THURSDAY, APRIL 17, 1902.

THE EVOLUTION OF MARRIAGE.

The Mystic Rose: a Study of Primitive Marriage. By Ernest Crawley, M.A. Pp. xviii + 492. (London: Macmillan and Co., Ltd., 1902.) Price 12*s.* net.

THE interest of the scientific problems concerning the origin and development of the marriage relation is perennial. A large part of that interest, though by no means all of it, is derived from the complexity of the factors, the obscurity enshrouding the prehistoric development of the race, and the consequent difficulties attending all investigations into primitive culture. It is forty years since Bachofen published his work on "Das Mutterrecht," to which may fitly be applied that much-abused epithet "epoch-making," for it initiated all really scientific inquiry into the subject. Since then anthropologists, one after another, have incessantly attempted to complete, to correct or to controvert the bold Swiss jurist's conclusions. Mr. Crawley is the latest in the field. He comes well-equipped for his task. He brings psychology to the aid of anthropology, and many of his psychological observations display real insight and throw an important light upon the customs described. His reading has been wide, and his illustrations are generally well chosen. But he rests too often upon second-hand authorities like Ploss and Featherman when the original sources are not difficult to reach, overlooking the possibility that the context of passages used by such compilers may seriously modify their summaries.

Mr. Crawley's theory of marriage is founded upon the universal institution (if it be right to call it an institution) of taboo. He holds that man was probably not always gregarious. At all events, "in early society he had none of the solidarity of clan, tribe, or kin, which is often attributed to him." He was strongly individualistic. As an individual he felt both attraction and repulsion for society. He longed for union with others, and yet he feared their influences. This conflict of emotions gave birth to the complicated system of taboo. It was naturally strongest in the mysterious allurements and repulsions of sex. Next to the craving for food, sexual desire is the most powerful of human appetites. The difference of sex, entailing a difference of physical function, of physical and moral aptitudes and of occupations, inevitably divided man from woman. It produced a sense of strangeness, which behoved caution. That very strangeness, and the consequent shyness, intensified the attraction. All the strength of taboo was therefore concentrated upon sexual relations. From their early days children of different sexes were more or less separated. At puberty (a time of special danger) that separation was emphasised by ceremonies, explained by instruction, and rendered perpetual by the vocations of the two sexes. But separation is impossible. The sexes instinctively seek one another. The puberty-ceremonies, therefore, are a preparation for new and closer relations. Very often they amount to preliminary marriage-rites, espousing the one sex to the other in the abstract, and preparing it for the concrete individual union to be consummated in due time. They do not, however, remove the dangers "responsible for the taboo between the sexes and the various sexual properties of which the contagion is feared." It is the function of the marriage-ceremonies proper "to neutralise these dangers and to make the union safe, prosperous and happy," and, moreover, to bind the contracting parties "so as to prevent, if possible, later repudiation." The object "is not, and never was, to join together the man or the woman, as the case may be, with 'the life, or blood, or flesh of the *tribe*.' There is no trace of this sentimental socialism in primitive society, though there are facts which look like it, no more than there is or ever was a community of wives; marriage is between individuals and is an individualistic act. The mere existence of the egoistic impulse, not to be casually identified with jealousy, is enough to discredit the suggestion; and the tendency of society from primitive animalism upwards has been from individualism to socialism. It is a perversion of history and of psychology as well, to make man more communistic the more primitive he is."

From this sketch of the argument it will be seen that the author arrives at the main conclusions of Dr. Westermarck in his "History of Human Marriage," but by a different route. The wide, if not universal, prevalence of a complicated system of taboo among savages is explained by a primitive individualism. This primitive individualism, if it existed in the full force ascribed to it by Mr. Crawley, must, however, have resulted from the solitary habits of our primitive human and pre-human ancestors. But were their habits solitary? No attempt is made by Mr. Crawley to prove this. Dr. Westermarck certainly attempted it, but his evidence is meagre, vague, often contradicted by his own witnesses, and generally unsatisfactory. The most it could be held to show was that certain outcast races like the Veddahs live ordinarily in pairs or very small communities; while other low races disperse, when food is scarce, into small separate hordes or families to search for sustenance, coming together again at other times. Seeing that mankind, wherever they have been found in a savage state, are, with such exceptions as these, found gregarious, a heavy onus of proof surely lies on those who either assert or assume the race to have been originally solitary. The fear of all contact, to which Mr. Crawley reduces, as its lowest term, the influence of taboo, must have arisen from normal absence of contact, and especially of contact with the opposite sex. But this even Dr. Westermarck's evidence does not prove. Had it been the case, mankind would have speedily perished in the struggle for existence, or been confined, like the higher apes, to limited districts and small numbers. Space to discuss the matter here is wanting. It must suffice to say that the evidence seems to me to point to the development of mankind from a gregarious ape or ape-like being, and that all theories based on a contrary assumption at present lack support.

Among such theories is that of a primitive monogamy. The opposite theory—that of a primitive promiscuity—does not imply perpetual, unbounded, meretricious change of partners. There is some reason to think that mankind, like other mammals, had once a definite breeding-season. If so, the conduct of other mammals subject to "rut" may lead us to suspect that constancy on the part of women at such times was hardly more pronounced

than on the part of men. Nor would such inconstancy be sufficient to produce a pathological condition unfavourable to reproduction, as urged by Maine and Westermarck. As humanity advanced, the organisation of society would compel limitations of licence, which would not necessarily take everywhere the same form. They might very well result in such practices as those of the South Australian tribes (which, despite Mr. Crawley's pleading, bear marks of a transitional character), of many Bantu tribes, of the Eskimo, and of the Seri, perhaps the lowest of all extant peoples. It may be said that this is speculation, since we have no positive proof of a breeding-season, or of the primitive habits of mankind. No doubt it is. But we have to account as best we may or practices not consonant with monogamy. And the fact remains that Mr. Crawley has omitted to study the various forms of the marriage-relation, personal choice among savages, the rights of the husband's kin in the wife and of the wife's kin in the husband, and other subjects the due consideration of which is essential to a correct solution of the problem.

I cannot, therefore, regard "The Mystic Rose" as a complete or satisfactory account of "primitive marriage." I must not, however, be understood to think that it is anything but a valuable contribution to the discussion of the evolution of sexual relations in man. If the author's attention has been absorbed by taboo, it must be remembered that the influence of taboo is an aspect of the theme hitherto greatly neglected. His researches have, consequently, thrown unexpected light on a number of questions which arise out of the strange and what seem to us the preposterous customs of savages. Science has not yet attained the point at which it is possible to identify and unravel all the strands of the tangled web of the history of human marriage. To single out one of the strands for careful and concentrated study helps us appreciably forward. A few more such works, and we may hope to be brought within measurable distance of the goal. E. SIDNEY HARTLAND.

CLIMATOLOGICAL ATLAS OF THE RUSSIAN EMPIRE.

Atlas climatologique de l'Empire de Russie. Publié par l'Observatoire physique central Nicolas, à l'Occasion du cinquantième Anniversaire de ses Fondation, 1849-1899. (St. Petersbourg, 1900.)

THIS magnificent atlas has been prepared by Director Rykatchew and published in commemoration of the fiftieth anniversary of the foundation, by the Emperor Nicholas I. on April 1, 1849, of the Central Physical Observatory. The atlas comprises eighty-nine large meteorological maps, together with fifteen graphical tables, which give the best presentation hitherto published of the main features of the climates of the great Eurasian Empire of Russia. Previous to 1849, the meteorology of Russia was prosecuted chiefly by the establishment of first-class meteorological observatories in different parts of the empire, at which eye observations were made hourly by night and by day. It is scarcely possible to exaggerate the importance of these hourly and other results in furthering the development of the science. Indeed, it may be safely predicted that in future developments of meteorology the knowledge thus obtained of the hourly variations from year to year of pressure and temperature, the two prime elements of climate, will always hold a prominent place, more particularly in investigating the relations of meteorology to the secular solar changes.

About the same time Kupfer added considerably to the number of second-order stations, and from this combined system of observation, fuller and more satisfactory climatic data began to be available for different parts of the empire; and when isobaric charts were first published in 1868, no country in the world outrivalled Russia for the importance of the data contributed to the undertaking. Immediately thereafter a phenomenal increase of meteorological stations took place in almost all countries; and here again, with the appointment of Wild as the Director of the Meteorological Department of Russia, the empire took a first position, whether regard be had to the number and quality of the stations or to the wide extent and diversified character of the climates over which they spread.

By the beginning of 1871 this great change may be regarded as having been substantially made. It is with the observations during the thirty years from 1871 to 1900 that the "Climatological Atlas" mainly deals. Quite a large number of stations have been established since 1871, the observations from which have been incorporated and utilised in the preparation of the atlas and the accompanying text by Rykatchew and the collaborators who have written the different sections of this great work.

The atlas gives, for the months and for the year, thirteen charts for each of the departments of pressure, temperature, vapour tension and relative humidity; and similarly five charts for the seasons and the year showing the rainfall, the days of precipitation, and the cloudiness. Additional charts are added representing the annual range of the mean temperature, the absolutely highest and the absolutely lowest observed temperatures, and the absolute range of temperature for each station for the whole time under review. Here it is interesting to note that the lowest temperature anywhere observed on the globe hitherto is $-90°{\cdot}0$ Fahr. at Werkojansk, at a height of 460 feet, lat. 67° 34′ N., long. 133° 51′ E., in the valley of the Yana. On the other hand, the highest temperature was $110°{\cdot}8$, in the arid region of the Trans-Caucasian province. Two charts show the months of greatest and of least precipitation, two the greatest and the least number of rainy days, and two the seasons of greatest and of least cloudiness of the sky. Three charts show the opening and the closing of rivers with ice, one chart the number of days snow lies on the ground, and another the number of days of thunderstorms. Finally, five charts exhibit the paths of cyclones and the types of weather in Russia. The charts, which measure 16 to 27 inches, are printed in colours, showing at once and effectively the geographical distribution of the different elements of climate intended to be represented.

The data showing the mean results of pressure, temperature and other elements of climate, represented on the coloured charts, are given on twenty-seven graphical plates. The usual method is to publish in numerical

tables; but the method now adopted is attended with the great disadvantage of adding enormously to the labour of examining the work critically.

In 1868 the most serious desideratum in Russian meteorology was the large number of undetermined heights among the stations. But shortly thereafter Wild commenced vigorously to make good this great defect, and his successor, Rykatchew, is successfully carrying out this good work. It is much to be desired that in a few years it will be completed. The more important desiderata still outstanding are large portions of northern and south-eastern Siberia.

The new hypsometrical and meteorological data put before us in this atlas are exceedingly valuable accessions to meteorology. For while the broad features of the geographical distribution of pressure and temperature, as previously disclosed, remain substantially the same, yet the fresh data now submitted result in many cases in more accurately defined positions of the isobars, isotherms and wind direction in their occurring changes from month to month.

It is truly a genuine pleasure to the climatologist to use these rectified monthly isobars and isotherms in explanation of the monthly changes in the geographical distribution of snow and rainfall, number of days of precipitation, humidity, cloudiness and other weather phenomena in their all-important bearings on the agricultural and other economic interests of the Russian Empire. Prof. Rykatchew and his singularly able staff are to be congratulated on the successful termination of this great work. ALEXANDER BUCHAN.

A FRENCH CRITIC OF MAXWELL.

Les Théories électriques de J. Clerk Maxwell. Étude historique et critique. Par M. P. Duhem. Pp. 228. (Paris: A. Hermann, 1902.) Price fr 8.

IN this work the earlier writings of Maxwell on electrical subjects, as well as his "Treatise on Electricity and Magnetism," are discussed. The general attitude is somewhat severe, as may be inferred from the following extract translated from the preface:—

"The different theories of the Scottish physicist are irreconcilable with the traditional theory; they are irreconcilable with each other. . . . At each instant it seems that the result even of his own reasoning and of his calculations is going to drive Maxwell to impossible and contradictory results; but . . . Maxwell makes an embarrassing term disappear, changes an inacceptable sign, transforms the meaning of a symbol; then, having passed the dangerous spot, the new electric theory, enriched by a paralogism, pursues its deductions."

Of the electrostatics in the paper "On Faraday's lines of force," which Prof. Duhem regards as the first of three different theories of statical electricity propounded by Maxwell, his concluding remark is that it is only the semblance of a theory. Maxwell states sufficiently clearly, we should have thought, that his object was not to establish any physical theory, but to point out certain analogies between lines of force and lines of flow.

Of the theory developed in the paper "On physical lines of force," Prof. Duhem writes that it does not even lead to the expression in equations of the problem of the polarisation of a given dielectric medium; this seems to be because Maxwell assumes without formal proof that the function whose spacial differential coefficients express on his theory the electromotive force is identical with the potential of the classic theory; it seems very easy to rectify the omission.

Altogether too much capital is made of Maxwell's unfortunate confusions of sign, and it seems puerile to complain of the use of the popular term "electric tension" where "electric pressure" is required by strict analogy.

Prof. Duhem's objection to Maxwell's interpretation of the various terms in the expression obtained for the magnetic force[1] appears well grounded.

In discussing the third electrostatic theory of Maxwell, as contained in the paper "On a dynamical theory of the electromagnetic field" and in the "Treatise," comments are made on the obscurity of Maxwell's idea of electric displacement and on the confusion caused in the form of the equation of continuity by thinking of a charge of electricity sometimes as a real thing and sometimes as a mere fiction representing the effect of nonuniform polarisation. All readers of Maxwell know these difficulties; most will be disposed to agree with Hertz that if we interpret the word "electricity" in a suitable way, nearly all the apparent contradictions can be made to disappear, rather than follow Prof. Duhem in his *reductio ad absurdum*.

Prof. Duhem contrasts Maxwell's theory of displacement through a dielectric considered as a continuous medium having an elastic constant different from that of pure æther with the theory which regards all the phenomena as due to action at a distance on the analogy of Poisson's theory of induced magnetism. His expression for the electrostatic energy on the latter theory contains a term which is furnished by the surface separating two different dielectrics and which corresponds to the fictitious charge of electricity due to change of polarisation on crossing that surface; consequently he infers that this theory clashes with that of Maxwell. Consideration of the work actually required to charge the conductors in such a case renders it difficult, however, to see how on either theory the expression for the total organised energy can differ from that given by Maxwell. Prof. Duhem then refers to Gouy[2] as having shown that the classic doctrine completely explains the actions observed between conductors and dielectrics by Pellat,[3] among others, and concludes that such actions could not be deduced from Maxwell's theory. In the absence of precise numerical calculation and comparison with experimental results, this inference appears somewhat rash, even if the premisses were correct. Gouy, however, in the paper referred to does not consider the case of two different dielectrics at all. Pellat, moreover, considers the results of his experiments to be in perfect accordance with Maxwell's theory; he points out, however, that as his calculations of the effective forces on the surfaces of conductors and dielectrics are deduced from the variation of the electrostatic energy, his experimental results, as well as those of Quincke, may be explained without accepting Maxwell's

[1] "Scientific Papers," vol. i. p. 463.
[2] *Journal de Physique*, 3e série, t. v. p. 154, 1896.
[3] *Annales de Chimie et de Physique*, 7e série, t. v. 1895.

theory and thus do not serve to establish it. (The simplicity and directness of Pellat's theoretical investigation seem noteworthy when compared with the discussions of Gouy and of Larmor ;[1] in each of the latter some of the apparent forces have to be explained away, and they appear to contradict each other. It may be that in such discussions too much importance is at present assigned to Maxwell's stress-system in the absence of more definite knowledge concerning the transmission of force between æther and matter, if the use of such a phrase is permissible.)

