical gearing to merchant ships. The steam turbine has not hitherto been applied to vessels of slow normal speed on account of the high initial cost and inferior economy in steam. No promising scheme has, as yet, been evolved whereby the efficient speed of the turbine may be reduced and that of the propeller increased for vessels of 12 knots sea speed and under. The only approach of meeting these conditions has been in the combination system of reciprocating engines and turbines, in which the lower stages of the expansion are effected in the turbines.

Provided the losses in transmission, first cost, and cost of maintenance are not too great, the most satisfactory solution for slow-speed vessels would appear to be by means of gearing. Mechanical, electrical, and hydraulic gearing have been proposed or applied, and the author proceeded to give an account of his successful experiments in developing a mechanical gearing.

Helical and double helical gear wheels of fine pitch were probably first introduced by De Laval in connection with his turbine, and have proved to be very satisfactory and efficient. Mr. Parsons has had several sets made. One of these, made in 1897, gearing from 9600 revolutions of the turbine to 4800 of the dynamo, transmitted 300 horse-power with an efficiency of more than 98 per cent. This gear ran fourteen hours a day for about a year. Recent and better cut gears have given a total loss in the gear-case of 1·5 per cent., including friction of gear and bearings.

The author was thus led to experiment with a view to obtain comparative figures for a cargo vessel, first fitted with ordinary reciprocating engines, and then with turbines and mechanical gearing of the above-mentioned type. The *Vespasian* was purchased for this purpose. Her dimensions are:—length on load water-line, 275 feet; breadth moulded, 38 feet 9 inches; depth moulded, 21 feet 2 inches; mean loaded draught, 19 feet 8 inches; displacement, 4350 tons. The vessel was first fitted with triple-expansion surface-condensing engines of ordinary pattern, cylinders 22½ inches by 35 inches by 59 inches, and 42-inch stroke. There were two boilers, each 13 feet in diameter and 10 feet 6 inches long, of total heating surface 3430 square feet, and grate area of 98 square feet. The working pressure was 150 lb. per square inch. A four-bladed cast-iron propeller was fitted, having a diameter of 14 feet, pitch 16·35 feet, and expanded area of 70 square feet.

Before proceeding on the experimental voyage from the Tyne to Malta, the reciprocating propelling machinery was completely dismantled and overhauled. The machinery was thus brought into an efficient and first-class working order. Suitable tanks were provided for measuring the steam consumption. Loaded with a cargo of coal, the *Vespasian* left the Tyne on June 26, 1909, and careful measurements of coal and water consumption were made throughout the voyage by a special recording staff.

On the completion of this voyage the vessel returned to the turbine works, the reciprocating engines were removed, and turbines and gearing fitted. The importance of these trials lies in the fact that the only alteration made in the vessel was in the type of propelling engines. Boilers, propeller, shafting, and thrust blocks remained the same as for the reciprocating engine.

The turbine machinery consisted of two turbines in series, one high-pressure and one low-pressure, the high-pressure turbine being on the starboard side of the vessel and the low-pressure on the port side. At the after end of each turbine a driving pinion is connected, having a flexible coupling between the pinion shaft and the turbine, the pinion on each side of the vessel being geared into a wheel which is coupled to the propeller shaft. A reversing turbine is incorporated in the exhaust casing of the low-pressure turbine. The usual air, circulating, feed, and bilge pumps are driven from the forward end of the gear-wheel shaft. The turbine and pinion shaft bearings are under forced lubrication; the teeth of the gear wheels are lubricated by means of a spray pipe extending over the whole width of the wheel face.

The high-pressure turbine is 3 feet maximum diameter by 13 feet over-all length, and the low-pressure 3 feet 10 inches in diameter by 12 feet 6 inches in length. The turbines were balanced for steam thrust only, the propeller thrust being taken up by a thrust block. A new condenser with a vacuum augmentor was fitted. The gear wheel is cast iron with two forged steel rims shrunk on. This wheel is 8 feet 3½ inches in diameter of pitch circle, and has 398 double helical teeth of circular pitch 0·7854 inch. The total width of face of wheel is 24 inches; the teeth have an inclination of 20° to the axis. The pinion shafts are of chrome nickel steel, 5 inches diameter of pitch circle, with twenty teeth of 0·7854 circular pitch. The ratio of the gear is 19·9 to 1.

On completion of the alterations, at the end of February of this year, the vessel was loaded to the same draught and displacement as that recorded for progressive trials on the Hartley mile with reciprocating engines. In the short interval since the completion of the alterations the vessel has been out to sea on four occasions.

Mr. Parsons gives full information and curves showing the results of the trials. We abstract the following important figures from these.

Water Consumption per Hour, for all Purposes.

Revolutions of propeller	Speed of vessel, knots	Lbs. of water per hour: Reciprocating engines	Lbs. of water per hour: Turbines	Saving, per cent.
60	8·87	11,750	10,750	8·5
65	9·55	14,500	12,600	13
70	10·2	17,500	14,750	16

The turbines and gearing have given no trouble, and have worked satisfactorily, with very little noise or vibration, throughout the trials. There is no appreciable wear on the teeth or bearings. It is proposed to put the vessel into commission and run extended trials. Mr. Parsons further added that the saving in weight on installing the turbines amounted to 25 per cent.

Speakers in the discussion were unanimous in commending Mr. Parsons for his success, which is likely to revolutionise the means of propulsion of tramp steamers, which, as Sir William White remarked, form the backbone of mercantile business. Prof. Ewing pointed out the greater simplicity of mechanical gear as compared with electrical, and also directed attention to its much higher efficiency. He thought it most appropriate that the solution of this important problem should have fallen to the lot of the inventor of the steam turbine. The economy of Mr. Parsons's new system could be simply expressed as the saving of one boiler in six required for ordinary reciprocating engines.

AN INSTRUCTIVE EARTH MODEL.

AT the Hotel Cecil on March 17 Mr. G. R. Gill showed a large model of the earth which, while large enough to admit of the representation of surface features in detail, can be packed into a comparatively small cabinet. A rectangular box 5 feet by 3 feet by 1¼ feet is wheeled easily into position, the folding lid is opened, a quadripod arrangement is raised and made rigid, a steel axis with aluminium ends is slipped into position, eighteen meridians are fitted into the ends and stay in place by their own elasticity, the three parts which go to form the equator are placed by the side of the box, and this gives the arrangement of the skeleton globe which is shown in Fig. 1.

The slope of the axis is adjustable to any angle, that of 23½° being noted by a bell signal. The globe can be made to rotate by hand or by electric motor. The diameter of the globe is 4 feet 2¼ inches, which gives a scale of $1/10^6$. The meridians are made of twelve thicknesses of very thin wood cemented and rivetted together.

The equator is then fixed, and from a cupboard thirty-six sections are taken and fitted into place. Fig. 2 shows the operation of inserting the last section, and shows, approximately, the height of the erected globe. The sections are of mild steel faced with *papier-mâché*, and are sufficiently strong to resist fairly rough treatment. The surface shown in Fig. 2 is that of the earth in relief, where the scale is $1/5 \cdot 10^5$, giving an exaggeration of twenty times. This surface shows the relief of the land, the depressions of lakes and rivers, while the limits of pack- and drift-ice in the Polar regions are ingeniously marked. From the scientific point of view it is perhaps a pity that the relief of the ocean beds has not been shown, as one of the important advantages of a globe on this scale appears to be the possibility of an adequate realisation of the gradients of the land surface, and such a conception loses more than half its value when it is limited to the subaërial parts; possibly the inventor, Mr. G. R. Gill, will be able to make sections to show the complete relief of the solid crust.

Other surface sections are available; first, political sections showing by divers colours the great world empires, the railways, the rivers, and the ocean and cable routes; secondly, plain sections on which the demonstrator may draw his own sketches. These sections are interchangeable, so that pupils may be tested as to their power to draw coast lines, &c. The whole globe can be set up in a few minutes, and a few seconds suffice for the changing of sections. Additional attachments are provided so that the large globe may be used to represent the sun, and a set of small balls, mounted at varying slopes, the planets; the Pole Star and Ursa Major are represented by a set of small balls to be fixed to the axis. There appears to be no difficulty in arranging the surface sections so that the upper half represents the southern hemisphere.

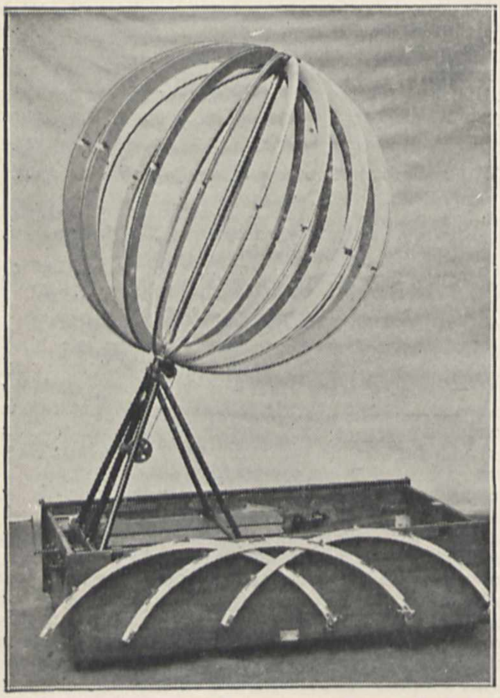


FIG. 1.—Meridians in place.

FIG. 2.—Inserting the last section.

For purposes of measurement, and for the elucidation of "great circle sailing," schoolmasters will probably ask Mr. Gill to supply a thin steel band, graduated in degrees, which could be used to demonstrate and measure the shortest distance between two places upon the earth.

The model is sufficiently large and rigid that a youth may climb into and hide within the interior, and it is probable that for teaching purposes the possession of this globe would render the use of wall maps of the continents unnecessary for class work in geography. The teacher of geography by the methods of modern science will find this globe extremely useful, not only as his final resort in summarising the pupils' studies of a definite region, but in putting that region in precise relationship with the neighbouring regions; in our opinion there seems to be no end to the many practical exercises of a "heuristic" nature which pupils could be set, even to the extent of several at a time working on the one globe.

Many little devices suggest themselves at once whereby the main factors of the earth's climatic conditions might become more real; it will suffice to suggest one use of a slightly different nature; the room is darkened, the rays from the lantern are centred accurately on the model, questions of local time and sun time are discussed, and with a needle to represent a stick the shadow exercises so common in school work in the playground are repeated on the globe, with this advantage, that the graph obtained to show the sun's altitude, which took the whole of one school year to make, may now be made in a shorter period, when the work may be carried through without a break. The inventor may be congratulated on the way in which he has surmounted many mechanical difficulties, and in which he has produced an important addition to the apparatus which may be used to teach geography scientifically.

B. C. W.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING.

THE fourth annual report of the president and treasurer of the Carnegie Foundation for the Advancement of Teaching is now available, and deals with the work of the year ending September 30, 1909. It will be remembered that, in dealing with the third report in our issue of June 3, 1909 (vol. lxxx., p. 399), Prof. J. Edgar described at length the scope and character of the foundation, and it is necessary here to deal only with points of interest in the work of the past year.

During the year the foundation granted 115 pensions amounting to 35,400*l*. It is now paying 318 pensions, the cost being 93,200*l*. The professors receiving these pensions are from 139 colleges, distributed over forty-three States of the Union and provinces of Canada. To the accepted list of colleges, that is, to the list the professors of which may regularly receive pensions under fixed rules as a right and not as a favour, seven colleges were admitted during the year. The governors and legislatures of twenty-six other States asked that their universities should also be admitted to the foundation. The fact that only five State institutions, one of these in Canada, have been admitted to the Carnegie Foundation, after a year of administration of the rules under which tax-supported colleges and universities became eligible, testifies to the scrutiny exercised in the admission of institutions. There are now sixty-seven institutions on the accepted list.

The second section of the report is devoted to an examination of the working of the rules for retirement, as shown in the experience of the past four years. As a result of the experience, two changes were made in the rules by the trustees; one extends the benefits of the retiring allowance system so that service as an instructor shall count toward the earning of a retiring allowance. Heretofore only service in the rank of professor was counted toward an allowance. The other change makes retirement after twenty-five years of service possible only in the case of disability unfitting the teacher for active service. Except in the case of such disability, the teacher can, under the rules as now framed, claim a retiring allowance only upon attaining the age of sixty-five. Formerly a professor might retire after twenty-five years of service. This change in the rules does not, however, deprive the widow of a teacher who has had twenty-five years of service of her pension.

The third section of the report is devoted to tax-supported institutions. Agricultural education and the agricultural college are also treated at length. The trustees make clear their intention to ask of the institutions of every State whether the university and the college of agriculture are competing or cooperating parts of a State system of education. The low standards and general demoralisation resulting from the competition of these two types of tax-supported institutions in the various States are pointed out. In the fourth section of the report it is said to be noteworthy that only a small proportion of the colleges and universities calling on the public for support print a straightforward financial statement showing what they do with the money collected from the public. Following the report of the president is the report of the treasurer. In this matter the foundation has followed the advice which it gives to other institutions, and prints a detailed statement, showing, not only the larger items of expense, but even the individual salaries which are paid.

BOSTON MEETING OF THE AMERICAN ASSOCIATION.

EXTRACTS FROM THE ADDRESSES OF SECTIONAL PRESIDENTS.

The Teaching of Physics.

IN his address to Section B (Physics), Prof. K. E. Guthe discussed reforms needed in the teaching of physics. He maintained that the decision as to how physics should be taught rests finally with those men who know the subject, understand the spirit of the science, and for this reason are the only judges of its characteristic educational value. Concerning himself particularly with the teaching of physics in American colleges and universities, he proposed two questions, "May not the preparation which professors give future teachers be faulty?" and "May not the professors' teaching be capable of improvement?" He said he believed both these questions should be answered in the affirmative. The system of the teaching of physics in many American colleges and universities is, he maintained, more adapted to train professional physicists than future high-school teachers. The two should receive a different training. The ideal high-school teacher is one who has passed through a complete and thorough graduate course. At the present time the great majority of American high-school teachers do not go beyond graduation, and Prof. Guthe would deplore any attempt to crowd so much physics into the undergraduate course that the physicist finally turned out lacks the general culture which an undergraduate course should give. American professors of physics should, he insisted, emphasise more problem work in connection with the elementary course. An utter helplessness of many higher classmen in attacking elementary problems is not unusual. The laboratory work given with the elementary course is frequently quite insufficient, and a somewhat advanced course, not in special lines, but covering the whole field, will do an untold amount of good. Finally, there should be a general review of the whole subject from a higher point of view than is possible in the elementary course. The calculus might be a required study for this. At this point subjects might be taken up which have been omitted in the first course; the treatment could be more thorough and more exact. The introduction of such an advanced course would also have a good influence upon the first course. Prof. Guthe advised future teachers of physics to take also a course in meteorology, a short course in dynamo-electric machinery, and an elementary course in instrument-making, all of which might properly be given in the physics department. Such a graded course will produce, he thinks, teachers to whom may be left without hesitancy the question as to how physics should be taught in the high school. The second proposition considered was, "Professors of physics are far from being unanimous in the use of certain terms, and frequently employ the same term to designate two entirely different physical quantities." This means that enough attention is not paid to the very things which make physics so valuable as a training of the mind, namely, clearness of thinking and accuracy of expression. Prof. Guthe cited and considered numerous cases in point, among them being the terms used in connection with pressure, surface tension, measurement of quantities of heat, and fields of magnetic force.

The Study of Solutions.

Prof. Louis Kahlenberg, of the University of Wisconsin, presided over Section C (Chemistry), and in his address dealt with the past and future of the study of solutions.