Prof. Duhem points out that Maxwell, in obtaining his first estimate of the velocity with which electromagnetic waves are propagated,[2] confounds Lamé's coefficient of rigidity with one of his own, which is really double the former, and that on correcting this mistake a velocity is obtained which exceeds that of light in the ratio of $\sqrt{2}$ to 1. This work of Maxwell's is, however, generally regarded as containing only the germ of a theory of light and as indicating that the two velocities concerned are of the same order of magnitude.

The author concludes by lauding the electrodynamic theory of Helmholtz, which he regards as satisfactorily reconciling the electromagnetic theory of light with the ancient theories of electricity and magnetism.

It is surprising to find no reference whatever to Larmor or to H. A. Lorentz in the historical sketch of this branch of the subject.

Although some of the mistakes pointed out by Prof. Duhem are real and important, the view taken throughout, as will be gathered from the above, appears a very narrow one. W. MCF. ORR.

OUR BOOK SHELF.

Clinical Pathology and Practical Morbid Histology. By J. Strangeways Pigg, M.A. Second edition. Pp. 107 ; 5 plates and 6 figures. (London : Strangeways and Sons, 1901.) Price 5*s*.

THIS is a small interleaved handbook for use in the laboratory, dealing with the different methods employed in examining blood and other normal and pathological fluids and morbid tissues.

The descriptions of the various methods referred to are brief and concise, and the steps of each operation are tabulated in exact sequence, with perhaps the exception of 24, D, where steps 6 and 5 should obviously be transposed. Objection may be raised to such an arrangement as being too dogmatic and allowing no scope for individual ingenuity, but, on the other hand, those who have to deal with large classes of students, to whom the book is chiefly directed, will agree that some such method is absolutely necessary if one would instil the principles underlying good technique.

The general "get-up" of the book is good ; there are very few printers' errors save an occasional missing letter at the end of a line, or the interpolation of a letter from another fount of type. "The illustrations," we are told, "are diagrams only," a description obviously applying to those of apparatus and urinary sediments—which latter, by the way, would have been more useful had they been bound up in somewhat closer proximity to the letterpress relating to them—but hardly fair to the two coloured plates of blood-cells. These are, in spite of their accuracy, beautiful and artistic, and reflect nothing but credit on artist and lithographer.

The methods set out in the text are, for the most part, well chosen and well described ; those dealing with morbid histology are, however, by far the most successful. In blood work, we notice, the author recommends Cabot's "two-cover-slip" method of spreading films—a method which in the hands of experts yields, perhaps, 10 per cent. of stainable specimens—and quite ignores the simpler method introduced by Manson, in which guttapercha tissue or a piece of cigarette paper is employed.

We notice, too, in the preparation of cover-glass films from pus or sputum, that extremely dirty and slovenly method of pressing out a small portion of the material between two cover-glasses and then sliding them apart, is given as the usual method. We hope that this is not the universal practice in Cambridge laboratories.

The sections dealing with bacteriological methods and urinalysis are certainly disappointing—in the latter the methods are few in number and, in our opinion, not always happily chosen, whilst fuller indications of the fallacies which attend some of the tests would have enhanced their value. In that portion dealing with bacteriological investigations, many of the methods might find favour in the clinical laboratory, but would certainly be *taboo* in the well-regulated bacteriological laboratory. We notice, too, that the author invariably uses *Carbol*-gentian-violet in staining by the method he terms Gram's ; it is true the actual stain is easier to prepare, but its results are decidedly inferior to those yielded by the Anilin-gentian-violet originally described by Gram.

As we have before mentioned, the book is intended for the medical student, and as such is of distinct value, a fact sufficiently evidenced by the success with which the first edition has met

The Balancing of Engines. By W. E. Dalby, M.A., B Sc. Pp. xi + 283. (London : Edward Arnold, 1902.) Price 10*s*. 6*d*. net.

THIS work is of a character which can be studied with interest. It deals with a subject of great importance to mechanical engineers, and one which is coming more and more to the front in the design of high-speed engines and machinery.

Prof. Dalby is the author of several papers dealing with this important subject, read before the Institutions of Naval Architects and Mechanical Engineers ; these papers are largely drawn upon in the present volume.

"The main object of the book is to develop a semi-graphical method which may be consistently used to attack problems connected with the balancing of the inertia forces arising from the relative motion of the parts of an engine or machine." This we learn from the preface, and, what is more, it requires nothing but the knowledge of the four rules of arithmetic and good draughtsmanship to apply satisfactorily the methods so well described.

The balancing of the working part of locomotives has always been treated from different points of view, and the practice of a particular drawing office largely governed the result ; in fact, not many years ago an eminent locomotive engineer looked upon the balancing of his locomotives as an unnecessary addition to their weight.

Chapter iv. deals with this very important subject in a clear, concise and practical manner, and even only for this one chapter all interested in locomotive design should possess this volume. The author advises that those interested in locomotive work should begin chapter iv., after working the examples of arts. 48 and 49, progress being tested by working the exercises at the end of the book.

The treatment is simple, several types of Lancashire and Yorkshire Railway Company's locomotives being taken as examples, and little thought will be necessary to carefully follow the threads of the argument. The experimental apparatus described to illustrate the

[1] *Phil. Trans.* 1897, A. p. 248.
[2] "Scientific Papers," vol. i. p. 500.

various problems of locomotive balancing is very interesting, appearing to thoroughly fulfil the conditions.

Prof. Dalby has produced a book useful alike to the mechanical engineer and the student. N. J. L.

Guide to Italy. Pp. civ+352+4. Price 10*s.* net. *Guide to the Western Mediterranean.* Pp. xxvi+238. (London: Macmillan and Co., Ltd., 1901.) Price 9*s.* net.

IN adding one more series of guide-books to those already in existence, the publishers have struck out in a somewhat new line by making conciseness their most important feature. The overworked professional man, who has little time to read up lengthy descriptions, will here find, condensed into a smaller compass than has previously been done, the most important points to be looked out for on his proposed journey. The authors of these books have been remarkably successful in condensing so large an amount of information into them.

The "Western Mediterranean" is divided into sections dealing respectively with Lisbon, Andalusia, Morocco, Algeria, Malta, Naples, the Riviera, the Balearics, and other ports and districts of interest. In "Italy" a different and novel order has been adopted. The book opens with articles on Italian life, art and architecture by "O. B." and other well-known writers. Next comes a description of routes *only*, without lengthy descriptions of towns; lastly, the towns of Italy are described in alphabetical order. The advantages of this method may not, perhaps, impress the reader at a first glance, but as soon as he is accustomed to the new order of things he will become converted to the belief that the system effects a considerable saving of time and trouble and is most convenient. Hotels are enumerated in a list by themselves; in a future edition the authors might with advantage make an effort to give fuller information under this head, especially in reference to tariffs. There are also a few minor points on which opinions may differ. Most Italians know an "Inglese" fast enough and do not take every foreigner for a Frenchman (p. xii.); in the vocabulary (p. xvi.), "entrate" is a more familiar equivalent for "come in" than "avanti"; and if the authors of "Italy" are *really* right as to the situation of Virgil's tomb (p. 147), Neapolitan guides and cab-drivers have been wrong for many years. The maps are excellent.

Outlines of Electrochemistry. By H. C. Jones. Pp. vi + 106. (New York: The *Electrical Review* Publishing Co., 1901.)

THIS is an exceedingly interesting book. The title is, perhaps, a little misleading. To our mind it would be better to call it "Physical Foundations of Electrochemistry," or some similar title. There is an inclination among writers of electrochemistry to treat the subject entirely from the physical standpoint, hence many books on the subject lack breadth of treatment. The present book, as the author explains in the preface, is a republication of papers which originally appeared in the *Electrical Review* (New York).

Chapter i. deals with osmotic pressure in a very clear and lucid manner. Chapter iv., on the "newer theories of electrolysis," is very ably written, and here Mr. Jones, in explaining the theory of the electrolysis of water containing acids, alkalis or salts in solution, adopts the theory of Le Blanc, which looks upon the electrolysis of water as being a *primary* and not a secondary reaction. Most writers explain the electrolysis of water as being of a secondary nature, due to the presence of the acid or base in solution. According to Le Blanc, it is entirely a question of the decomposition value of the water, and of the salts, acids or bases in solution. In an aqueous solution of an acid, for example, it is simply a question whether the ions of the acid or those of the water will the more readily give up their electrical charges, it being assumed that pure water is slightly ionised.

Chapter vi., which is divided into two parts, deals with the "conductivity of solutions," and a very interesting lecture experiment, due to Noyes and Blanchard, for showing the different conducting powers of various electrolytes, is described. A good deal of attention is devoted to the dissociating power of different solvents, especial stress being laid upon the dissociation of electrolytes in alcohol. Mr. Jones does not, however, refer to the fact that certain inorganic salts are considerably ionised when dissolved in pyridine. In this connection it is interesting to notice that quite recently Kahlenburg has succeeded in depositing lithium in the metallic form, from the solution of its chloride in pyridine.

Mr. Jones is to be congratulated upon having presented us with a very readable and scientifically written account of the foundations of electrochemistry. We notice that the author is engaged upon a work on physical chemistry, the production of which we await with interest.

F. M. P.

Outlines of Botany. By R. G. Leavitt. Pp. 272. (New York: American Book Company.)

THIS book has been compiled for use in high schools and is based on Asa Gray's "Lessons in Botany," an abridgment of his well-known standard work on plant morphology. The author points out that he is not in agreement with the strong ecological bias developed in so many recent American text-books, and that he has endeavoured rather to develop the study of structure and form, and also to emphasise the physiological factors which control plant life. This view will be endorsed by many botanists.

The method adopted is to suggest a series of practical studies, each being followed by an elaborated theoretical discussion. The principle involved of setting the student to learn by direct observation depends firstly on the student and secondly on appropriate treatment of the subject. For advanced students such a course might be admirable. But for students at high schools there is neither the requisite time nor training required for such investigations; for these introductory lectures are absolutely necessary. Then again, as regards his treatment of the subject, one must entirely differ from the author. The first chapter, dealing with seeds and seedlings, will illustrate the objections to be raised. Beginning with the gross features of the castor bean, lupin and maize, the author next proposes a series of physiological exercises—*e.g.* the nature and location of food reserves; absorption of oxygen, production of carbon dioxide and heat evolved in germination; geotropism and development of chlorophyll. He then returns to morphology to give a brief summary of special morphological features. It will be observed that on the one hand the training to be gained by a well-balanced and varied series of anatomical exercises seems to have been overlooked, for the castor bean does not offer a favourable object for a first investigation, and at least eight or ten seeds should be examined. On the other hand, the physiology is too varied. What teacher with practical experience does not know the many difficulties and pitfalls which attend even simple experiments? What success may be expected for a young and inexperienced investigator who attempts these broadly-extending exercises, with the help of descriptions which are often extremely vague? Throughout the chapters dealing with the flowering plant there is the same paucity of development and want of judgment in choosing anatomical exercises. The book contains a cryptogamic course which is somewhat superficial, and closes with two unsatisfactory chapters on anatomy and physiology.

LETTERS TO THE EDITOR.

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

The Permeability of Iron Alloys.

IN a paper in the last number of the *Proceedings* of the Royal Society, Prof. Barrett refers to the increased permeability conferred on iron by alloying it with aluminium, and suggests an explanation on the supposition that the aluminium would remove traces of oxygen from the iron.

Some seven years ago, in the course of a series of measurements on the magnetic properties of iron alloys, I found that aluminium, phosphorus and arsenic decreased the coercive force and hysteresis loss very considerably, whilst aluminium very largely increased the permeability—the others less so. Silicon produced little effect, but probably slightly improved the iron. On mentioning this to my colleague, Prof. Arnold, he at once pointed out that these elements are just those which increase the size of the crystals in iron. Annealing, which also improves permeability and lessens hysteresis, also increases the scale of the crystals. It is probable, therefore, that the increase of permeability due to these substances is a secondary effect due to the increased size of the iron crystals. A foreign substance might be expected to act deleteriously in two ways: (1) by occupying space better filled by iron, (2) by combining with iron and forming a less magnetic chemical compound. Phosphorus and silicon would act in both ways, aluminium in the first only, which might account for a larger difference between its indirect favourable action on the iron crystals and its direct deleterious action. It would be interesting if investigators in this direction would try to correlate their permeability measurements with the results of microscopical analysis as well as chemical.

W. M. HICKS.

University College, Sheffield, April 10.

Reform in Mathematical Teaching.

SOME of Prof. Perry's followers seem to me to miss a point which he realises clearly—viz. that the key to the whole position is in the examination system.

(1) The strength of the present system is very great. An impending examination converts the teacher from an enemy of the idle and refractory pupil into an ally—to the comfort of all parties. The success of his pupils at examinations gives a teacher some return for his labour; otherwise he would have to comfort himself by hoping that Kipling's great lines, "Therefore praise we famous men," might some day in some degree apply to him. The realised hope would be worth ten thousand times the immediate return, but hope deferred is discounted at very heavy rates.

(2) The present system might be very much better. Examining work is often badly paid; in the main and in the long run, bad pay means bad work. Thring said that you might have one generation of martyrs, but the second would be cheats.

The band of fossil examiners, each with his fossil syllabus, does much more harm than Procrustes. A is clever, but he must not go beyond the syllabus; B is slow, but he must be bustled along and got through the course somehow.

The fate of anything new or fresh is pretty sure. There is a Cambridge yarn about some one who set his favourite question, "Define a differential coefficient," but instead of getting the expected three or four lines of cram, he got the substance of five or six pages of Harnack's new German book on the calculus. He rose to the occasion and promptly marked it 0.

(3) But written examinations have inherent and inevitable defects, clearly indicated by Dr. Lathom "Examinations considered as a means of selection." The old style of question, which was rather reproduced than parodied by the famous "Very small elephant whose weight may be neglected, and whose coefficient of friction was $\sqrt{7}-\sqrt{3}$," may be replaced by "The relation between the weight and length of tusk of an elephant being represented by the equation $W=Al^3+Bl+C$," and so on . . . but a system of written examinations based on the new model would in the end be like unto the first.

The following axioms are put forward in the hope that they may be condemned as truisms:—

(1) Examinations are not to be multiplied beyond necessity.

(2) No examination is entitled to any confidence in which teachers or persons in close touch with the teachers have no part.

(3) *Viva voce* examinations are essential if weight is to be attached to the results of a single examination.

It would be most interesting if Prof. Perry, who has influence and persuasiveness, could arrange an experiment.

Get answers to a paper from a dozen candidates, good and bad mixed, have facsimile copies made, and submit them to twenty or so competent examiners. The discrepancies in the marks would, I think, be surprising.

If the examiners adopt the received plan of cutting each question into several bits and giving marks for each little bit, they will get results more concordant and more entirely out of relation to common sense or real life.

C. S. JACKSON.

Woolwich.

THERE are two places in Prof. Perry's letter appearing in your issue of March 27 in which he mentions schoolmasters in terms of, in the one case praise, in the other blame. The first passage is where he congratulates the "reformers" "on having with them the good wishes of every thoughtful teacher of the whole country," but in the last passage he expresses the conviction that we shall "not very long remain in the foremost files of our time if we depend upon the schoolmasters." I hope that teachers are good for more than mere good wishes, and I think Prof. Perry will find that the reform he laments as scarcely within sight has not only begun, but is actually bearing fruit in the place in which, though the subject of controversy, the noise of the conflict is heard least—the schoolroom. Schoolmasters, like others, move with the times, and the "conventional schoolmaster" is a much rarer bird than the conventional examiner or the conventional inspector. I suppose syllabuses and text-books are a necessity still, but the competent teacher of mathematics needs not to be bound by anything of the kind. Personally, I see no necessity for this ideal text-book one hears about which is to replace Euclid, and those who caricature him; we are better without a text-book at all. Let a master be engaged capable of making his own syllabus for his own pupils, and give him a free hand to introduce modern geometry, differential calculus, &c., as he sees fit; such a man will welcome the appreciation of a competent inspector, himself a mathematician and, beyond that, a successful teacher of mathematics. As I have already hinted, reform in the schoolroom proceeds as rapidly as examiners will allow, rather more so in fact, for I know that many boys learn much that no examination they have been in for, or are likely to take, tests. My own work is in such a small way that I do not care much to bring it forward, but I must confess to periods of guilty satisfaction when I have robbed time from examination teaching and introduced boys, much to their interest, and I feel sure profit, to such things as coaxal circles, theory of inversion, cross ratios, and fundamentals of the integral calculus. Let the mouse help the lion!

I feel sure Prof. Perry and his fellow reformers—if they will find out what is being done on the spot by the teachers, or if the latter have as yet shrunk from any sort of attempt at reform, what their wishes and opinions are—will find convention at least as hateful to the teachers as to themselves. Of course, I am not speaking, as I am not qualified to speak, on behalf of those who form what I may term the "aristocracy" of the teaching profession; I myself and my teaching friends are mostly engaged in the small schools, large in number, situated in industrial districts, where the endowed school fights for an existence with the "technical" or even the higher-grade Board School, where boys leave between fourteen and sixteen, at the latter of which ages they are supposed to have the groundwork on which a knowledge of engineering can be built up. Yet to these Euclid must be taught. Of course, as a matter of fact, Euclid is not taught to them; they pass examinations in a subject that goes by that name, the satisfaction I personally have felt being in the reports of examiners, who, intending to reprove, have written, "the constructions and principles of proof were well known, but the wording of Euclid was not adhered to, and some points in the proofs were omitted. The riders were well done." In these schools, "practical plane and solid geometry" is a subject taught throughout; and there is many a germ which only requires a little encouragement to bear great fruit. I think that the power behind the reformers

may be even more potent than it is reckoned. With associations growing in influence, and the great facilities afforded for exchange of ideas, the body of teachers is very rapidly increasing in strength, and this reform in the teaching of mathematics, together with many another much-needed reform, is perhaps much more in the immediate future than is thought. At any rate, if the bow and arrow is still the official weapon, the use of the magazine rifle is being secretly taught, and we school teachers look forward with no misgivings to that great fight. Prof. Perry sees ahead for our people, rather we are "spoiling for it," for with it will come our freedom!

FRANK L. WARD.

1 Macdonald Place, Hartlepool, March 29.

Rearrangement of Euclid Book I., Pt. i.

IN answer to Prof. Lodge's letter I should like to say that we have for some time followed much the order he suggests. Euclid's order unnaturally separates propositions which should come together, *e.g.* I. 4, 8, 26, and is, therefore, a serious hindrance to a clear grasp of the subject-matter as distinct from mere exercise in logic.

The following order—substantially that suggested by Prof. Lodge—seems natural, and we have certainly found it work very well in practice.

(1) The propositions on angles, viz. 13, 14, 15, 27, 29, 32, cor. 2, 32. At this stage logical deduction from definitions and axioms is difficult and, to a boy, unconvincing. The following proof of I. 32 cor. 2 is convincing, at least: "If a man walks right round a rectilineal figure (starting and ending at a point in the middle of a side), he turns once round. Hence the exterior angles, which are the angles through which he turns, are together equal to 4 right angles." Similar proofs of 27 and 29 are equally convincing. Any attempt to analyse these proofs into the axioms on which they depend seems to me at this stage foolish; it is work for a highly trained and speculative mind, not for a boy.

(2) Triangulation, I. 4, 8, 26.

These are, I think, best presented as the outcome of experience passing into intuition, and as special cases of the general fact that three data are necessary and sometimes sufficient to determine a triangle. The special case of right-angled triangles with hypotenuse and one side given should be added and proved deductively from I. 5.

The rest of Book I. consists of exercises on these fundamental propositions:—Properties of a single triangle, I. 20, 5, 18, 6, 19; loci; quadrilaterals; areas. The order in which these last three subjects are taken is immaterial.

A special advantage of this arrangement is that it makes it easy to combine practical with theoretical work. It was, indeed, from the attempt to do this that we were led to follow this order, but even in purely theoretical work it has proved a great gain.

As to the omission of "constructions" from the deductive course, we agree—they are properly treated as exercises.

As to the effect of this change on real progress we have no doubt. As to examinations, we hope that they will before long (1) permit freedom in the order of propositions, (2) diminish bookwork and insist upon riders and practical work, as some, indeed, already do.

It seems illogical, but even in deserting Euclid's order we adhere to his numbers. The constant reference to cardinal propositions is a great help to thoroughness and clearness of knowledge, as well as to ease of questioning and answering. Probably no one will ever succeed in fixing fresh labels on to the propositions, and for the present at least we find the old ones useful, though they are to our boys quite arbitrary.

W. C. FLETCHER.

Liverpool Institute.

I QUITE agree with Prof. Alfred Lodge as to the order of propositions he proposes, which is practically the order I adopted in my "Foundations of Geometry." But he does not in his letter refer to what seems to me the chief reason for it, which is that the elementary geometry of straight lines and angles should precede the geometry of plane surfaces, including any propositions about areas. And to carry out this idea, the fundamental propositions which Euclid gives so badly in his XIth. book (props. 1–9) ought to be taken before such propositions as his I. 35 and 36. On the other hand, there are important propositions in the XIth. book, notably prop. 10 (if this is not included in the definition of parallelism) and props. 20 and 21, which come properly in what Prof. Lodge calls the first part of Book I.

By the way, I may mention that it seems to me illogical to prove I. 27, as Prof. Lodge does, by a simple "which is impossible," and to refer I. 29 to "Playfair's axiom." Neither proposition is nearer *a priori* truth than the other, and it is just as easy to disguise the difficulty, if you wish to do so, in either case.

EDWARD T. DIXON.

Racketts, Hythe, Hants, April 14.

WE have had the following arrangement of Euc., 1–32, in use for three years with more than two hundred pupils. 13, 14 (from the definitions); 15; 32, cor. 2, 32, 16, 17; 23, 8, 9; 4, 10. Locus of a point equidistant from two given points. 11, 12, 5; 26, 6. Locus of points equidistant from two intersecting straight lines.

This gives fourteen propositions; thirty-seven more complete all the plane geometry of Euc. I.–VI. and XII. required in mathematics or science. We have no superposition "proofs"; they merely obscure obvious truths. Parallels by superposition have been found beyond the capabilities of beginners. Why not alter the definition? At present it gives the least obvious property of parallels.

A caution to the professors who are teaching us how to teach. We are seeking a system of geometry suitable for boys of ten, and the most logical method is not necessarily the best; it is better to separate 4, 8, 26 by examples of their use and to leave the remaining case for trigonometry. Again, an ideal course must be inventional, and must grow out of practical work; therefore it must introduce problems as early as possible: a beginner should not be allowed to quote a construction which he cannot perform. Is not the demand for a purely theoretical course due to a desire to use 1, 9, in proving 1, 5, whilst retaining Euclid's proof of 1, 8?

T. PETCH.

Leyton Technical Institute, April 14.

IN reply to the appeal of Prof. Alfred Lodge for opinions with reference to his proposal to alter the sequence of Euclid's propositions by introducing those relating to parallels at the earliest possible stage, permit me to express what I hold to be insuperable objections to his proposed innovation.

Whatever other objections may be raised to Euclid's sequence of propositions, it at any rate has this distinguishing merit, that it separates the propositions (I. 1–28) which are independent of the postulate of parallels from those which are true only when that postulate is admitted. To obscure this distinction, as, for instance, by treating props. 16, 17 as corollaries of prop. 32 and so appearing to depend on the postulate of parallels, would to my mind, especially now that the non-Euclidean geometry of Lobatchewsky and others is an established part of mathematical science, be a distinctly retrograde step.

Further, this innovation is not in the least necessary to secure Prof. Lodge's object (with which I entirely sympathise), namely, a better and more natural grouping of the propositions about triangles.

For this purpose all that is necessary is to add I. 16 to the three (13, 14, 15) with which he proposes to begin. This proposition may at once be proved as follows:—

The triangle being A B C, the side B C produced to D and E the mid-point of A C, turn the triangle A E B about E until E A comes on E C and A on C, then E B comes to a position E F in the same straight line as B E, and since B E F, B C D meet in B. they cannot meet again, so that F lies on the same side of B D as A [N.B., here comes in the difference between plane and spherical surface geometry], and E C F or the angle A is less than the exterior angle A C D.

This proved and I. 17 as its corollary, the propositions about a single triangle and those about the comparison of triangles easily fall into a simple and natural sequence and grouping.

Shanklin, April 12. ROBT. B. HAYWARD.

Winter Phenomena in Lakeland.

THERE being no record within my knowledge as to whether holly and ivy are starch-trees or fat-trees, *i.e.* as to whether their wood-starch disappears or otherwise in winter, a strict watch was set upon the phenomena. During the months of December, January and February, sections were taken at

intervals of the twigs and smaller branches of these trees, and their content in starch was carefully tested and observed. The general result was that the ivy is a decided starch-tree, inasmuch as at no time during the winter was its wood found free of starch or anyway nearly so. No doubt, as compared with summer, there was a great diminution of this substance, many of the medullary ray cells being completely empty of granules, and moreover, *e.g.* on January 18, only about one-quarter of these cells were stored with starch, and even this gave a reddish-brown tinge to iodine, as if amylodextrin was intermixed therewith. As regards the holly, there could be no question that the amylaceous reservoirs of its wood had suffered a still more serious depletion. Nevertheless, they were never found completely void, a more or less considerable accumulation of starch granules being readily distinguishable along some portion of the medullary rays; the pith, too, was never empty (that of the ivy was found invariably depleted). It may be added that in both cases starch was completely absent from the bark during the winter months.

The overthrow by the boisterous gales of the departing year of a crab-apple that was perched aslant on a sharp ridge of rock afforded an opportunity for observation of the root appanage of this tree. The wood of the root contained a considerable amount of starch, but none was found in its bark. The alcoholic and aqueous extracts of the latter proved very rich in phloridzin, the reactions thereof being yielded with eminent distinctness and beauty, and the phloretin prepared from it indicated by its behaviour in alkaline solution with nitroprusside of sodium that it was a fatty aromatic ketone. Phloroglucin was detected in the wood, but none in the bark.

Whilst exercising on the hills on January 19, numerous faded and embrowned brackens were seen which a week or so previously had been overlaid with a thick mantle of snow. The fronds of one of these were incinerated, and the crude ash was found to contain no less than 43·6 per cent. of silica, also 13·2 CaO and 0·8 phosphorus (or 1·8 P_2O_5). This enormous amount of silica is all the more remarkable, inasmuch as in August the ash of the fronds contains only about 9 per cent. of this constituent and that of the stem about 7 per cent.—the difference is doubtless to be attributed to the very considerable diminution of the soluble salts, and not of the lime, during the course of autumn. In this case, as in that of all calcifugous species, a strong proportion of lime in the young and vigorous frond would offer a serious obstacle to the presence of a considerable quantity of potass. Thus, on June 3 the amount of potass and soda in the ash is somewhere about 32 per cent., in August 27 per cent., and in late autumn about 2 or 3 per cent. The lime, on the other hand, fluctuates from about 6 to about 13 per cent. only, and thus while in a great many leaves the autumnal deficit is, so to speak, covered by lime, here in the case of the bracken it is refunded by a lavish plethora of silica. The general inference is that the frond, having been utilised as a support for the reproductive parts (sporangia), the strain thereby involved leads to a very advanced condition of decay, whence a tremendous drainage of silica towards the organ. Perhaps it is this very faculty of remaining decayed without disfigurement, encased in silica, that is one of the causes why abundant remains of ferns are found in the fossil state.

Patterdale, Westmorland. P. Q. KEEGAN.

The Species Problem in Corals.

MAY I direct the attention of your readers to an exhaustive article, dealing specially with "species" among the reef-corals, by Prof. Döderlein in the current number of the *Zeitschrift für Morphologie und Anthropologie*? It is somewhat hard to find myself there blamed for continuing to use the word "species" in relation to a group in which it is totally inapplicable, for I laid the whole subject before the Linnean Society a year ago. I stated the difficulty and suggested a provisional alternative method of designating specimens. I carefully explained that I was proposing a method of work in order that we might discover the true species by gradual arrangement of the variations. In the autumn of the same year I made a brief statement at the International Congress of Zoologists in Berlin, but the report has not yet appeared; and again, later in the year, I read a paper before the Cambridge Philosophical Society. This has appeared in the last number of the *Proceedings* of that Society under the title "On the Unit of Classification for Systematic Biology."