The study of solutions, he said, was begun with the chemical conception of solutions, and upon this conception many relationships were worked out during the first eighty-seven years of the nineteenth century. The older chemists clearly recognised that whether solution will take place or not in a given case is first of all determined by the chemical nature of the substances brought into contact with each other. They saw that the temperature factor was next in importance, and that pressure was of vital consequence when a gas was under consideration, but of slight importance in the case of solids and liquids. When the conception that solutions are mere physical mixtures came to the foreground, through the introduction of gas analogies and the intense propagandism of the dilute school, the fact that the act of solution is really chemical in character was lost sight of by many able, enthusiastic young investigators. In the ardour of their quest they were misled, and unwittingly they naturally misled others. It is really pitiable to see how physiologists, having thus taken up these misconceptions of the nature of solutions, are still wasting precious time in endeavouring to work out the complicated and very important processes that occur in living plants and animals. In these problems, which are in reality perhaps the very greatest that confront us at the present day, theories of solutions based on gas analogies are of no avail. They are thoroughly misleading, and worse than worthless here.

The clear recognition that solutions are really chemical in character, and that there is no wide gulf that separates the act of solution from other chemical phenomena, will do much toward furthering the future study of the subject. Years of experimental study of the chemical, physical, and physiological properties of a long list of both aqueous and non-aqueous solutions have led to the conviction that the act of solution is chemical, that solutions are chemical combinations, and that we can only make real progress toward a better understanding of the various solutions by recognising this as the basis of all our future work. The efforts to gain a better insight into the different solutions that confront us must be chiefly experimental, rather than mathematical; for in the study of solutions, just as in the study of chemical compounds in the narrower sense of the word, we are continually confronted with discontinuities. Now discontinuous functions cannot be handled mathematically at present, not even by the greatest of our mathematicians, for though work of this kind has been begun, it is still in a very rudimentary stage. It is highly probable, too, that the renewed study of solutions from the chemical point of view will greatly aid us in getting a broader and more correct conception of the nature of chemical action itself. Certainly in living beings we have numerous, fundamental, and deep-seated chemical changes going on continually with apparently the greatest ease at ordinary temperatures and pressures, and it is tantalising that we are unable to comprehend how this is all brought about. In the unravelling of the questions that here confront us a clear recognition that solutions are chemical in nature will be of the greatest service.

Engineering as a Profession.

Prof. G. F. Swain, of Harvard University, addressed Section D (Mechanical Science and Engineering) on engineering as a profession. During the course of his remarks he said:—

The field of engineering is more extensive than that of any of the three so-called learned professions, and the different branches of the profession differ from each other to such an extent as in some cases to have little in common, except a knowledge of the general principles of physics, chemistry, mechanics, and other sciences. The profession of the physician, it is true, is divided into many specialities, but while the throat specialist deals with the throat, and the stomach specialist with the stomach, they are all dealing with the human body, in which all the parts and functions are closely interconnected; but even within the field of what is termed civil engineering, the railroad engineer and the irrigation engineer, or the railroad engineer and the architectural engineer, have little in common.

The work of the engineer as applied to any contemplated project consists essentially of four parts, first, to ascertain whether anything should be done, and, if so, what should be done; second, to design and formulate the means to be employed in doing it; third, to select the proper materials; and, fourth, to carry on the actual work into execution. As the engineer's problem is to adapt the materials, the forces, the sources of power in nature to the use and convenience of man, it is clear that in order to fulfil his calling to the highest extent the engineer should be scientifically trained—that he should be familiar with the fundamental principles which govern natural phenomena. Different branches of science are required in varying degrees in the different branches of the profession, but every engineer should know, and know thoroughly, the fundamental principles of chemistry, physics, mathematics, and mechanics. The engineer should be possessed of the true scientific spirit, loving the study of science for its own sake as well as for its applications, and trained to seek always the truth, the whole truth, and nothing but the truth; but the work of the engineer deals, not with science for its own sake, but with its applications to the practical affairs of men. The engineer must, therefore, be above all a *practical man.* He must not be a pure theorist, a dreamer, a visionary. He must see in his mathematical formulæ a meaning, and not a simple accumulation of letters. The engineer, then, must not only be a scientific man, but he must be, first and foremost, a practical man; and, on the whole, the latter is more important than the former, although it is in the proper combination of the two that the greatest excellence will result.

The engineer, unlike the true man of science or mathematician, does not work in his laboratory or his study—his work is with the affairs of men. Engineering is more than half business, and the successful engineer, therefore, must be to a considerable extent a *business man* and a *financier.*

The profession of the engineer is a wide and varied one, but it requires varied qualifications, and demands pre-eminently an all-round man. It must not be forgotten, however, that without the scientific training, or at least the scientific spirit, the engineer will not attain the highest success. It is also evident that the thoroughly trained and capable engineer will find many opportunities to make himself useful in scientific as well as in administrative positions. He will also find many opportunities for doing general public service to the State or nation. Different men have different ideals of success, but the highest ideal is the one which most involves the idea of public service.

The Principles of Palaeogeography.

In his presidential address to Section E (Geology and Geography), Prof. Bailey Willis, of the University of Chicago, discussed the principles of palæogeography. To summarise his remarks, it may be said that the following were given as the fundamental principles of the science:—

Ocean basins are permanent hollows of the earth's surface, and have occupied their present sites since an early date in the development of geographical features. This principle does not exclude notable changes in the positions of their margins, which have encroached upon continental areas.

Superficial oceanic circulation within the permanent oceans has persisted since an early stage of their existence, essentially in the great drifts which it now follows under the trade winds. It is probable that the present deep circulation of oceanic waters, poleward at the surface and equatorward below the surface, is due to exceptional refrigeration at the pole.

Diastrophism has been periodic. Viewed according to the periodicity of diastrophism, the earth's history falls into cycles, and each cycle into two periods, one of inactivity and another of activity. The periods of inactivity have been long, and during a major part of the duration of any such period the condition of inactivity has been common to the entire surface of the globe. The periods of diastrophic activity have been relatively short, and, as regards the whole surface of the earth in general, not contemporaneous. The great ocean basins are distinct dynamic provinces, and each has experienced periods of diastrophic activity peculiar to its individual history. The epochs of organic deformation are relatively brief. Folding and unconformity are frequently not contemporaneous even in one and the same dynamic province.

The processes of erosion, sedimentation, chemical activity, and organic evolution have been periodically conditioned according to the periodicity of diastrophism. The corresponding physical phenomena exhibit rhythmic changes which repeat similar conditions in like associations.

Erosion has been constant on land surfaces through the activity of some of the subprocesses, decay, denudation, or aggradation, which have never failed to make a record.

Marine sedimentation has sometimes been inconstant. During periods of diastrophic activity, when lands have been high, epicontinental seas small, and marine currents largely confined within deep ocean basins, sedimentation has been dominant; but during periods of diastrophic inactivity, when lands have been low, epicontinental seas extensive, and marine currents active on shallows and straits, sedimentation has failed in consequence of non-deposition or marine scour in appropriate situations.

The criteria of correlation are both physical and organic. The physical facts are basal. The organic forms, though endowed with evolutionary energy, are dependent and sequential.

Evolution of Intelligence.

Prof. C. Judson Herrick in his presidential address to Section F (Zoology) discussed the evolution of intelligence and its organs. In the course of his address he observed:—

Many a boy's brains are curdled and squeezed into traditional artificial moulds before he leaves school. His education is complete, and senile sclerosis of the mind has begun by the time he has learned his trade. For how many such disasters our brick-yard methods in the public schools are responsible is a question of lively interest. We who seek to enter into the kingdom of knowledge and to continue to advance therein must not only become as little children, but we must learn to *continue so.* The problem of scientific pedagogy is essentially this—to prolong the plasticity of childhood, or otherwise expressed, to reduce the interval between the first childhood and the second childhood to as small dimensions as possible. The docile or educational period of a mammal is largely devoted to the progressive mechanisation of the in-born plastic tissue of the higher correlation centres, *i.e.* to habit formation, or otherwise expressed, to the elaboration of acquired automatisms and reflexes of the type commonly referred to as lapsed intelligence. Much confusion has arisen from the failure to distinguish these individually acquired automatisms from those performed in the hereditary pattern, *i.e.* lapsed intelligence from true instinct.