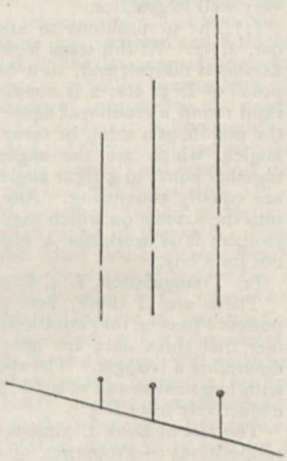
It will be noticed that while Prof. Döderlein discusses the general problem very fully, he makes no practical suggestion as to how to designate the different forms for reference. I, struggling with nearly a thousand foolscap pages (dealing with three genera) for the "Catalogue" of the Great National Collection of Corals at South Kensington, was compelled to invent some way of labelling them. But before finally adopting it, I sought the advice of many of the leading zoologists and botanists within reach. HENRY M. BERNARD.

Clapham, S.W., March 21.

Sun Pillars.

ON January 19, 1901, during zero weather at Winnipeg, Manitoba, the fine icy particles which floated over the city as a cloud at 11 a.m. gave a halo round the sun with two mock suns to the right or left at the same altitude as the sun, and above the halo an inverted arc of about 120° showing prismatic colours. There was a good deal of wind at the time.

At night the wind dropped and the air became very still. The haze of icy particles descended, and in the middle of the night its illumination by the strong arc lamps of the city gave a column of light, comparable to a sun pillar, extending above each lamp to a height estimated at 300 feet. A striking feature of the phenomenon was the perspective effect, the columns diminishing in apparent height in such precise proportion to the increasing distances of the street lamps that it was evident the upper surface of the cloud of particles was truly horizontal. At this time the vertical columns of light were also visible below the lamps and extended to within a few feet of the ground. A few hours later, viz. at 4 a.m. January 20, the lower ends of the columns were more than 60 feet from the ground, and therefore far above the lamps.



They extended to a height of about 300 feet, as judged by the distance of the nearest lamp and my elevation above the ground, which was about 60 feet. A narrow rift extended horizontally through the cloud, breaking each column of light into two parts. The figure is re-drawn from a rough sketch made at this time of the columns above three, only, of the numerous arc lamps.

The slight haze of minute icy particles which is common in zero weather is, I believe, called *poudrette* in Eastern Canada

VAUGHAN CORNISH.

Swarm of Velella.

ON a former occasion while sailing in the Mediterranean I have noticed the abundance of this beautiful Hydro medusa, usually known as the "Portuguese Man-of-War," sometimes distributed over the surface of the sea, but never in numbers such as have been stranded along the northern shores during the past few days.

When taking my usual morning bathe at Mentone on April 5, I plunged into a living mass of these Siphonophora, which extended many yards from the shore. It was about the same on the 6th, when I gathered a number and preserved them in formol (5 per cent. from the 40 per cent. solution). Since then the shore has been literally strewn with them, a very disagreeable odour being emitted. At Bordighera yesterday and here to-day, nearly fifty miles from Mentone, their dried remains strew the shore and appear to be well preserved, though, of course, minus their beautiful colour. We have had no strong south winds, and I cannot see how to account for so remarkable a shoal. ISAAC C. THOMPSON.

Alassio, April 9.

Resultant-Tones and the Harmonic Series.

THE following method of recovering, by inspection of the harmonic series, the position of the differential resultant-tone of the first order for any given musical interval has occurred to me, and, as far as I have been able to learn, has not yet found a place in the text-books on musical acoustics which are in most common use. I therefore venture to hope that a brief statement of it may gain admittance to your columns and be the means of saving some time and trouble to students of the subject.

The harmonic series up to No. 10, with the order of each number placed below it, may be written thus:

C C′ G′ C″ E″ G″ (B″♭) C‴ D‴ E‴
1 2 3 4 5 6 (7) 8 9 10

the brackets of course indicating that No. 7 is not identical with the seventh note of the diatonic scale. As the "vibration numbers," or "frequencies," of these harmonics are proportional to their respective order-numbers, these latter may, for the purpose in hand, be treated *as if they were the vibration-numbers* of the corresponding harmonics. Hence the difference between any two order-numbers will give the vibration-number of the resultant-tone for the interval formed by the two corresponding harmonics, and the position of the resultant-tone in the harmonic series will thus be at once assigned.

Successive application of the above method to a series of intervals gives the following results:—

Minor tone D‴ – E‴, 10 – 9 = 1. Resultant tone C, 3 octaves and a major tone below the graver primary.

Major tone C‴ – D‴, 9 – 8 = 1. Resultant tone C, 3 octaves below the graver primary.

Minor third E″ – G″, 6 – 5 = 1. Resultant tone C, 2 octaves and major third below the graver primary.

Major third C″ – E″, 5 – 4 = 1. Resultant tone C, 2 octaves below the graver primary.

Fourth G′ – C″, 4 – 3 = 1. Resultant tone C, a twelfth below the graver primary.

Fifth C′ – G′, 3 – 2 = 1. Resultant tone C, 1 octave.

Minor sixth E″ – C‴, 8 – 5 = 3. Resultant tone G′, major sixth below the graver primary.

Major sixth G′ – E″, 5 – 3 = 2. Resultant tone C′, fifth below the graver primary.

Octave C – C′, 2 – 1 = 1. Resultant tone C, coincident with the graver primary.

Ninth C″ – D‴, 9 – 4 = 5. Resultant tone E″, a major third *above* the graver primary.

In order similarly to treat semi-tones, sevenths and other dissonant intervals, it is only necessary to include higher numbers of the harmonic series, and the method is evidently as applicable to summational as to differential resultant-tones.

MARGARET DICKINS.

Tardebigge Vicarage, Bromsgrove, April 5.

Municipal Meteorology.

IN your notes in NATURE for April 3 (p. 518) you mention Dr. H. R. Mill's observations as to the length of the February frost, the period at Torquay being reported the shortest, viz. nine days.

I think it should be pointed out that for scientific purposes the Torquay temperatures should be treated with much caution, as those of an extremely sheltered spot, viz. Cary Green. Up to last year Torquay had two observing stations; but one of them, viz. that at Chapel Hill, was given up. On moving the adoption of the report advising, among other things, the discontinuance of the said station, a member of the Town Council very honestly remarked that "the range of temperature at Chapel Hill was greater than that at the Princess Gardens, and it was *more satisfactory for the town* to have as small a range of temperature as possible"! (*Western Morning News*, March 6, 1901). According to the last meteorological report, the temperatures are still taken at one of the old stations, viz. Cary Green. The differences between Chapel Hill and Cary Green were often considerable, *e.g.* on March 18, 1900, Chapel Hill 23°·9, Cary Green 27°.

A. R. HUNT.

Torquay, March 10.

A Gall-making Cynipid Fly in Jamaica.

THE Hymenopterous gall-makers of the family Cynipidæ, though widely distributed over the earth, have seemed to be totally absent from the West Indies, somewhat to the astonishment of entomologists. However, in February, 1892, Mr. W. Harris sent me a gall on *Bidens reptans*, collected by Mr. Nicholls at Cinchona, Jamaica. The gall was a large oblong swelling attached to the stem of the plant, and contained many cells. Unfortunately, I was not able to breed the flies, but I secured some immature fragments. which sufficed to show that they were Cynipidæ. Mr. W. H. Ashmead, to whom I submitted my notes and sketches, is of opinion that the genus must be Aulax or allied thereto. Although it is impossible to determine the species, it seems desirable to call attention to the occurrence of this gall-maker in Jamaica; and perhaps one of your West Indian readers will be able to supply us with complete information.

T. D. A. COCKERELL.

East Las Vegas, New Mexico, U.S.A., April 3.

Criticism of "The Great Persian War."

MAY I call attention to one or two points in your critic's treatment of my work (p. 434)?

(1) Your critic says that at Thermopylæ "the mound and the Phocian Wall are the only debatable points."

I may mention that, among many other debatable points, some persons who have examined the pass have located the fight at the West gate.

(2) Your critic is apparently not aware that the site of Trachis is uncertain. Two sites at some distance from one another have been proposed.

(3) Of Aphetæ he says, "it is hard to reconcile Mr. Grundy's situation with the remark of Herodotus, that the wreckage of the first sea-fight drifted *out* (the italics are your critic's) to Aphetæ, which is badly misrendered in the words 'was thrust in upon the Persian fleet.'"

Either your critic or Liddell and Scott are guilty of a bad mistake in scholarship (*vide* L.S. sub. *ἐκφορέω*. 4. Pass, "to be cast on shore": with a reference to this very passage Herod. VIII. 12; *cf.* also *ἐκφέρω* in the same dictionary). If I sin, I sin in very good company.

(4) In reference to B.C. 479, your critic asks, "Why should they (the Persians) stop at Cithæron?"

I would ask in reply, (1) Why did not the Persians stop in Attica? (2) Why, above all, did the Greeks follow them into Bœotia?

(5) Your critic says, "It is absurd exaggeration to call Taurus 'an all but blank impassable wall.'"

In the part of that chain which separates Asia Minor from the Euphrates region between the pass from Laranda to Kelenderis and the pass of Kiskisos, a distance of 170 miles, there is only *one* pass, the Cilician Gates. The two first mentioned afford circuitous and difficult routes to the Euphrates region. The Cilician Gates are by no means an easy pass. (For Map *vide* Ramsay, "Asia Minor," p. 330.)

(6) Your critic says that "for downright geographical nonsense" it would be hard to beat the description of Pteria as the chief strategic point in the Halys region, as commanding the middle portion of the valley through which the river flows.

He is apparently under the impression that in order to command a valley strategically, a town must be in it. On the importance of the position of Pteria the evidence of Herodotus is sufficiently striking (H. I. 76), "Now Pteria is the strongest position in the whole of this country."

(7) Your critic asks, "Are the Phrygians and the Bithynians still to be called Thracians in the days of Darius?"

His answer is obviously No! Another authority, Herodotus, however, speaking of the races which Crœsus ruled, mentions (I. 28) *Θρήικες οἱ Θυνοί τε καὶ Βιθυνοί.*

(8) Your critic says, "On p. 378 a whole paragraph is based on a childish mistranslation of Herodotus."

This charge is based on a somewhat careless mistake of his own. I speak of a "decision." He refers to the "discussion" of chapter lxxiv. of Herod. VIII.

I have dealt with all the major charges brought against me. I cannot expect you to allow me space to deal with the minor charges, though I believe them to contain inaccuracies.

G. B. GRUNDY.

THE EDUCATION BILL.

THE Education Bill introduced by the Government on March 24 has been so freely discussed in the public Press that everyone interested in educational work is familiar with its chief provisions. The fundamental idea is the creation of local bodies to supersede School Boards, managers of voluntary schools and technical instruction committees, and to be responsible for the organisation and maintenance of the various educational agencies—both primary and secondary—within their respective areas. The local education authority will be the County Council in counties and the Borough Council in county boroughs; it will work through committees appointed under schemes to be approved by the Board of Education, consisting of members appointed by the County and Borough Councils, with a minority of persons possessing expert knowledge of educational work. The committees will thus be similar to those under which the work of technical education has been carried on since 1889.

In the contributions by Dr. Oliver Lodge, Sir Joshua Fitch and Prof. Wertheimer, which are subjoined, several aspects of the measure are described. It will be evident from these articles, and from the views which have been expressed elsewhere by persons and organisations whose opinions merit attention, that the principle of local educational authorities meets with general approval. But it is apparently impossible for primary education to be considered in England without raising religious difficulties; and the controversy over this subject is of such an uncompromising nature that it threatens to delay or wreck the present measure as it has others.

The abandonment of the Bill would, in our opinion, be a disaster to education in England, for the measure represents an earnest attempt to put our educational system on a sound organic basis. The only way to avoid such a disappointment seems to be to divide the Bill into two parts—one concerned with secondary and the other with primary education—and let each part be dealt with as a separate measure. Secondary education includes technical education, and national progress depends more upon the coordination and extension of these higher stages than upon elementary instruction. What the country needs are masters and managers educated in the truest sense of the term, men with scientific training and sympathies, able to appreciate latent possibilities of industrial developments and anxious to encourage all work which aims at the advancement of knowledge. It is in students of this class that England is lamentably deficient as compared with Germany and the United States, and it is to such students that the country must look for material progress.

We ought not to have to wait for a settlement of the differences of theological parties before organising the agencies for higher education, which have fortunately been emancipated from these difficulties. The Bill as a whole is a comprehensive measure which could be made an Act of decided value to education, but as there seems little hope of removing the opposition to the part dealing with primary education, the sections dealing with secondary education, which are less contentious and are generally accepted, should be separated from it and passed first. The local authorities which would thus be created would then be able to gain experience, and perhaps in the course of time public opinion would be intolerant of the interference of sectarian parties with schemes for secular education. To permit such differences of opinion to delay the establishment of higher education on a sound basis would be a national misfortune.

EDITOR.

I.

The opposition threatened to the Education Bill just introduced by Mr. Balfour may or may not be weighty, but it is voluminous enough to demand some activity and energy on the part of those who realise the immense leeway in secondary education that has to be made up, and who welcome any real and public-spirited attempt to grapple with the difficulties of its effective organisation.

It is unlikely that the new Bill is free from faults, but it clearly represents a strenuous and conscientious effort to legislate in the right direction; to many it appears a statesmanlike attempt to grapple with the numerous difficulties and at the same time to leave as much opportunity as possible open for local experiment, for growing experience, and for the subsidence of needless hostilities; and in any case it should be welcomed by all who are interested in educational progress. For though they may not be able to approve every minute detail, yet the more they study it, the more they will realise the care and forethought which have been exercised in steering through the maze of conflicting interests and in endeavouring to lay down the wisest course.

The form of educational government which has most promoted rapid development and has shown itself to be extremely well qualified to adapt itself to new requirements is the kind of government which controls University colleges. The success and growth of these institutions has been the prominent educational feature of the last quarter century, and they are governed by a council consisting of local business and professional men, not specifically qualified—qualified highly in other directions,—who have sufficient public spirit to give some time and trouble to the work; this body, the council, is advised and assisted in all academic matters by the professorial staff in subordinate conclave, who form a body called the senate, which has no financial power, but has usually in practice, by reason of its special interest and knowledge, a very considerable guiding influence. The business man, when properly advised on technical matters, but only when so advised, is extremely expert as an organiser and conductor of affairs on commonsense lines; he is usually far more efficient in these respects than the academic officers themselves; and the combination of the two works admirably.

The system which has proved so effective may well be extended so as to take control of the schools also. Something like it is what the Government propose. The real education authority is to be the County or Borough Council, an assemblage elected for general purposes, and containing, it is to be hoped—certainly containing in all places where local self-government has been a credit and an inspiring example—the best and ablest of the citizens. It is vital that the best and most competent men shall consent to serve in this capacity, and everything which increases the interest and the dignity of the proceedings of such bodies is to be welcomed. But though each County and Borough Council is the ultimate authority, with power of purse, subject only to the central Board of Education which may be said to take the place of the Court of Governors of a University college as court of appeal and general supervisor, it is not to be the working administrator. This is to be a committee appointed by the Council, together with other persons who may be nominated by representative institutions, and may include experts in education of all kinds; and this administrative body will roughly correspond with the senate, and will have much power, but it must contrive to act so as to carry with it the conviction and the support of the local education authority itself.

The precise constitution of this committee is left undecided by the Bill—a feature which has excited hostile

comment—and the county authorities are asked each to draft and submit a scheme to the Board of Education, so as to allow as much local initiation as possible. This and many other provisions of the Bill may seem, to persons who come new to the subject, as a needless opening of the door to variety and difficulty; but the more we appreciate the different circumstances obtaining in different localities throughout the country, and the more we discuss the matter with representative men who have been connected with official educational matters in the past, the more does some such course seem desirable.

A series of private conferences was held in the University of Birmingham during November 1901, and was attended by a specially invited number of representative educationists, prominent members and officials of School Boards, managers of voluntary schools, and other men of experience and various views, representing opposite schools of thought; and at these conferences a general idea of the provisions which would be likely to secure practical agreement was arrived at. I propose in this article to summarise them and to indicate how far and in what way the Government Bill satisfies the conditions then laid down as most suitable.

First, there are three general conditions which any effective Bill should satisfy, and on which there was universal agreement:—

(A) That all education shall be included in the purview of the education authority so as to secure continuity of the educational system throughout the country.

(B) That the new authority should be sufficiently strong and independent of sectional interests to deal effectively and impartially with educational defects in its district, whoever is responsible for them.

(C) That it should be provided with prompt and efficient means of obtaining funds, both imperial and local, for carrying out its policy; that it should have proper borrowing powers; and likewise the power of compulsory purchase of sites.

To these may be added a fourth, which, though it touches upon controversial topics and when pressed into detail could easily excite difference of opinion, yet in its general form will probably be accepted by all fair-minded men:—

(D) That while insisting on a minimum of efficiency and on representation on the boards of management of all schools drawing assistance from national or local funds, the new authority should recognise the value of the voluntary schools to the nation, and do nothing to discourage the interest of religious bodies in the education of the people.

Next it seems to be quite widely and generally accepted that a unification of educational organisation is desirable, so as to break down the strict line of demarcation between primary and secondary, to raise the status of the primary teacher, and to open a career and the highest educational posts to competent men who enter the profession even at the lowest grade. It is also generally accepted that this general education authority should not be central, but be local; so as to spread the interest, to adapt itself to varying conditions, and to secure the many advantages of distributed local self-government. This was expressed in the first resolution:—

(1) That there should be one local Education Authority, which should control all the educational agencies receiving public support in the district—primary, secondary and technical—and should get into effective contact with institutions for higher education, such as non-local or endowed schools, University colleges and Universities.

But the difficulties begin as soon as it is attempted to lay down a constitution for the new authority. There are many who advocate that one uniform constitution should be laid down in the Act. Others hold that it would be better to let each locality consider what is best for itself, and to have at least the option of formulating a scheme, to be approved and sanctioned by the central authority or Board of Education; but that no scheme should be drafted by that body except in cases where the locality did not choose to exert its power of choice. Although there would be a certain disadvantage in having different schemes simultaneously in force in different places, yet it is likely that each County Council would take more interest in and would take more pains to work a scheme that they themselves had had a hand in drawing up, rather than one which had been forced upon them, in which they had no voice, and might feel that they had no responsibility for its success or failure. Again, it appears difficult to say of any scheme that could be suggested that it is absolutely the best. It may be necessary to ascertain the best by actual experiment, and if different places adopt somewhat different schemes, the best of them may before long emerge and may hereafter be imitated elsewhere. At any rate, the majority of the conference was in favour of some local option in this matter, and adopted the following clauses:—

(2) That each County Council and each County Borough Council, either separately or in combination with other neighbouring councils and with representatives from adjacent boroughs, and in consultation with some recognised educational experts, shall formulate a scheme for the constitution of the Educational Authority in its district, and shall submit it to the Board of Education; subject to the proviso that no scheme is in general likely to be acceptable which does not provide:—

(*a*) That about two-thirds of the suggested Education Authority shall consist of members in some way or other elected by ratepayers of the district (though not necessarily elected for the specific purpose of education).

(*b*) That a reasonable proportion (say in general about one-sixth) of the suggested Education Authority shall consist of members nominated by specified educational institutions of weight and influence in or near the district.

(*c*) That the remainder shall be co-opted according to some scheme to be submitted.

(*d*) That place shall always be found, in one or more of the above classes, for women on each educational authority.

(*e*) That the members of the Educational Authority, whether co-opted or nominated or elected, shall retire in rotation, say one-third every three years or one-half every two years, but shall be eligible for re-election.

Note.—A minority held that it was undesirable to leave even this amount of experiment and variety to local option, but that a uniform constitution should be enforced in the act.

(3) If no scheme is formulated by a County Council, the Board of Education shall formulate one.

(4) Any scheme for the constitution of a local authority, however formulated, shall be published in the locality, and criticisms considered, and petitions heard against it, before confirmation and adoption.

The Government Bill differs from these clauses in the following particulars:—First and most important, it is not the authority itself which is to be thus constituted, but only the working committee; next, the Bill does not dictate to the County or Borough Council in what way it shall formulate a scheme which it shall submit for approval to the Board of Education; and, lastly, there are only two provisos laid down, which, however, embody the essence of the above provisos *a*, *b*, *c*, except that, instead of two-thirds, a majority only is insisted on, and this majority need only be elected by the ratepayers at second-hand, being appointed by, but not necessarily themselves being members of, the council. In practice, however, no doubt a large number of them would be actually elected-members of the council. In practice also it is to be hoped that proviso *d* above would always be enforced, for since half the children to be taught are girls, it is only a matter of common sense that place for women should be found on each education authority; and it might have been wise to attract support by definitely inserting this provision. But this and the business arrangements about retiring are left as part of the optional scheme to be drawn up by the various localities; indeed, the whole proposals of the

Government tend in the direction of leaving as much liberty and elasticity as possible, having faith in the county authorities to devise a suitable scheme without coercion from Parliament. This feature, it seems to me, should be welcomed except by persons who have no faith in popular government.

But there is one important item in the Government Bill which was not adopted by the above-mentioned conference, and which appears certain to excite the hostility, and which evidently has excited the hostility, of members of School Boards, though the reasons why they object to it do not lie on the surface. This is a matter on which much controversy turns, and it may be as well to explain it.

In the above proposals of the conference it was all along assumed that the committee appointed to work the educational scheme would be itself the education authority, and the following additional clauses with regard to its financial powers were drawn up :—

(5) That the Education Authority as constituted be an authority subject only to the Board of Education, that it have independent rating power, borrowing power and purchasing power, and be not regarded as a committee of the County Councils with proceedings subject to revision by those bodies.

Note.—Whatever objection may be felt to this independence of rating power for educational purposes, it is felt that if it were not granted the incipient harmony and agreement would be destroyed, for the School Boards would not willingly consent to resign an important portion of their powers to any but a strong and autonomous education authority.

(6) That the local authority shall administer and apportion all public educational funds ; of which it is desirable that a larger proportion than at present should be derived from imperial revenue (since the local rate falls with undue severity on the poorer districts, and for other reasons), and that no limit be placed by Act of Parliament on the rating power for education of a local authority.

But here the Government Bill differs entirely ; it constitutes the County Council itself the local authority and gives it full control of the purse (subject, however, to certain limits of rating power, which limits are too absurdly narrow as specified in the Bill, though a means of widening them is provided, for any education higher than primary) ; and the working education body is only a committee of this local authority, consisting of appointed, co-opted, and nominated members. The object of this contrivance is manifest, viz. to leave the ultimate financial control entirely in the hands of persons directly elected by the ratepayers, and to get rid of the anomaly of two independent rating powers. But there at once we touch upon the jealousy or rivalry which has existed between the County Councils and the School Boards, for the latter are not likely to be willing to give up their powers to a body elected for other purposes than education, the members of which are not necessarily even members of the education committee ; nor are they likely to willingly resign their financial autonomy in favour of a mere committee without rating power. This has always been recognised as one of the most difficult points about the Bill, and it is not likely that any solution would meet all objections. On the whole, the Government solution seems to me ingenious and hopeful, but they must be prepared to face a genuine conflict of opinion on this point. Fortunately, the urgency of the conflict is mitigated by the optional provision which permits efficient School Boards to continue for a time ; but the option does not rest with the School Board—it rests with the County Council ; and this fact, though probably unavoidable, may lead to conflict. On the whole, it appears not unlikely that this provision for choice between adoption and non-adoption of the elementary education portion of the Bill may be abrogated ; but strong arguments in favour of it are given below (see paragraphs following 14).

The next four propositions are little more than business arrangements, though it may be convenient to quote them. They are as follows :—

(7) That financial support be not granted to any institution until proper means be taken to secure its effective expenditure.

(8) That any existing powers whereby a locality aids an educational institution nominally outside its area shall be preserved.

(9) That it shall be the duty of each local authority to forthwith examine into the educational need of the district, to report to the Board of Education both on its present supply and from time to time on the further additional supply necessary, and, subject to control and approval by the Board of Education, to take steps for its provision.

(10) A right of appeal to the Board of Education on behalf of any aggrieved institution shall be conceded.

Of these it is satisfactory to find that No. 8 is included in the Bill, so that, for instance, a University college which manifestly serves an educational area without being actually located in that area, can as heretofore be assisted by the council controlling the area.

It is to be feared that No. 10 does not find a counterpart in the Bill. Right of appeal to the Board of Education as an arbiter is given in connection with primary education, but it is needed on behalf of any institution, though not of any individual, which feels itself aggrieved by some action of the local Education Authority.

Then there arises the question as to the proper size of an educational area. It would be desirable, if possible, that each complete area should contain an example of every grade of educational institution, from the primary school to the college and University. This is not feasible, but what is feasible is that for certain purposes some common action could be taken, or some amalgamation effected, by areas which are educationally too small. Moreover, there are many instances where the administrative county area will turn out very artificial for educational purposes, giving rise to much needless overlapping ; and, although it would seem impracticable to mark out new areas, yet even that might be permitted if locally desired ; anyway it would be quite feasible for county authorities to combine for educational purposes, and accordingly the conference adopted the following resolution :—

(11) That local Education Authorities of adjacent districts which for any reason have educational interests in common be empowered to combine, to discuss, and to appoint joint committees for all such purposes as may be common to their areas ; and likewise, if they choose, to combine altogether or amalgamate for educational purposes, so as to constitute a large educational area administered by one authority ; and that facilities for such combination be afforded.

Note.—Opinion was divided as to whether it was feasible to enforce combination among administrative counties for educational purposes, with the object of securing a large dignified and comprehensive educational area.

The essence of this desideratum is provided for in the Act in an ingenious manner, the arrangement of an education committee not itself a County Council facilitating the matter, because plainly county authorities could combine to work their districts by a single education committee nominated conjointly.

The educational standing of non-county Boroughs and urban districts has been a matter which has always given great trouble and excited considerable controversy. A non-county borough with a large population, for which it has made considerable educational provision, and possessing a penny rating power for technical instruction, would resent being treated by a County Council on the same lines as the surrounding rural districts ; and yet it seemed difficult to constitute so small a body with no great variety of schools in its area an actual Education

Authority. Accordingly the conference adopted the following resolutions :—

(12) That it be exceptionally permitted to some boroughs and urban districts in the neighbourhood of county boroughs to link themselves for educational purposes with the said county borough by mutual agreement instead of directly with their proper county.

(12*a*, supplementary to 12) Any Borough or District Council with general rating power shall be empowered to levy an additional rate for education in its own boundaries over and above that demanded by county authority from the entire area of which it forms a part ; but this rate shall not be expended by the Borough or District Council until its recommendations have been submitted to, and approved by, the Education Authority in whose area it is situated.

The Government Bill solves the difficulty in a somewhat analogous but still more liberal manner —some think an over-liberal and unwise manner;—the Borough Council itself, when it represents more than a certain population, is constituted the local Education Authority, but it is given the option, not only of sharing, but actually of transferring, the responsibility, either the whole or a part, to a County Council, provided the latter is willing to take it, and at the same time its independent rating power for education higher than elementary is preserved.

It is to be hoped that the power of amalgamation between neighbouring counties, boroughs, and urban districts will be exercised ; for this question of the size of an administrative area is really a very important one. Many eminent persons hold that an area the size of a Province would be in many ways better and more dignified than the present area of an administrative county : a return, as it has been called, to the heptarchy, the natural provinces of which were marked out by physical features, and have always retained a certain set of common interests. These ancient provinces are large enough to support highly dignified governing bodies, to which a great part of the local government still at present cumbersomely and expensively administered at Westminster could with propriety be transferred, thereby setting free the time of Parliament for Imperial purposes, and leaving local questions connected with locomotion, drainage and the like to be dealt with by the localities which most thoroughly understand them. It is just possible that amalgamation for educational purposes might form the beginning of this much-to-be-desired result.

Returning now to the business arrangements which must be made by an education committee, it is manifestly desirable that the authority for a large area shall not attempt actually to manage the schools in its area, but shall operate on them through Managers more immediately in contact with each school, such a board of managers being in most places already in existence, and being therefore conveniently continued, though with some modification.

The following resolutions were adopted by the conference, and similar provisions are included in the Bill :—

(13) That the Education Authority, though having control over all schools dependent on public funds, shall not constitute itself a board of management for any school ; but shall provide that managers be appointed or continued for every school or group of schools within its area, according to some scheme approved by the Board of Education.

(15) In order to establish and maintain connection between the managing bodies and the local Education Authority, the latter shall nominate one or more persons to serve on each managing board or governing body concerned with any school or group of schools deriving financial benefit from rates or taxes.

(16) That in order to facilitate connection with and representation from the local authority, existing non-elected managing bodies be combined with one another for purposes of administration, on lines similar to those in use under the Aid Grant Act of 1897.

But it is desirable that those specially appointed managers who represent the controlling body shall report to that body regularly. Otherwise the control might gradually cease to be effective.

I have omitted No. 14, which had to do with the future of the more efficient School Boards—those which had done good work and had gained the confidence of the community, and which it seemed undesirable to suppress. It was a very difficult point, and no satisfactory solution was arrived at. The resolution may be quoted, in order to emphasise the difficulty ; and it was drawn in vague terms in order to cover, not only School Boards, but the boards of all other schools which are to be affected by the Act.

(14) That existing administrative educational bodies, wherever they have shown themselves efficient, be continued in their office and function as managing boards, and in such dependence on popular vote as already exists, and with their present attendance authority, but without rating power, and subject to the control, as hereafter defined, of the local Education Authority.