Summarising the argument of his address, Prof. Herrick said:—In our analysis of the behaviour of animals and its mechanisms we start with the tropism and the reflex. This type of response is in some of its simpler phases indistinguishable from the reactions of dead machines to the forces which actuate them; but the more complex reflexes, on the other hand, grade over into those behaviour types which we call intelligent. No one has yet succeeded in formulating a clear-cut definition of the limits of the reflex at either its lower or its higher extreme, and perhaps no one ever will, for the whole list of behaviour types from machines to men probably forms a closely graded series.

Even the simpler reflexes exhibit a measurable refractory phase or pause in the centre where the afferent impulse is made over into the efferent. When reflexes are compounded, there is another factor which may tend to modify or delay the response. This is the dilemma which arises when two or more reflex centres are so related that a given afferent impulse coming to one of them may take any one of several final common paths to the organs of response. The reflex response which actually emerges in such a case will generally be the adaptive one, *i.e.* the one which is best for the organism. The selection of the adaptive response in such a case may be termed *physiological choice*, and it always involves a lengthening of the refractory phase. In the neural tensions of the refractory phase of physiological choice we find the germs of the complex anticipatory reactions which in turn have nurtured the awakening intelligence.

The comparative study of animal behaviour in the broadest sense of the term is as essential as other branches of physiology to the comprehension of animal structures, and the enlargement of our knowledge of scientific fact in this field will contribute greatly to the more perfect integration of the three great branches of biology—anatomy, physiology, and psychology—and the correlation of the whole with other departments of knowledge. Our philosophy of nature is sound just in proportion as we succeed in effecting these correlations of experience.

Response to Chemical Stimulation.

In Section G (Botany) the president, Prof. H. M. Richards, of Columbia University, New York, addressed the members on the nature of response to chemical stimulation. Few, if any, physiologists would, he said, to-day be inclined to deny the ultimate chemical nature of the response of protoplasm to any form of stimulus. It is the purpose here to limit the examination of chemical irritation more especially to actual concrete chemical substances brought into relation with living protoplasm, and to inquire somewhat more particularly into their mode of action and the nature of the changes which they induce. The importance and fundamental nature of these reactions cannot be doubted. For this purpose we may include in the list all those substances which it may reasonably be believed induce, by their chemical action, constitutional changes in protoplasm. These substances may be mineral salts, organic compounds of great diversity of structure, including anæsthetics, which have been, perhaps, wrongly placed in a special class, and even gases of a simple constitution. They may be crystalloidal, electrolytes or non-electrolytes, or perhaps even colloidal.

There are some points in regard to the normal food supply which have a direct bearing upon the question of chemical stimulation, as defined even in its restricted sense. In the case of some of the necessary food materials the concentration may vary within relatively wide limits before the effects of a lack or excess of these substances are observable. In such cases the increase necessary to produce a reaction may readily be so great as to involve a material increment in the isotonic coefficient of the solution, and thus confuse any result produced by any direct chemical stimulus with those initiated by the change in osmotic pressure. It is known, however, that some of the necessary salts which are required by the plant in relatively small quantities may, if the concentration be raised above the normal point, cause a secondary stimulation of growth, and eventually, if the increase be continued, become inhibitory after the manner of poisons.

In its restricted sense, chemical stimulation may be said to deal with the effects of chemical agents which are not only not necessary, but which may be positively deleterious to the organism—poisons, in short. It has been established that many, if not all, classes of substances which exert a toxic action on protoplasm will become stimulatory if presented to the cells in sufficiently small doses. Somewhere between an infinitesimally weak solution which produces no reaction to the toxic dose which kills there is a stimulative optimum which gives the maximum of reaction. The question is not the possible ultimate lethal effect of these poisons, but how far they may serve to excite the protoplasm to extraordinary activity. The amount required to effect the latter result will naturally vary with the substance, certain mild poisons possibly never affecting the plant beyond the stage of stimulating growth, no matter how high a concentration was employed.

Prof. Richards concluded by dealing in some detail with the influence of chemical stimulus on the physiological activities of the plant, and why and in what manner the specific irritants used affect the quantitative, and even perhaps the qualitative, formation of enzymes.

Racial Differences in Mental Traits.

In Section H (Anthropology and Psychology) Prof. R. S. Woodworth, of Columbia University, the president of the section, in his address took up the question of racial differences in mental traits.

Our inveterate love for types and sharp distinctions, he said, is apt to stay with us even after we have become scientific, and vitiate our use of statistics to such an extent that the average becomes a stumbling-block rather than an aid to knowledge. We desire, for example, to compare the brain weights of whites and of negroes. We weigh the brains of a sufficient number of each race—or let us, at least, assume the number to be sufficient. When our measurements are all obtained and spread before us, they convey to the unaided eye no clear idea of a racial difference, so much do they overlap. If they should become jumbled together, we should never be able to separate the negroes from the whites by aid of brain weight; but now we cast up the average of each group and find them to differ, and though the difference is small, we straightway seize on it as the important result, and announce that the negro has a smaller brain than the white. We go a step further, and class the white as a large-brained race, the negro as a small-brained. Such transforming of differences of degree into differences of kind, and making antitheses between overlapping groups, partakes not a little of the ludicrous.

We seem to be confronted by a dilemma; for the group, as a whole, is too unwieldy to grasp, while the average, though convenient, is treacherous. What we should like is some picture or measure of the *distribution* of a given trait throughout the members of a group; and, fortunately, such measures and pictures can be had. Convenient and compact measures of variability are afforded by the science of statistics, and are of no less importance than the average; but still better, because closer to the actual facts, are graphic or tabular pictures of the distribution of the trait, showing the frequency with which it occurs in each degree. The distribution of a trait is for some purposes more important than the average.

After considering certain precautions and criticisms, Prof. Woodworth dealt in order with the various senses. The point of special interest is, he pointed out, as to whether the statements of many travellers, ascribing to the "savage" extraordinary powers of vision, hearing, and smell, can be substantiated by exact tests. The common opinion, based on such reports, is, or has been, that savages are gifted with sensory powers quite beyond anything of which the European is capable, though Spencer explains that this is a cause of inferiority rather than the reverse, because the savage is thus led to rely wholly on his keen senses, and to devote his whole attention to sense impressions, to the neglect and atrophy of his intellectual powers.

Sight, hearing, smell, touch, the pain sense were each considered in detail, and Prof. Woodworth came to the conclusion that, on the whole, the keenness of the senses seems to be about on a par in the various races of mankind. Differences exist among the members of any race, and it is not improbable that differences exist between the averages of certain groups, especially when these are small, isolated, and much inbred. Some interest, said

Prof. Woodworth later, attaches to tests of the speed of simple mental and motor performances, since, though the mental process is very simple, some indication may be afforded of the speed of brain action. The reaction time test has been measured on representatives of a few races, with the general result that the time consumed is about the same in widely different groups.

Chemical Regulation of the Processes of the Body.

Prof. W. H. Howell, of the Johns Hopkins University, delivered the presidential address in Section K (Physiology and Experimental Medicine). He summarised the present state of knowledge of the chemical regulation of the processes of the body by means of activators, kinases, and hormones. The chief points touched upon are as given in the following brief abstract.

In recent years we have come to understand that the complex of activities in the animal body is united into a functional harmony, not only through a reflex control exerted by the nervous system, but also by means of a chemical regulation effected through the blood or other liquids of the organism. Having referred to Brown-Séquard's generalisation, according to which every tissue of the body in the course of its normal metabolism furnishes material to the blood that is of importance in regulating the activities of other tissues, Prof. Howell said in recent years it has been re-stated in attractive form by Schiefferdecker in his theory of the symbiotic relationship of the tissues of the body. According to this author, we may conceive that among the tissues of a single organism the principle of a struggle for existence, which is so important as regards the relations of one organism to another, is replaced for the most part by a kind of symbiosis, such that the products of metabolism in one tissue serve as a stimulus to the activities of other tissues. From many sides and in many ways facts have been accumulating which tend to impress the general truth that the co-activity of the organs and tissues may be controlled through chemical changes in the liquid media of the body as well as through nerve impulses, but in physiology, at least, we owe the definite formulation of this point of view to Bayliss and Starling. Starling's convenient term of "hormone" as a general designation for such substances has served to give a wide currency to the conception.