What the Bill proposes, however, is not this poor compromise ; it proposes to leave it optional with each locality, at any rate for a time, to decide whether the existing School Board shall continue to take control as heretofore of primary education, or whether it shall be at once superseded by the new and comprehensive authority. Perpetuating the School Board system in places will have the effect of perpetuating there the undesirable dislocation between primary and secondary education ; but, on the other hand, it will avoid introducing sudden disturbances ; it will allow the present conditions, wherever efficient, to persist for a time ; it will allow business to continue during alterations, and it will pave the way for a gradual change on to the new lines when time and experience are ripe. Hence it appears to me that this optional clause, permitting the transfer of primary control to be locally delayed for a time, is to be distinctly welcomed as affording an easy and elastic means for introducing the provisions of the Bill with the consent of each community, rather than forcing them to accept them prematurely. Ultimately it is to be hoped that but little conflict will arise between School Boards and County Councils on this matter, because no County Council would be foolish enough to overlook the advantage of nominating the prominent and efficient members of School Boards on to the new Education Authority, thereby continuing to reap the benefit of their wisdom and experience, just as they will continue the Board officials in practically their present office and function.

Those who advocate the abrogation of this optional clause, and the compulsory forcing on each County Council of full and immediate responsibility for primary as well as for secondary education, would do well to remember that voluntaryism is the essence of local government in England ; and that if a body is overweighted, or prematurely loaded, people of judgment may decline to serve on it. Compulsory adoption of the Act would logically involve a measure to enforce service on a County Council.

The vexed question of how to improve and give rate aid to the schools provided by religious denominations, and of what special privileges can be conferred on such schools in return for certain pecuniary sacrifices made by the denominations interested in them, has excited, and will no doubt continue to excite, much controversy ; but, as it seems to me, controversy of a belated kind, more noisy than effective, and largely maintained by those who have lived through the sectarian controversies of 1870. To the younger men these sectarian difficulties loom very small :

it is felt to be fair that if a religious denomination provide and keep a school in effective order, it should have the power of giving its specific instruction during certain limited hours, arranged so that scholars not belonging to that denomination may be withdrawn at the wish of their parents; and it is felt to be unfair that the secular instruction of the children in the district which such a school serves should suffer by reason of deficient funds owing to sectarian jealousies; it is felt, in fact, that the district can be properly called upon to support such a school in as thorough a manner as any other, provided always that the ratepayers' authority be extended (*a*) to a voice on the managing board in accordance with the above resolution No. 15, and (*b*) so that it shall have an effective voice in the appointment and dismissal of teachers. Accordingly the following resolution, together with the "powers and functions" numbered 3, 4, 5, 6, 7, below, was adopted, and practically represents what is, or may be under a "scheme," provided by the Bill; except that very unfortunately the word "dismissal" has escaped explicit mention. It may be held to be legally included in the word "appointment," but it is a vital matter to get security of tenure for all teachers, and not leave any of them at the mercy of individual action unchecked by the Education Authority.

(17) That a school whose buildings are the property of a religious organisation, by whom they are maintained to the satisfaction of the local Education Authority, shall be regarded as a privileged school in which special religious instruction is permitted at certain hours, in accordance with a time-table to be submitted by the managers to the Education Authority for its approval, and subject to the conscience clause of the Act of 1870.

Note.—A small minority considered that the upholders of these privileged schools, managed by non-elected bodies, though under the control of an elected educational authority, should be called upon to provide one-sixth of the income in addition.

It is desirable, however, and it may be feasible, to introduce a clause giving to other denominations, which are not providing a school, if they are in sufficient numbers and if there is no other school in the neighbourhood, to make application, not only for mere withdrawal of their children from the specifically denominational religious instruction provided, but, in addition, for the supply of general Biblical teaching for those children to attend in the same school at some other hour.

This question of the so-called voluntary schools—which is a misnomer, the proper title being denominational schools or privileged schools—is by no means an insignificant one, since more than two-thirds of the schools in the country are of this kind; and if they were not taken advantage of, it would not only be a blow to educational and humanitarian enthusiasm, but it would involve the ratepayers in enormous additional expense. At present these schools are suffering from extreme poverty, the voluntary contributions and the Imperial grant together being quite inadequate for their proper maintenance; and the buildings themselves are often inadequate, antiquated and unwholesome. With rate aid and proper control of teaching appointments, no longer leaving teachers subject to the caprice of an accidentally injudicious local clergyman, educational efficiency can be secured; and the denominational subscriptions will still be required, in some places even more than hitherto, in order to put the fabric into a satisfactory condition and to maintain it in substantial repair, as required by the Education Authority. If they do this, the denominations cannot be expected to do more, and they are entitled to give specific religious instruction at certain hours on the strength of this. But if they go further than this in their demands for rate aid, if they resent any element of popular control—resent, for instance, any interference with their appointment and dismissal of teachers, or any influx of nominated members on to their managing board, that is to say, if they resent effective control of their rate-aided secular instruction—they will be taking an unwise course, and must not be surprised if the clauses in the Bill, which already give them everything to which they are reasonably entitled, are opposed so strongly as to be modified in a direction opposite to that which they desire. It is undoubtedly the interest of Churchmen, meaning by interest, not selfish interest, but public and denominational interest, to support the Bill; but the unwisdom of some few of the letters which have appeared in its support is extreme.

The last resolution adopted by the conference, having reference to the training of teachers, unfortunately has no corresponding clause in the Bill. It ran as follows:—

(18) That Education Authorities shall be empowered to enter into relations with Universities and University colleges and other institutions for higher education, in order to make provision for the proper training of teachers; and that after a certain date special sanction should have to be obtained for the employment of unregistered teachers.

But it is to be hoped that the omission has no real significance, that operations for the training of teachers will be in every way encouraged, and that it was only omitted because of the inadvisability of loading the Bill, or the duties of the new Education Authorities, with more than was absolutely necessary.

This represents all that I need now say on the general subject. The remainder of what the conference did was to draw up a specification of the "powers and functions" of the committee, stating in what way it should exercise control over the schools in its area, and what was meant by "control." It may possibly be useful to County Councils and other bodies engaged in formulating a scheme if these be here quoted; but it may be remarked that the first two are perhaps somewhat doubtfully wise in their present too unrestricted form.

Specification of powers and functions.

The functions and powers of the local authority shall be:—

(1) To keep a register of the efficient schools in the area, and to transfer schools and endowments from places where they are not wanted to places where they are.

(2) To make orders for the use of endowments or other grants, for establishing scholarships from schools to other schools or to colleges and Universities.

(3) To inspect all schools in its area as to buildings and sanitation, and publicly aided schools as to educational efficiency, and to make regulations in accordance with the reports of its inspectors.

(4) To withhold financial aid from any school and to close any publicly aided school which fails to comply with its regulations or which is educationally inefficient.

(5) To frame a scheme to be submitted for approval to the Board of Education for the remodelling, when necessary, of the constitutions of existing publicly aided schools, and for providing new schools.

(6) To receive and consider the curriculum of each publicly aided school, as submitted by the board of managers; to amend and refer back any part of such scheme; and ultimately to approve the curriculum adopted, having regard to the educational needs of the district.

(7) To receive and consider recommendations of the managing board concerning the appointment and dismissal of teachers in the schools under its management, and to be the final court of appeal in such matters.

(8) "Control" shall mean the exercise of any of these powers.

OLIVER LODGE.

II.

The Bill recently introduced by Mr. Balfour is a complex measure, carrying with it some consequences which are not apparent at first sight. Many of its clauses—notably that which makes the adoption of

some of its provisions voluntary on the part of the County Councils—will doubtless be subject to much criticism and to many amendments in detail before it passes into law. Meanwhile it may be useful to review the chief features of the Bill, as they affect (1) technical, secondary and higher education, and (2) the public elementary schools.

Part II. of the Bill follows in the main the line indicated in the former Bill of 1896, which was withdrawn by the Government of that year. It gives to each council of a county and of a county borough, and to the council of any other borough with a population of more than ten thousand, the name of the "local education authority," and empowers it to supply or aid the supply of education other than elementary. The Technical Instruction Acts of 1889 and 1891 are repealed, and with them disappears the definition of "technical instruction," which has practically restricted the application of funds under those Acts and under the Local Taxation (Customs and Excise) Act to technical and scientific instruction. The local education authority of the future is therefore set free to allot its revenues to advanced instruction in any form which the circumstances of the district need, whether scientific, commercial, literary, technical or manual, or whether, as is more probable, the secondary schools include in their programmes all of these forms of instruction in varying proportions. This is a clear gain; the Bill may, it is to be hoped, encourage the formation of a sounder public opinion respecting the true scope and purpose of a liberal education, as distinguished from the specific preparation of the student for any one form of practical or industrial pursuit. Since in another part of the Bill (clause 18) evening scholars and scholars above the age of fifteen are excluded from the elementary schools, and presumably from a share in the ordinary Parliamentary grant, it may be inferred that, in addition to the existing grammar and endowed schools, and technical and secondary schools generally, all the higher-grade and continuation schools, and evening schools now controlled by the School Boards, will come into the domain of "higher education" and will receive aid only under the provisions of Part II. of the new Bill. Beside these, it is to be assumed that the local education authority will have under its care the training colleges for teachers, the pupil-teachers' central classes, and the management of local scholarships and of such endowment funds as are applicable to education in their respective districts.

The resources available for advanced education under all these forms will be drawn from the fees of the scholars, from the whole residue of the fund generally known as "whisky money" and provided by the Local Taxation Act, and from a rate which is not to exceed twopence in the pound in counties and county boroughs, or a penny in the pound in non-county boroughs. It is manifest that these resources will not suffice to fulfil all the purposes just enumerated, and will leave little chance for the establishment of such new schools or colleges as may be needed, or for any adequate organisation of secondary instruction in the whole country on a generous scale. Moreover, it is to be observed that the new educational authorities will be only "committees" of the County Councils. They will have no power to raise rates or to give effect to their own recommendations, but will act in all respects in subjection to the veto of larger bodies, which are chiefly concerned with county business, with the water supply and with gas, tramways and sewage, and will be strongly tempted to keep down the rates and to give to the interests of education a subordinate place. It may fairly be concluded that the measure of the Government, if passed in its present form, will have the effect of repressing rather than encouraging educational enterprise, the expansion of existing institutions, the establishment of new ones, or the trial of new experiments.

This serious defect in the constitution of the local educational authority becomes more evident when we consider its probable influence on elementary education. At present the School Boards, which are the popularly elected administrators of the public funds available for elementary education in a given district, are under no restriction as to the local contributions to be levied in the form of rates, and are responsible only to two superior authorities—the ratepayers who elect them and the central Board of Education at Whitehall. Under the proposed measure, the managers of schools will be placed in relation to three authorities—the Board of Education, the County Council and the nominated Committee. It is difficult to see what can be gained in administrative efficiency or in unity of educational purpose by this arrangement. The measure will certainly check the ambition of "educationists" who are busy in discovering new methods and increasing the usefulness of the schools, and in effect it will encourage local authorities to prefer economy to educational improvement. As to the Board of Education—hitherto known as the Education Department—its policy of late has been to abdicate many of the most important functions which it once discharged to the great advantage of the public. Until lately it set up standards of excellence, and sought by graduating its grants to secure that these standards were attained. It has in recent years deemed it better to relieve itself of all attempt to discriminate between good, bad and indifferent schools, and has declined to examine the scholars and has awarded practically the same grant to all schools alike. It now proposes to leave to school managers the responsibility of framing such schemes of instruction as will satisfy the local public, and of seeing that these schemes are carried into effect. Thus between a central Department which is ceasing to exercise more than nominal control and a County Council which may chance to consist of persons hostile or at least indifferent to the intellectual progress of the people, or are else absorbed in county business of another kind, our principal safeguards for such progress, which have hitherto been found in School Boards elected *ad hoc*, and presumably caring most of all about the credit of their own town and the goodness of their schools, will be seriously weakened. It is impossible to look forward without grave misgivings to the future of popular elementary education in England under the new conditions contemplated in the Bill.

But, after all, the true significance and the obvious *motif* of the measure are to be sought elsewhere. Its best friends do not claim that elementary education under the new conditions will become sounder, larger in its scope, more scientific in its methods, or nobler and loftier in its aims. They advocate it chiefly because it will bring relief to the supporters of voluntary schools, especially to those of the Established Church. It is well to recall the actual facts of the present situation. About half of the children under instruction in England and Wales are taught in Church schools, owing to the fact that in the rural districts there is generally but one school in the parish and that the parents have no opportunity for exercising a choice. In towns, however, where such an opportunity exists, the Board Schools are generally fuller and more popular. Out of a total expenditure of nearly thirteen millions of pounds upon elementary education, the Church of England contributed last year about six hundred thousand pounds, in the form of subscriptions, congregational collections, and grants from local endowed charities. For this sum the representatives of the Established Church secured the sole management of schools attended by more than two millions of scholars, and the full power to give distinctive theological teaching and to administer the schools in the interests of the Church. To a plain man this arrangement appears to be an excellent bargain, from the point of view of those who regard those interests as supremely important. But it is always described in diocesan conferences,

episcopal charges and religious newspapers as a gross injustice and an "intolerable strain" upon the benevolence of Church people. Accordingly, the Government has been urged by the advocates of the denominational principle to make two concessions by way of relief: (1) to increase the public grant so as to make all voluntary subscriptions unnecessary, and yet to leave the existing managers free to preserve the distinctive denominational character of their schools, and (2) to repeal that clause (the fourteenth) in the Education Act of 1870 which forbids the teaching of creeds and formularies in the Board Schools, and so to permit the ministers of religion to give separate instruction in those schools to the children of their respective flocks. Both of these proposals were accepted by the Government and embodied in the abortive proposal of 1896. The second, however, does not appear in the new Bill. The Cowper Temple clause is not repealed, but will still remain applicable, not only to all existing Board Schools, but presumably to all new elementary schools to be provided by the proposed education authority. But to the former of the two demands, the Bill makes a liberal response. Denominational schools are to be financed and supported in future at the expense of the rates, on the easy condition that the managers provide and maintain in repair the school building—not, it should be observed, the furniture and equipment—and shall continue to maintain it as a Church school, subject only to the proviso that a number of members of their body, not exceeding one-third, shall be nominated by the local authority.

It will be seen from a careful study of the Bill that its dominant purpose, so far as regards elementary education, is to encourage the multiplication of denominational schools, to remove the "intolerable strain" of maintaining them from the shoulders of the churches to those of the ratepayers, to strengthen the denominational system and to give it a renewed chance of permanence. It may be that this great change in the national policy will commend itself to the approval of the English Parliament and people, but its meaning should not be misunderstood. It was the prayer of the Greek soldier, "Let me die in the light," and if, after all our experience and the efforts of statesmen to make our system of public instruction more national and less sectarian, we are really destined to see that system impaired if not destroyed, we ought at least to have our eyes open, and to see clearly what is the nature of the present reactionary movement and whither it tends.

J. G. FITCH.

III.

The two main causes for the relative poorness of British technical education as compared with that given in Germany and the United States are, (*a*) the fact that comparatively few British manufacturers have as yet learned the need for the efficient technical training of those whom they employ, and (*b*) the chaotic condition of the secondary, and part of the elementary, education of this country.

The Government Bill is a step towards the rectification of the latter defect, for not only does it make possible some organisation and improvement of secondary education, but it also tends to secure greater efficiency for the denominational elementary schools, many of which are at present in a starved condition.

Most of those connected with technical education will be glad to see that the Government has chosen as its educational authority a body on which, while the representative element will rightly predominate, there will be a minority of educational experts. Evening classes will come under the control of this new authority, and it will be possible to grade them properly and to secure that the bulk of the money spent upon them is not frittered away in simply giving many thousands a mere smattering of knowledge. At present this is the case to a considerable extent, and one reason for it is the lack of proper coordination between evening classes in Board Schools and higher institutions; such coordination would encourage a much greater number of the Board-School pupils to continue their studies to a stage when these studies might prove of real benefit, not only to the pupils, but also to the nation.

The Bill has two serious defects, both of which, however, can be easily remedied. In the first place there is the optional clause, which leaves it to the various county and borough councils to decide whether or not they will make themselves responsible for the whole of the education in their districts. If this stands it is certain to perpetuate old difficulties and to give rise to a whole series of new ones; it is to be hoped, therefore, that the Government will stiffen its back and leave no option in regard to this important matter.

Secondly, there is no clause in the Bill which appears to safeguard the interests of technical education by ensuring that the residue under the Local Taxation (Customs and Excise) Act, 1890, shall continue, as heretofore, to be devoted to the purposes of technical education. It is of great importance that this should be specifically enacted, as otherwise there will be a danger that, in view of the increased demands upon the ratepayers for improved elementary and secondary education, the local authorities may curtail the sums they now expend on technical education, though those sums are still inadequate when compared with the sums spent by our leading industrial competitors.

Finally, it would be well to include in the Bill some provision, not only for the coordination of work within the district of each local authority, but also for the coordination by means of the central educational authority of the work undertaken by the local authorities themselves. This is particularly necessary in the matter of technical education, for, if we are to have technical colleges which will be comparable in efficiency with those of the United States of America, we must gather large numbers of students into a relatively limited number of centres, and provide in each centre the best possible equipment and a teaching staff on a scale much more generous than in any example at present to be found in Great Britain. Elementary technical education ought, of course, to be given as far as possible in all parts of the country, but the attempt of small towns to give the highest technical education to few students should be discouraged. These students should be drafted into centres, and the determination as to where these centres should be placed should be left in the hands of the central educational authority. Moreover, higher technical education being a matter of more than local importance should be subsidised, not only, or mainly, by local authorities, but very largely by the State itself. One may hope for such increased State aid at present, but it seems scarcely justifiable to expect it; our statesmen have yet to learn that expenditure on an army and a navy to keep the "open door" for our commerce will not suffice to enable us to meet foreign competition, unless we expend time and money on the training of our industrial and commercial leaders in the same liberal and enlightened manner as is the case in the foremost foreign countries.

J. WERTHEIMER.

THE REGINA MARGHERITA OBSERVATORY.

THE investigation of the physiological phenomena which present themselves when man ascends to high altitudes is as fascinating as the results are, or promise to be, important. The fascination and the importance are connected with the complexity of the problems which have to be dealt with. The effect on respiration due to the diminished oxygen of the rarefied

air, so far from being the one thing to be studied, as the casual observer might suppose, is perhaps not even the chief thing. Of still greater importance, probably, are the manifold effects of diminished pressure on all the tissues and organs of the body, on the vascular system in all its parts, peripheral and central, and the far-reaching secondary results of the changes in the circulation thus brought about. These are further complicated by the influence of variations in temperature and in the qualities of the sun's rays.

It is through their complexity that the problems in question hold out so much promise; for they carry us beyond the mere question why such or such physiological incidents occur during a high mountain ascent, they lead us more or less directly to fundamental matters of physiology.

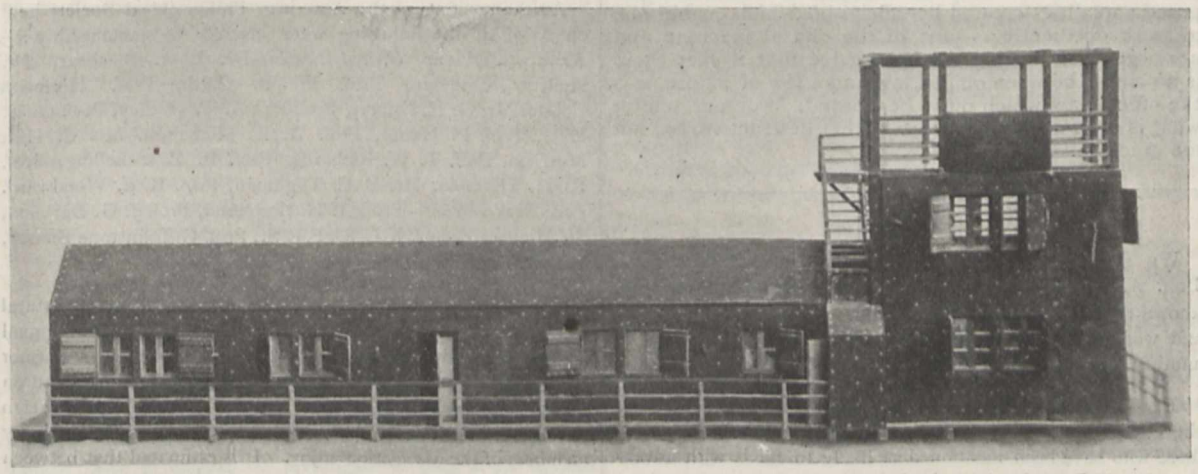
To solve these problems two things are needed—the possession of exact instruments of precision, and the opportunity of making use of these instruments at ease and with freedom from disturbance. The observations necessary to solve the problems which we have now before us cannot be satisfactorily conducted by means of rough instruments carried in the pocket, and cannot be adequately made in the open while the observer, blown about by a cutting wind, is steadying himself on his ice-axe. Happily, both these needs can now be supplied to any competent observer whose inquiry justifies the concession of them.

It was a happy thought of the Dowager Queen Margherita of Italy, whose love for the Alps is known to all the world, to convert into a scientific observatory the Regina Margherita Hut, which stood on the Gnifetti Peak of Monte Rosa at an altitude of 4560 feet, and which had proved of such service to mountain climbers. At her spontaneous suggestion, and by her beneficence, assisted by the Italian Government and with other help, the Hut, largely through the zeal and activity of Prof. Angelo Mosso, of Turin, has been transformed into the Regina Margherita Observatory, fitted up for scientific observations of various kinds.

Prof. Mosso is a physiologist, especially interested in the physiological problems of high altitudes, as shown by his book "Life of Man on the High Alps," and it is through his care that in the Regina Margherita Observatory, in addition to the provision for meteorological, astronomical and other physical observations, physiology has not been neglected. One of the rooms has been set apart for physiological observations and experiments. The great benefit thus rendered to physiology was acknowledged at the International Congress of Physiology held at Turin in September last under the presidency of Prof. Mosso. On the motion of Prof. Bowditch, of Harvard University, it was unanimously resolved to recommend the physiological laboratory forming part of Regina Margherita Observatory to the International Association of Academies as worthy of international support.

Nor was this the only token of approval shown at the Congress. One of the features of the Congress was an exhibition of physiological apparatus gathered from various countries; many of the pieces so shown, including several valuable exhibits from this country, were presented by the makers or private individuals exhibiting them to the Observatory. These, under the care of Prof. Mosso, now belong to the physiological laboratory of the Regina Margherita Observatory.

Hence any physiologist who desires in the ensuing summer vacation to enjoy the united pleasures of high Alpine life and physiological investigation, and we trust that there are not a few such, can do so with ease or even in luxury, finding in the Observatory, not only quiet and shelter, but also almost every apparatus and appliance which he is likely to need. I think I may venture to say that my friend Prof. Mosso deserves the warm thanks, not only of all physiologists, but of all men of science, for what he has thus done. M. FOSTER.



The Regina Margherita Observatory. The first room to the left of the two-storied part of the Observatory is the physiological laboratory.

PROF. EXNER ON SCIENCE AND THE STATE.

THE Vienna correspondent of the *Times*, writing on the 7th inst., comments upon a recent address of Prof. Exner which deals with the coming rule of technically trained men, that is, of men who can apply the principles of natural science; engineers trained in colleges as well as in works. The encouragement to scientific education given by foreign statesmen excites in this country only a feeble attention not unmixed with contempt. With us, higher education is still what it was in the time of Queen Elizabeth, and its advocates affirm that the education of men like Burleigh and Bacon, of Coke and Raleigh is good enough for statesmen of the twentieth century. This explains our difficulty in understanding Prof. Exner. Much of the pure science of the world is due to such British genius as could escape the academic net, and yet the power to apply that science is carefully kept away from the British people. We have started all the

branches of engineering; we have invented nearly all the important things, but the great development of these things has gone out of the hands of the amateurs of our nation. It is because our statesmen are Gallios who "care for none of these things," because they know nothing of science. Huxley failed to move them. The German Emperor's fosterage of engineering only amuses them, and hence our manufacturers blame everything except their own ignorance for their loss of trade. Prof. Exner wants to put the technically educated man in charge of all departments of Government which have to do with manufacture and distribution; with the use of all tools, including, we presume, guns and other weapons of destruction. He does not seem to know what is so obvious to us in England, that the Ministers in charge of departments must have had such a training of another kind that it is impossible for them also to be engineers. All we ask is that they shall know just a little about science, so that they may be able to take scientific advice. But alas! even this condition of things is remote. However important it would be to have men of the quality of engineers as their advisers or in charge of the various parts of a great department, there are qualifications more important—power to coax the Treasury for necessary money; social qualities such as come from good birth and enable one to keep one's superiors favourably disposed; qualities created by official life which enable one to work obediently as part of the official machine and never get into a rage; the knowledge that if ever there is a conflict between official law and a law of nature, it is the official law which must be obeyed. For our reform what is wanted is a cataclysm, rather destructive, but not too much so. J. P.

NOTES.

WE see with deep regret the announcement of the death of Prof. A. Cornu, whose numerous researches in physics are known throughout the scientific world. An account of the life and work of this distinguished investigator will appear in another issue of NATURE.

BY the death of Lord Kimberley, the office of Chancellor of the University of London becomes vacant. Of the names of those who have been mentioned as likely to fill it with advantage that of Lord Rayleigh is obviously the most appropriate. The new teaching University of London must achieve a high reputation on scientific lines or it will fail of its mission; a mere politician as a figure-head would be an anachronism.

PROF. RAY LANKESTER, in a letter to the *Times* of April 15, raises a new point in relation to the Rhodes scholars at Oxford. He states that the University of Oxford keeps its college residences, lecture rooms and laboratories open for only twenty-one weeks out of the fifty-two which make up a year; so that "it will not be worth while for a young German of ability to sacrifice three or four of the best years of his life to dawdle through the Oxford half-time system, even when paid 300*l.* a year for doing so." If it be true that the laboratories are shut for thirty-one weeks in the year, then certainly the sooner William Morris's idea of dispersing the inhabitants and consecrating Oxford to Death and Beauty, the better for others as well as the Germans to whom Prof. Lankester refers.

THE high esteem in which the late Sir John Donnelly was held was shown by the large body of mourners that attended his funeral at Brompton Cemetery on Friday last besides the members of the family. The Lord President of the Committee of Council on Education was represented; and among other mourners were the Clerk to the Council, the vice-president and officers of the Board of Education, representatives of the Victoria and Albert Museum, Geological Survey and Museum of Practical Geology, Royal College of Science, and Solar Physics Observatory. The Royal Society, Royal Academy, and the London Technical Education Board were also represented. Among the wreaths was one bearing a card on which was printed: "A tribute of affectionate regard from the vice-president of the committee of council, officers and staff of the (late) Department of Science and Art, including the Victoria and Albert Museum, the Royal Colleges of Science and Art, and the Geological Survey and Museum, 11 April, 1902." Another wreath was from the Dublin Science and Art Institution: "In token of affectionate remembrance and sincere regret from those who served under Sir John Donnelly." Other wreaths were sent by Sir Trevor and Lady Lawrence, Sir Lawrence and Lady Alma-Tadema, and many others. The Victoria and Albert Museum was closed on the morning of the funeral.

DR. J. LARMOR, Sec. R.S., and Dr. Oliver Lodge, F.R.S., have been elected members of the Athenæum Club under the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

AT the meeting of the American Philosophical Society held on April 4, the following were elected to membership:—*Residents of the United States*—Dr. J. A. Brashear, Dr. Andrew Carnegie, Prof. W. B. Clark, Prof. Hermann Collitz, Mr. G. K. Gilbert, President A. T. Hadley, Prof. G. E. Hale, Prof. P. Haupt, Prof. A. A. Michelson, Mr. C. Hart Merriam, Prof. T. W. Richards, Prof. F. E. Schelling, Prof. R. H. Thurston, Mr. B. C. Tilghman, Prof. R. S. Woodward. *Foreign Residents*—Prof. A. H. Becquerel, Prof. J. G. Darboux, Sir Michael Foster, K.C.B., F.R.S., Prof. G. Johnstone Stoney, F.R.S., Prof. S. P. Thompson, F.R.S.

AS already announced, the German Association of Natural Philosophers and Physicians will hold its seventy-fourth annual congress at Carlsbad on September 21–28. As on former occasions, the rule that lectures and debates may be carried on in any language of the world will be followed, and foreign visitors will be accorded the same privileges as the ordinary members of the association enjoy. It is estimated that between 6000 and 8000 representatives of natural philosophy and medicine will gather at Carlsbad, and great preparations have already been made there to receive the members and friends of this famous association. Nearly all the principal professors of the Berlin, Vienna, Prague and most of the other continental universities and important colleges will be present, and twenty-eight different branches of ancient and modern science will form the programme for the lectures and debates. At the exhibition of scientific objects, which will be held in connection with the congress, no charge will be made to exhibitors for the space required, nor will any entrance fee be asked from visitors. Inquiries or letters should be addressed to "The 74th Congress of Natural Philosophers at Carlsbad."