In treating this subject one must consider also the more or less nearly related instances of combined activity of a chemical sort which are expressed by such terms as chemical activators, kinases, and co-ferments. These terms, like that of hormone, are relatively new; they have been brought into existence by investigators to explain or to express special reactions connected with metabolism, and particularly with the action of ferments. The word activator has reference to the fact, long known, that the ferments, or some of them at least, are secreted in an inactive form, a proferment, which is activated or converted to an active form by a reaction with some definite substance produced elsewhere in the body.

The term kinase is used at present in animal physiology in connection with two reactions only. In both cases it refers to an activating process where the activator is a colloidal substance of unknown composition.

In addition to the activators of the inorganic and the colloidal type, there is perhaps a third kind of activation exemplified in the substances known as co-enzymes or co-ferments. This term may be used to define that kind of cooperative activity between an enzyme and some other non-colloidal substance which we see illustrated in the influence of the bile salts upon pancreatic lipase. The process differs from activation of a proferment to a ferment only in that the combination of the enzyme with its activator is dissociable instead of being permanent. By dialysis or otherwise the co-enzyme can be separated from the enzyme, and the action of the two may be tested separately or in combination. Starling defines hormones as chemical messengers which, formed in one organ, travel in the blood stream to other organs of the body and effect correlation between the activities of the organ of origin and the organs on which they exert their specific effect. Such substances belong to the crystalloid rather than the colloid class; they therefore are thermostable, and do not act as antigens when injected into the living animal.

The substances of known composition which may be regarded as playing the *rôle* of hormones are few in number, three or four at most, as follows:—first, the carbon dioxide formed in the tissues, particularly in muscle during contraction; secondly, the adrenalin of the adrenal glands, which in some way, directly or indirectly, makes possible the full functional activity of the involuntary musculature of the body; thirdly, the hydrochloric acid produced in the stomach, which stimulates the formation of secretin in the duodenal epithelium; and, fourthly, possibly the iodothyrin of the thyroid gland, with its dynamogenic effect upon the neuro-muscular apparatus of the body. In addition, there are a number of hormones of unknown composition which have been either proved or assumed to exist, and are held responsible for certain well-known correlations of function.

Method and Matter of Science.

Under the title "Science as Subject-matter and as Method," Prof. John Dewey, of Columbia University, in his presidential address to Section L (Education), introduced the question of how far the science teaching in schools has up to the present been educational in the true sense.

All, he said, who are much interested in securing for the sciences the place that belongs to them in education feel a certain amount of disappointment at the results hitherto attained. The glowing predictions made respecting them have been somewhat chilled by the event. Of course, this relative shortcoming is due in part to the unwillingness of the custodians of educational traditions and ideals to give scientific studies a fair show. Yet in view of the relatively equal opportunity accorded to science to-day compared with its status two generations ago, this cause alone does not explain the unsatisfactory outcome. Considering the opportunities, students have not flocked to the study of science in the numbers predicted, nor has science modified the spirit and purport of all education in a degree commensurate with the claims made for it. The causes for this result are many and complex. One influential cause, the remedy for which most lies with scientific men themselves, is that science has been taught too much as an accumulation of ready-made material with which students are to be made familiar, not enough as a method of thinking, an attitude of mind, after the pattern of which mental habits are to be transformed.

The infinitely extensive character of natural facts and the universal character of the laws formulated about them is sometimes claimed to give science an advantage over literature; but viewed from the standpoint of education, this presumed superiority turns out a defect; that is to say, so long as we confine ourselves to the point of view of subject-matter. Just because the facts of nature are multitudinous, inexhaustible, they begin nowhere and end nowhere in particular, and hence are not, just as facts, the best material for the education of those whose lives are centred in quite local situations and whose careers are irretrievably partial and specific. If we turn from multiplicity of detail to general laws, we find, indeed, that the laws of science are universal, but we also find that for educational purposes their universality means abstractness and remoteness.

One of the most serious difficulties that confronts the educator who wants in good faith to do something worth while with the sciences is their number and the indefinite bulk of the material in each. At times it seems as if the educational availability of science were breaking down because of its own sheer mass. There is at once so much of science and so many sciences that educators oscillate, helpless, between arbitrary selection and teaching a little of everything. Science teaching has suffered because science has been so frequently presented just as so much ready-made knowledge, so much subject-matter of fact and law, rather than as the effective method of inquiry into any subject-matter.

We define science as systematised knowledge, but the definition is wholly ambiguous. Does it mean the body of facts, the subject-matter? Or does it mean the processes by which something fit to be called knowledge is brought into existence, and order introduced into the flux of experience? That science means both of these things will doubtless be the reply, and rightly; but in the order both of time and of importance, science as method precedes science as subject-matter. Systematised knowledge is science only because of the care and thoroughness with which it has been sought for, selected, and arranged. Only by pressing the courtesy of language beyond what is decent can we term such information as is acquired ready-made, without active experimenting and testing, science. The force of this assertion is not quite identical with the commonplace of scientific instruction that text-book and lecture are not enough—that the student must have laboratory exercises. A student may acquire laboratory methods as so much isolated and final stuff, just as he may so acquire material from a text-book. One's mental attitude is not necessarily changed just because he engages in certain physical manipulations and handles certain tools and materials. This problem of turning laboratory technique to intellectual account is even more pressing than that of utilisation of information derived from books. Almost every teacher has had drummed into him the inadequacy of mere book instruction, but the conscience of most is quite at peace if only pupils are put through some laboratory exercises. Is not this the path of experiment and induction by which science develops?

It must not be supposed that, in dwelling upon the relative defect and backwardness of science teaching, the intention is to deny its absolute achievements and improvements, but it must be pointed out that only to a comparatively slight extent has the teaching of science succeeded in protecting the so-called educated public against recrudescences of all sorts of corporate superstitions and silliness.

It is not to be expected that our schools should send forth their students equipped as judges of truth and falsity in specialised scientific matters; but that the great majority of those who leave school should have some idea of the kind of evidence required to substantiate given types of belief does not seem unreasonable. Nor is it absurd to expect that they should go forth with a lively interest in the ways in which knowledge is improved and a marked distaste for all conclusions reached in disharmony with the methods of scientific inquiry.

The future of our civilisation depends upon the widening spread and deepening hold of the scientific habit of mind, and the problem of problems in our education is therefore to discover how to mature and make effective this scientific habit. Mankind, so far, has been ruled by things and by words, not by thought, for until the last few moments of history humanity has not been in possession of the conditions of secure and effective thinking. Without ignoring in the least the consolation that has come to men from their literary education, it is not too much to say that only the gradual replacing of a literary by a scientific education can assure to man the progressive amelioration of his lot. Unless we master things we shall continue to be mastered by them; the magic that words cast upon things may indeed disguise our subjection or render us less dissatisfied with it, but, after all, science, not words, casts the only compelling spell upon things.

The modern warship seems symbolic of the present position of science in life and education. The warship could not exist were it not for science—mathematics, mechanics, chemistry, electricity supply the technique of its construction and management; but the aims, the ideals in the service of which this marvellous technique is displayed, are survivals of a pre-scientific age, that is, of barbarism. Science has as yet had next to nothing to do with forming the social and moral ideals for the sake of which she is used. Even where science has received its most attentive recognition, it has remained a servant of ends imposed from alien traditions. If ever we are to be governed by intelligence, not by things and by words, science must have something to say about *what* we do, and not merely about *how* we may do it most easily and economically; and if this consummation is achieved, the transformation must occur through education, by bringing home to men's habitual inclination and attitude the significance of genuine knowledge and the full import of the conditions requisite for its attainment. Actively to participate in the making of knowledge is the highest prerogative of man and the only warrant of his freedom. When our schools truly become laboratories of knowledge-making, not mills fitted out with information-hoppers, there will no longer be need to discuss the place of science in education.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—Committees of members and friends of the University have procured contributions amounting to some 1500*l.* for the purpose of commemorating the services of Dr. John Cleland, regius professor of anatomy from 1877 to 1909, and Dr. William Jack, professor of mathematics from 1879 to 1909, who retired last year. It has been decided to present to the University a portrait of Dr. Cleland, painted by Sir George Reid, with a replica for Mrs. Cleland; and a portrait of Dr. Jack, painted by Sir James Guthrie, and also a prize, to be awarded at intervals, for the best thesis on a mathematical subject approved for the degree of Doctor of Science during the preceding period.

The University Court and Senate have had under consideration a proposal, emanating from the general council of graduates, for the establishment within the University of an order of independent lecturers, analogous to *privat-docenten*, who should give courses of lectures qualifying for graduation, and duplicating those already given by the regular professors and lecturers. The new lecturers were to be provided with class-room accommodation, and were to depend for their remuneration on the amount of fees received from students attending their classes. After a prolonged discussion, in which the Senate expressed the opinion that the proposal was not likely to contribute to educational efficiency, and the finance committee that it would seriously disarrange the University funds, the Court decided that effect could not be given to the scheme under the existing constitution of the University.

The University Court has sanctioned the establishment of a new course of instruction in chemistry, including metallurgical chemistry, for students of engineering. The course will be given by Dr. Cecil H. Desch, and will extend over the first two terms of the session. The ordinary course by Prof. Ferguson will be attended by students of arts, medicine, and pure science. Dr. Desch announces a course in metallography during the summer session.

THE Civil Service Estimates in class iv. (education, science, and art), just issued as a White Paper, show a net increase for 1910–11 of 697,718*l.* over the figures for 1909–10. The total estimates of 18,651,483*l.* for the ensuing year include the following:—Board of Education, 14,064,677*l.*, increase 417,663*l.*; British Museum, 175,895*l.*, decrease 3333*l.*; scientific investigation, &c., 74,228*l.*, increase 9764*l.*; universities and colleges, Great Britain, and intermediate education, Wales, 218,100*l.*, increase 700*l.* Scotland: public education, 2,253,725*l.*, increase 106,434*l.*; Ireland: public education, 1,656,901*l.*, increase 34,980*l.*; endowed school commissioners, 925*l.*, increase 5*l.*; universities and colleges, 168,080*l.*, increase 139,930*l.*; Queen's Colleges, nil (last year 4700*l.*).

A DEPUTATION from the Trade Union Congress waited upon Mr. Runciman, President of the Board of Education, on March 17 to urge, among other matters, technical training in day-time classes, the raising of the school age, entirely free secondary education, and the appointment of a Royal Commission to inquire into the misappropriation of educational endowments. In replying, Mr. Runciman said he hopes that by next Session a Bill will be introduced which will deal partly with the raising of school age and partly with the question of day technical classes. If day technical classes are to be of much use, there must be pressure brought to bear on employers. All educationists desire to see the school age raised. Children who leave school at thirteen or fourteen know practically nothing about arithmetic or writing with ease. This deplorable state of things can be remedied in two ways, by raising the school age and by bringing the technical classes nearer to them. Trade unionists, he said, can do as much towards the advancement of education as Parliament can. Dealing with free places in secondary schools, Mr. Runciman said that, taking the whole of the secondary schools of this country in 1907–8, there were 2 per cent. more than the 25 per cent. standard, while in 1909–10 31 per cent. of the total places in the secondary schools were free places.

The State is making a change in many of the endowed charities which are scattered all over the country. In the course of time it will be possible, not only to apply the whole of the educational endowments to the original purposes of their founders, but to combine the small endowments so as to make them effective.

THE issue of the Journal of the Association of Teachers in Technical Institutions for January contains a paper by Mr. John Wilson, the president of the association, on the relation of the technical institution to the modern university. After commenting upon the advanced character of much of the teaching carried on in technical institutions, and mentioning the creditable amount of research work published yearly by the staffs and senior students of these schools and colleges, Mr. Wilson gave some interesting statistics as to the students who graduated in science at the University of London during 1909. It appears that altogether 292 candidates were awarded the degree of B.Sc., and that 57 of these studied entirely at technical institutions, while if the students who did part of their work at a technical institution are included, the number reaches 80. Mr. Wilson also gives the numbers of registered "internal" students and "recognised" teachers in London polytechnics, and compares the total with those in the case of certain other London colleges. During the session 1908–9, the number of registered internal students in the faculty of science was:—at University College, 224; King's College, 175; East London College, 162; and at eight "recognised" polytechnics, 372. In these eight polytechnics there are 94 "recognised" teachers of arts, science, and engineering. In other words, the polytechnics have become important centres of university work. Mr. Wilson maintains that the success of even the limited recognition of London polytechnics by the University of London clearly points to the desirability of the extension of that recognition by the University and to a widely increased measure of recognition of local technical institutions by the provincial universities.

AT a meeting of the Royal Dublin Society on March 9 Prof. Senier delivered a lecture on "The University and Technical Training." From the account of the meeting in the *Irish Times* of March 10 we learn that Prof. Senier considered four types of institutions for the advancement and diffusion of learning and of its applications to society; institutions of acknowledged university rank or residential college universities, exemplified by Oxford; the research university, as seen at Berlin; the examination university, first known in Napoleon's University of Paris; and the technical research university, Charlottenburg. In England, he said, where numerous new universities have been established in recent years, the type adopted has been a combination of the German Research University and the German Technical Research University, the one or the other type predominating, according to local needs, and the whole adapted to its surroundings, particularly to the conditions of secondary education. Whatever view may be held respecting the German practice of separating these two types, as adapted to German conditions, Prof. Senier thinks that for the conditions which prevail in the British Isles the combination of the two in new universities is a wise arrangement. The two new universities in Ireland are also of this combined type, and are to be adapted to Irish educational conditions and the needs of the country. After directing attention to the influence Liebig exerted through his students in the direction of scientific research, Prof. Senier said so great is that influence that science laboratories after the model of Giessen have become the recognised attribute of science professorships throughout the world. Another advantage possessed by the German university is the character of the leaving examination of the secondary school. It corresponds to a matriculation examination, with the added knowledge acquired by about two years' university study in arts, and its acceptance by the university as evidence of sufficient knowledge for matriculation relieves the university of the practice of giving the student an examination as his first experience on entering. In Prof. Senier's opinion secondary schools should abandon all attempts to teach experimental science. To rival the work of the German universities the better organisation and coordination of the entire educational system is necessary. Germany has built up a chemical industry with tens of millions of pounds annually through the agency of research chemists, methodically trained in technical schools. German manufacturers know the value in dividends of the services of trained research chemists; Irish and English manufacturers do not.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, February 25.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Prof. J. **Perry**: Telephone circuits. The author published a paper in the Proceedings of the society in 1893 showing how voltage v and current c are attenuated along a telephone or submarine telegraph line, a line with resistance r, capacity k, inductance l, and leakance s per unit length; currents are of the form $\sin qt$. When lq/r is considerable the mathematical expressions become simple. It was pointed out that the introduction of l is of great benefit. The author now points out that k may be made negative by the use of inductance leaks to earth, and l may be made negative by the use of condensers in series with the line. To introduce l, as Mr. Pupin has done, by inductance coils at equidistant places on the line, or to introduce the other properties mentioned by placing other contrivances at equal distances, is a mathematical problem of great complexity. Contrivances placed close together have the same effect as the continuous distribution of properties, but there is considerable expense; the problem is to find how far apart the contrivances may be placed so that the effect produced shall still be beneficial. Mr. Pupin has given a rule for the spacing of his coils, but practical men dispute its accuracy; nobody has given a rule for other contrivances; the object of the author is to give an easy method of calculation which is practically correct, and can be used when the contrivance is any network or other combination of resistances, inductances, and capacities—some being leaks to earth—and it may include transformers, motors, and generators. Suppose there are contrivances at the equidistant places A, B, &c., m miles apart in a cable which has the above-mentioned properties r, k, l, and s. There is a contrivance the terminals of which are A and A_0, another the terminals of which are B and B_0; between A_0 and B there is m miles of cable. Let the currents in the line at A, A_0, and B be c, c_0, and C. Let the voltages at these points be v, v_0, and V. The assumption on which the whole method is based is that $V/C = v/c = \rho$. This is practically true everywhere in a long line except near the ends. Now whatever be the nature of the contrivance, we can calculate v_0 and c_0 from v and c. It is also known that

$$V = v_0 \cosh mn + \frac{r+lqi}{n} c_0 \sinh mn,$$

$$C = c_0 \cosh mn + \frac{n}{r+lqi} v_0 \sinh mn,$$

when

$$n = \sqrt{(r+lqi)(s+kqi)}.$$

Putting V/C or ρ equal to v/c, we have a quadratic to calculate ρ, and therefore V and C, and the problem is solved. Taking $c = \sin qt$ and calling it 1, then $v = \rho$. Whatever the contrivance may be, we find that $V = \alpha + \beta\rho$ and $C = a + b\rho$, where α, β, a, and b are given in value; they are usually unreal quantities of the form $M + Ni$, where i is $\sqrt{-1}$. Solving for ρ, and finding C, we have two answers which are reciprocals of one another. If $\frac{1}{2}(a+\beta)$ be called P, and this is very easily evaluated, then

$$C = P \pm \sqrt{P^2 - 1}$$

Examples of the use of the method are given, some showing that the detached contrivances produce much the same and others very different effects from what might have been expected from a study of the cable with continuous properties. It was shown that a line may have contrivances somewhat far apart which will tune it to a musical note merely, so that it acts almost like an ohmic resistance, but which will not transmit well the currents of other frequencies, and that for the commercial transmission of speech there must be a compromise. The author laid stress upon the fact that his method of calculation could be taught to quite non-mathematical people.—Prof. C. H. **Lees**: The laws regarding the direction of thermo-electric currents enunciated by M. Thomas.—H. R. **Nettleton**: New method of determining thermal conductivity.

Mineralogical Society, March 15.—Prof. W. J. Lewis, F.R.S., in the chair.—G. W. **Grabham**: A new form of petrological microscope, with notes on the illumination of microscopic objects. The new instrument, which is of the "Dick" or "English" pattern, has a focussing sub-stage carrying a series of condensers mounted on a triple nose-piece, each capable of being inserted in the axis of the instrument. A new explanation was given of the "Becke" or bright-line effect, especially applicable to parallel polarised light traversing mineral sections, which meet along inclined junctions.—W. F. P. **McLintock**: Datolite from the Lizard district. Datolite, which is associated with calcite, chalcopyrite, and natrolite (rare) in veins and geodes at the junction of the serpentine and hornblende schist, Parc Bean Cove, Mullion, Lizard district, Cornwall, occurs in crystals measuring up to 2 cm. along the *b* axis, and displayed fourteen forms, of which two were new. An analysis gave SiO_2, 37·45; CaO, 34·67; Fe_2O_3 and Al_2O_3, 0·57; B_2O_3, 21·87; H_2O, 5·67; total, 100·23.—Arthur **Russell**: Additional notes on the occurrence of zeolites in Cornwall and Devon. The occurrence of heulandite, a mineral hitherto not recorded from Cornwall, at Carrick Du Mine, St. Ives, Cornwall, was described; also of chabazite and heulandite at the Ramsley Mine, South Tawton, Devon.—Dr. J. W. **Evans**: A modification of stereographic projection. Faces below the plane of projection are represented by the same points as parallel faces above it, upper faces being distinguished by a plus, and lower faces by a minus, sign.—Dr. J. W. **Evans**: Axes of rotatory symmetry. Coincidence is complete or codirectional when equivalent lines and their directions coincide, incomplete or contradirectional when equivalent lines coincide, but equivalent directions of uniterminal lines are opposed; in both cases it is colinear. If a minimum rotation of $2\pi/n$ result in codirectional, contradirectional, or colinear coincidence, the axis of rotation has codirectional, contradirectional or colinear symmetry, with cyclic number *n*.—Prof. H. L. **Bowman** exhibited models illustrating space-lattices and Sohncke's point-systems.

DUBLIN.

Royal Dublin Society, February 22.—Mr. R. M. Barrington in the chair.—Prof. W. **Brown**: Chrome-steel magnets. Eight steels containing from 1·75 to 9·22 per cent. of chromium were tested for magnetic moment per gram, the best result being obtained with a magnet which contained about 2·5 per cent. of chromium.—W. J. **Lyons**: The distribution of mean annual rainfall over the counties of Dublin, Wicklow, Kildare, and Meath. The rainfall over this area varies from below 28 inches to probably more than 60 inches in a very marked manner, closely related to the very striking orographical features of the area. The author suggested that the recognised action of hills in inducing condensation by causing ascensional currents was not an adequate explanation of the marked increase found in the rainfall of hilly districts. He thought it probable that mountains facilitated the processes of rain development, apart from any influence on condensation.—Prof. W. F. **Barrett**: A simple form of open-scale barometer. In form this instrument resembles an air thermometer, only that it indicates variations of atmospheric pressure and is almost insensible to changes of temperature. This is accomplished by making use of a Dewar's liquid-air flask as the air receptacle, into which is sealed a quill glass tubing containing an index of a dense non-conducting liquid. The tube is open to the air at one end, and is sealed into a wider glass tube which surrounds it, and from which the air has been exhausted as completely as possible. It is found in practice that the readings correspond fairly well with those of an ordinary barometer, and as it can be made as sensitive as desired by altering the ratio of the capacities of the bulb and index tube, it is adapted for domestic use as a weather-glass, and claims to be nothing more.

PARIS.

Academy of Sciences, March 14.—M. Émile Picard in the chair.—Henri and Jean **Becquerel** and H. Kamerlingh **Onnes**: The phosphorescence of uranyl salts at very low temperatures. The changes observed in the absorption spectra at temperatures down to that of liquid air have been described in a previous paper. In the present paper details of the spectra are given for the temperatures of 80° C. absolute (boiling nitrogen) and 14° C. absolute (solid hydrogen). The bands approach asymptotically a limiting position as the temperature is lowered. A very strong magnetic field (35,000 Gauss) is without influence on the spectra. Ordinary phosphorescent spectra appear to be due to the effect of traces of impurities in the phosphorescent substance; this is not the case with uranyl salts; the spectra appear to be due to the uranium itself. —H. **Deslandres** and P. **Idrac**: The spectrum of the comet 1910*a*. The arrangement of the spectrograph used is described, and the wave-lengths of the lines observed given. The bands of hydrocarbons and cyanogen were identified.—J. **Boussinesq**: The vertical propagation, at great depths, of the movement of waves by emersion in the case of a canal or basin indefinite horizontally.—MM. **Haller** and Ed. **Bauer**: The alkylation of the fatty ketones by the use of sodium amide. The decomposition of the hexa-alkylketones. Diethylketone has been methylated by sodium amide and methyl iodide, ethyl-isopropylketone, di-isopropylketone, a high boiling condensation product, and tetramethyl-ethylketone, being produced. The hexa-alkylacetones are split up by sodium amide, a trialkylmethane and trialkylacetamide arising from the reaction.—Prof. Hittorf was elected a foreign associate.—Charles **Nordmann**: The absorbing atmospheres and the intrinsic luminosities of some stars.—Jules **Baillaud**, J. **Chatelu**, and M. **Giacobini**: Observation of a minor planet at the Observatory of Paris. The traces of this planet were first noticed by Jules Baillaud on a negative of the international chart of the sky taken on March 3. Observations are tabulated for March 3, 5, 7, 8, 10, and 11.—Frédéric **Riesz**: Certain systems of functional equations and the approximation of continued functions.—L. **Remy**: The algebraic surfaces representable on that of Kummer.—H. **Larose**: The equation of telegraphists.—E. **Estanave**: The simultaneous production of stereoscopic relief and of changing aspect in the photographic image.—Pierre **Weiss** and Kamerlingh **Onnes**. The saturation intensity of magnetisation at very low temperatures. The intensities of saturation have been measured at the ordinary temperature and at the temperature of boiling hydrogen (20° C. absolute) for nickel, iron, and magnetite. The results for cobalt were not satisfactory.—Pierre **Weiss** and Kamerlingh **Onnes**: The magnetic properties of manganese, vanadium, and chromium. For these metals at the temperature of solid hydrogen (14° C. absolute) there was expected either the appearance of ferromagnetic phenomena or a paramagnetism considerably increased according to Curie's law. It was found experimentally that neither of these effects was produced, the magnetic phenomena remaining very slight. The theoretical consequences of these facts are discussed.—P. **Vaillant**: A particular case of evaporation. A study of the diffusion of the vapour arising from a liquid in a cylindrical tube the length of which was great in proportion to its diameter.—Ch. **Féry**: A new reflectometer. A hemispherical cavity is formed in a block of plane glass, and the hole exactly filled by a hemispherical block of glass of the same curvature. The drop of liquid the refractive index of which is to be measured is placed between the two blocks, and the radius of the dark ring formed by total reflection measured. From this and the corresponding radius of the dark ring when air is between the two blocks the index of refraction can be determined with an accuracy of about 0·005.—L. **Bloch**: Chemical actions and ionisation by bubbling. It is shown that the ionisation produced when gases are evolved from a liquid is the result of actions in the liquid surface.—O. **Boudouard**: The testing of metals by the study of the damping of vibratory movements.—M. **Vèzes**: The analysis of essence of turpentine by curves of miscibility. The author's results generally confirm those of M. Louise, but some differences are pointed out.—M. **Lecoq**: A colloidal solution of pure metallic arsenic. A colloidal solution of arsenic can be obtained by the electrolysis of an alkaline solution with arsenic for the anode, or by the electro-reduction of an alkaline solution of arsenious acid. The properties of the solutions thus obtained are described in detail.—J. B. **Senderens**: The catalysis of the aromatic acids. A study of various catalytic substances shows that only thoria, zirconia, and green oxide of uranium are of practical use in this reaction, and of these thoria has the preference. More than thirty aromatic mixed ketones have been obtained by the application of this reaction.—F. **Couturier**: The stability of the β-keto-aldehydes.—G. **Darzens**: A new method of synthesis of unsaturated ketones. Stannic chloride can replace aluminium chloride with advantage in reactions between acetyl chloride and hydrobenzenes. The experiments described have a bearing on the theory of the Friedel and Crafts reaction.—G. **Malfitano** and Mlle. A. **Moschkoff**: The coagulation of starch material by freezing.—L. **Ravaz**: Researches on the specific reciprocal influence of the subject on the graft in the vine.—G. **André**: The development of a bulbous plant: variations in the weight of nitrogen and the mineral matters.—M. **Biéler-Chatelan**: The estimation of assimilable potash in soils. It is concluded that the amount of potash extracted by a solution of carbon dioxide in water gives results that are best comparable with the actual culture experiments.—J. **Tissot**: The experimental study of intra-organic combustions in animals breathing air progressively deprived of oxygen, and the natural methods of defence of the organism against anoxyhæmia.—F. **Maignon**: The influence of the genital glands on glycogen production.—M. **Ranjard**: Contribution to the study of audition and its development by the vibrations of the vowel siren.—H. **Dominici**, G. **Petit**, and A. **Jaboin**: The persistent radio-activity of the organism resulting from the intravenous injection of an insoluble salt of radium, and on its applications. One milligram of radium sulphate was injected into a horse, and the distribution of the radio-activity studied. The effects could be traced for more than six months after the date of the injection.—Mlle. **Cernovodeanu** and Victor **Henri**: The action of the ultra-violet rays on micro-organisms and on different cells. Microchemical study. The ultra-violet rays produce chemical and physical transformations in protoplasm which modify completely all the colour reactions. This action of the rays is quite different from that of heat, hydrogen peroxide, or ordinary fixing agents.—J. **Nageotte**: The activity of the myeline sheath in nerves separated from the organism.—H. E. **Sauvage**: The Andersh ganglion in the horned Phrynosome.—P. **Hachet-Souplet**: The education of animals by man as a means of psychological research.—L. **Bordas**: General considerations on the Malpighi tubes of the larvæ of Lepidoptera.—Paul **de Beauchamp**: The existence and conditions of parthenogenesis in Dinophilus.—A. **Rodet** and M. **Lagriffoul**: The serotherapy of typhoid fever. Clinical results. In the greater proportion of the cases cited the disease has been arrested at the twelfth day or later. If the serum is administered at the eleventh day, at the latest, it appears to exert a beneficial influence on the course of the disease.—A. **Trillat** and M. **Sauton**: The influence of vitiated atmospheres on the vitality of microbes.—P. and N. **Bonnet**: The existence of the Trias and Mesojurassic in the neighbourhood of Djoulfa, southern Transcaucasia.—Const. A. **Ktenas** and Ph. **Négris**: The presence of layers containing Ellipsactinia in the Vardusa mountains and in Ætolia, in Greece.—Albert Michel **Lévy**: The pechstein strata in the Esterel.—Albert **Nodon**: Researches on terrestrial magnetism.—Henryk **Arctowski**: Some anomalies in the distribution of atmospheric pressure in the United States.

FORTHCOMING CONGRESSES.

MAY 16–21.—International Congress of Americanists. Buenos Ayres. General Secretary: Dr. Lehmann-Nitsche, Calle Viamonte 430, Buenos Ayres, Argentine Republic.

MAY 14–22.—International Botanical Congress. Brussels. General Secretary: Dr. E. de Wildeman, Jardin botanique, Bruxelles.

JUNE.—International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology. Düsseldorf. General Secretaries: Dr. Schrödter and Mr. Löwenstein, Jacobi-strasse 3/5, Düsseldorf, Germany.

JULY 27–31.—International Congress on the Administrative Sciences. Brussels. Secretary of British Committee: Mr. G. Montague Harris, Caxton House, Westminster.

AUGUST 1–6.—International Congress of Entomology. Brussels. Chairman of Local Committee for Great Britain: Dr. G. B. Longstaff, Highlands Putney Heath, S.W.

AUGUST 1–7.—French Association for the Advancement of Science. Toulouse. President: Prof. Gariel. Address of Secretary: 28 rue Serpente, Paris.

AUGUST.—International Congress of Photography. Brussels. Correspondent for United Kingdom: Mr. Chapman Jones, 11 Eaton Rise, Ealing, W.

AUGUST.—International Congress of School Hygiene. Paris. Secretary: M. Dufestel, 10 Boulevard Magenta, Paris.

AUGUST 15–20.—International Zoological Congress. Graz (Austria). President: Prof. Ludwig von Graff. Address for inquiries: Präsidium des VIII. Internationalen Zoologen-Kongresses, Universitätsplatz 2, Graz (Österreich).

AUGUST 18–26.—International Geological Congress. Stockholm. General Secretary: Prof. J. G. Andersson, Stockholm 3.

AUGUST 31 TO SEPTEMBER 7.—British Association. Sheffield. President: Prof. T. G. Bonney, F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 6–8.—International Congress of Radiology and Electricity. Brussels. General Secretary: Dr. J. Daniel, 1 rue de la Prévôte, Brussels. Correspondents for United Kingdom: Prof. Rutherford and Dr. W. Makower, University of Manchester, and Dr. W. Deane Butcher, Holyrood, Ealing, W.

SEPTEMBER 18–24.—German Association of Naturalists and Physicians. Königsberg. Secretaries: Prof. Lichtheim and Prof. F. Meyer, Drumm-str. 25–29, Königsberg.

SEPTEMBER 27–30.—International Physiological Congress. Vienna. President: Prof. S. Exner. General Secretary for United Kingdom: Prof. E. H. Starling, University College, London, W.C.

OCTOBER 6–12.—Congrès International du Froid. Vienna. Correspondent for United Kingdom: Mr. R. M. Leonard, 3 Oxford Court, Cannon Street, E.C.

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