IN reply to a question relating to the North Sea Fisheries, Mr. Gerald Balfour stated in the House of Commons on Monday that the Government has agreed to take part in the international scheme of investigations connected with fishery problems in the North Sea and adjacent waters as proposed by the conferences held at Stockholm and Christiania, and Parliament will be asked to make a grant to defray the cost of the British share of these investigations. These funds will be administered by a departmental committee with the advice o scientific experts. The details of the investigations will no doubt be finally settled at the forthcoming meeting of the inter

national council at Copenhagen, at which Great Britain will be represented, but the date of which has not yet been fixed. The Board of Trade has also appointed a committee under a minute dated August 13, 1901, to inquire and report as to the best means by which the State or local authorities can assist scientific research as applied to problems affecting the fisheries of Great Britain and Ireland, and, in particular, whether the object in view would best be attained by the creation of one central body or department acting for England, Scotland and Ireland, or by means of separate departments or agencies in each of the three countries. Quite apart from this important question of scientific research, the Board of Trade has, with the assistance of another committee, considered how the present system of collecting fishery statistics in England and Wales could be improved and extended. The chief recommendations of this committee are referred to below.

THE *Times* has published the recommendations of the inter-departmental committee appointed "to inquire into the system of collecting fishery statistics in England and Wales, and to report how it could be improved and extended, and what additional cost (if any) would be entailed thereby, having special regard to the opinion expressed by the Select Committee of the House of Commons on Sea Fisheries, 1893, and the proposals of the Stockholm Conference, 1899." Among the suggestions are:—the extension and improvement of the present system of employing collectors at the fishing ports with the view of obtaining fuller details relating to fishery statistics; the preparation of separate returns as to the amount of fish caught in Icelandic and Faroese waters and in the Bay of Biscay and on such other new fishing grounds as it may from time to time be found desirable and practicable to distinguish; and that conger eels, dabs, gurnards, lemon soles, skate and rays, and whiting should be separately distinguished. The present report does not extend to statistics of salmon or fresh-water fish. The adoption of the recommendations would involve an annual expenditure on the collection of fishery statistics of 2135*l.*, or 1435*l.* beyond what is provided at the present time, and a further annual expenditure of at least 1000*l.* for the supervision of collectors and for obtaining the additional information already described.

NEWS has come to hand that Dr. Elliot Smith, professor of Anatomy in the Medical School at Cairo, has been given two months' leave of absence to investigate at once some human remains discovered at Girga, in Upper Egypt. The graves containing the remains are said to consist of a continuous series extending over an interval of at least 8000 years, which represent the most archaic of prehistoric periods. The bodies are so well preserved, owing doubtless to the dryness of the atmosphere where they were interred and to the perfection of interment, that not only can the hair, nails and ligaments be made out, but the muscles and nerves. In almost every case the brain is said to be preserved, and the climax has been reached in two examples where the eyes with lens in good condition are present, and in others in which Dr. Elliot Smith has already observed the limb plexures and great splanchnic nerve. There are also now unearthed a series of later prehistoric graves, ranging throughout the first fifteen dynasties, others of the eighteenth, and yet others of the Ptolemaic and early and recent Coptic periods. This vast "cemetery" has been excavated by Dr. Reisner for the University of California, and we can but congratulate him and the Egyptian Government on having secured the services of so competent an anthropotomist as Dr. Elliot Smith, whose full report will be eagerly awaited.

A MEMORIAL to the late Dr. John Anderson, F.R.S., the first superintendent of the Indian Museum at Calcutta, has recently been erected in the upper eastern verandah of the main Chowringhi building. The memorial is in the form of a full-face medallion portrait in bronze, and is the work of the eminent Scottish academician, D. W. Stevenson. It is completed by a brass tablet, upon which the following words are inscribed:—"John Anderson, M.D., F.R.S., First Superintendent of the Indian Museum, 1865–1886. Besides organising and arranging the zoological and archæological sections of this Museum, he made large collections and many discoveries in Yunnan and Mergui, and achieved enduring distinction by his original contributions to vertebrate zoology. (Presented to the Museum by his widow and friends, 1901.)" Referring to the memorial, the *Englishman* remarks:—"As the gift of Dr. Anderson's friends, the location of the memorial is happily chosen; but from a wider point of view the museum itself—at least in its zoological and archæological sections—is *monumentum aere perennius* of Dr. Anderson's work in India, for although the institution has considerably developed since his time, it has done so strictly along the lines—well in advance of their day—that he laid down and fashioned. Dr. Anderson will also be remembered as one of the earliest advocates of a zoological garden for Calcutta, and as having greatly helped to shape the institution also when it was started." Every naturalist will be glad to know that Dr. Anderson's valuable work has been commemorated in this way. His labours could not easily be forgotten even if no memorial had been erected, but students unfamiliar with his career should be reminded of the great work he accomplished. In connection with this subject it is worth mention that the volume on "The Mammals of Egypt," on which Dr. Anderson was busily engaged when a brief illness unexpectedly terminated his useful life, will be published during the present year. This will be the second volume of Dr. Anderson's important work on the zoology of Egypt, and it will be similar in every respect to the first volume, on the reptiles of Egypt.

IN a discussion on West Africa at the monthly dinner of the London Chamber of Commerce on April 9, Sir Harry Johnston remarked that we were much behind Germany and France in respect of the scientific examination of the territories under our control. Writing to the *Times* upon the subject, he defends the Foreign and Colonial Offices from charges of want of sympathy with purely scientific work (examination of rainfall, fauna, flora, geology, minerals, &c.) in our African possessions by pointing out that they were often prevented from carrying out such work by the reluctance of the Treasury to expend national moneys in that direction. Referring to the Uganda Railway he says, "if in past decades we had been allowed to spend, say, 20,000*l.* in the scientific examination of East Africa, the knowledge thus acquired might have enabled us from omniscience to make the Uganda Railway for some half a million less money. Lacking this prior knowledge, those engaged in the construction of this remarkable line have done their very best to avoid mistakes and unnecessary expenditure, and the result is wholly creditable to the Office which employed them. The Treasury is sometimes unsympathetic towards scientific research, but the Treasury, after all, is only an exponent of the national will. It is the nation—the Empire—at large which is so indifferent to the value of scientific research, more especially in the domains of anthropology, zoology, botany, geology, and meteorology, that it cares little for the scientific examination of its territories, new and old. Some of this work can be done by private enterprise and generosity. But much might be accomplished by the Government if the Treasury would but agree. I am not asking for an expenditure of a million sterling per annum, or of even one of those unconsidered hundred thousand pounds cheerfully spent without blinking on an armed and punitive expedition. Twenty thousand pounds wisely expended on three scientific expeditions in West Africa, East Africa, and British Central Africa would probably give us all the information we require as to the products, soils,

minerals, natural history and human races of our tropical African dominions.

A NUMBER of prizes, varying in value from 800 to 8000 francs, are offered by the Belgian Royal Academy of Medicine for researches in various branches of pathological and medical science. The largest prize is offered for discoveries relating to the diseases of the nervous centres, with special reference to epilepsy, and for a really valuable discovery, such as a curative remedy for epilepsy; two premiums, one being of 5000 francs, may be given in addition to the prize of 8000 francs.

WE have received from Mr. J. Baxendell the report of the Fernley Observatory, Southport, for the year 1901. Mr. Baxendell continues his useful experiments and comparisons with the view of improving the records of self-recording instruments, especially those obtained from anemometers of various patterns. We quote the following climatological data from this important observatory:—Extremes of shade temperature, 88°·4 in July, 19°·1 in January and December; highest solar temperature, 129°·1, in August. Total rainfall, 26·7 inches, nearly 7·5 inches below the average. Bright sunshine (Campbell-Stokes recorder), 1738 hours. The report contains an interesting comparison of climatological statistics with upwards of fifty other health resorts.

MR. W. E. COOKE, Government Astronomer of Western Australia, has published a paper on the climate of that colony, from observations made during the years 1876-1899, containing a large number of valuable tables showing the monthly means and extremes of the various elements, illustrated by maps. The latter show that the records refer mostly to stations on or near the coast, and that the inland districts are, to a great extent, still unrepresented. In addition to the climatological tables, general descriptions of the types of weather most frequently experienced, and of the climate, with especial reference to that of Perth, are given in the text, and will be found very useful to all interested in the meteorological features of the country. Taking Perth to represent the south-west and south coastal stations, the mean monthly temperature is 64°·9, the highest extreme being 116°·7 and the lowest 31°·2. The mean annual rainfall is 32·9 inches. Within the tropics, records of 110° are not infrequent, the absolute maximum being 123°, at Onslow, in February, 1897. Thunderstorms, accompanied by heavy rain, are frequently experienced; the heaviest fall ever recorded was 36·49 inches, near Cossack, on April 2-3, 1898. On the other hand, only 0·73 inch was recorded in this district during twenty months ending January, 1892.

A NEW application of the electric furnace which may prove to be of great practical importance was described by Mr. C. B. Jacobs in a paper read before the New York section of the Society of Chemical Industry. The raw material for most of the barium compounds in common use is barytes, the natural sulphate, and this is usually converted into other barium compounds by treating it with coal or coke in a reverberatory furnace and then working up the crude barium sulphide thus obtained. It has been found that when barium sulphate and sulphide are heated together in suitable proportions at the temperature of the electric furnace, the sulphur is completely eliminated as sulphur dioxide and barium oxide remains, the conversion being so complete that only 2 to 3 per cent. of barytes remains unacted upon, as against 25 to 45 per cent. by the older process. By lixiviating with water and crystallising out, barium hydrate is obtained at once, containing only about 1 per cent. of impurities, chiefly barium sulphydrate. From this all the other barium salts are readily obtained. The electrical energy required for this process is got from the Niagara Falls, and the plant in use at the present time is turning out sixty tons per day. The fields into which it is finding its way are the tanning industry, the white pigment and dry colour trades, the purification of water for industrial purposes, and general manufacturing chemistry. The largest consumption, however, is in the beet sugar industry, for the recovery of the sugar remaining uncrystallised in the molasses. Barium hydrate is an ideal substance for the softening of water for boiler purposes, and its general introduction in place of the methods at present in use is only a question of price.

THE structure and design of electric automobiles are at present attracting much attention from electrical engineers. Sir H. P. Maxim in a lecture recently delivered before the Automobile Club of New York, commented on the progress made in the design of accumulators. The capacity of the cells per kg. of battery weight has been doubled, while the life of the plates has been increased 25 per cent. by the improvements made within the last three years. The best type of accumulator cell can now be utilised for running 8000 kms. before renewal of the plates is necessary. The electric automobile, in Maxim's opinion, is superior to all other types of automobile for general use. It is only likely to be supplanted by the petroleum or light spirit type of vehicle, where economy is the chief consideration, or where the distances to be covered are beyond the range of the electrically propelled car. Many of the latest types of electric automobile possess motors designed to act as dynamos for recharging the battery when the car is running downhill. A German engineer, Th. Müller, of Nuremberg, has been investigating the reality of the advantages claimed for this type of vehicle, and the details of his inquiry will be found in the *Zeits. f. Accumulatoren und Elementen-kunde* for March 1, 1902. The increased amount of copper required for motors, intended to act under such conditions as dynamos, and the greater complexity of their design, are held by Müller to quite counterbalance the gain of 10 to 15 per cent. which is all that results in the distance capacity of the cars.

A STATISTICAL comparison of developments of German and British trade in recent years is made in a long article in the *Times* of April 3. Though the writer seeks to show that there is little cause for uneasiness, he admits that Germany has advanced more rapidly than Great Britain in many departments of industry and commence. Especially is this true as regards chemical goods and electrical machinery, but no particulars as to these advances are given. So many industries depend upon chemical science for their means of progress that the present advantage which Germany possesses in applied chemistry is likely to produce far-reaching effects. Upon this subject the writer remarks:—"Years of research and theoretical training had made the German chemist *facile princeps*. Even in Great Britain, in France and in the States most leaders of the chemical trades and most assistants are Germans by birth or training; of Germany the chemical trades are a speciality. The technical colleges had likewise bred a highly efficient army of electrical, metallurgical and mining engineers who would soon find ample scope for their talents. In addition, the German mind has always been scholarly by inclination and open by habit. The self-sufficiency and the indifference to foreign doings, so characteristic of the British trader, never have been features of the German. On the contrary, he has always been open to foreign influences, and eager to adopt foreign ways." In the metallurgical trades, also, it is stated that Great Britain has not kept abreast of the times. During the last ten years of last century our iron production only rose from 7,900,000 to 9,421,000 tons, or, say, 17½ per cent., whereas that of Germany went in the same interval from 4,658,000 to 8,143,000 tons, and, therefore, increased more than 75 per cent. If the rate of progress be maintained on both sides, the German iron production

will be greater than the British in about three years' time. The general conclusion reached is that though as a nation Great Britain has continued to advance, Germany has made more rapid progress.

THE observatory on the summit of Mont Blanc, such a familiar object to all who visit Chamonix, has furnished M. Jean Binot with the means for making bacteriological investigations at the highest altitude yet explored. His researches are published in the *Comptes rendus* of the Paris Academy of Sciences. As was to be anticipated, the air on the summit away from the observatory contains scarcely any bacteria whatever, only from 4 to 11 being detected in as much as a thousand litres, whilst in somewhat smaller volumes of air frequently none at all were discoverable. As a rule, at lower altitudes, the number of bacteria present increased; thus at the Plan de l'Aiguille 14, whilst at the Montanvert 49, were found in a thousand litres. Inside the observatory, in which M. Binot tells us he spent five days, from 260 to 540 microbes were found in the same volume of air; these bacteria were doubtless introduced during the temporary invasion of the building by M. Binot and his companions. The investigations were not, however, confined to the air on the top of the mountain, but included also bacterial examinations of freshly fallen snow, old snow, ice on the surface and below, glacier water, and mountain streams. Freshly fallen snow, even when sampled in large quantities, frequently contained no bacteria whatever, whilst in snow which had lain for some time usually only from one to two individuals were discoverable per cubic centimetre; at the foot of the glaciers the surface snow contained rather more, the number varying from 6 to 65 per c.c. at the Mer de Glace. Glacier water is usually very pure, and, like the glacier-ice from which it is derived, was found to contain a number of yeasts and some streptothrix; but whilst high up such water contained but from 3 to 8 bacteria per c.c., a stream at the foot of the Glacier des Bossons contained 95, whilst the water of the river Arve at Chamonix was found to have as many as 7550 per c.c. Altogether M. Binot examined 121 samples of air, ice, snow and water, and isolated no less than 300 different varieties of microbes, one-third of which number he was able to identify as having been already studied and described, and the residue are being carefully investigated by him at the present time. Of great interest is the author's remarkable discovery of a virulent race of pyocyaneus bacilli in ice on the top of Mont Blanc; he also isolated from water a vibrio highly pathogenic to animals. Even the alluring and beautifully clear and crystalline spring water on the Montanvert road was condemned by being found to contain a dozen virulent colon bacilli in a cubic centimetre. Doubtless this pollution was due to the herds of cattle which graze on the mountain pastures.

IN the *Biologisches Centralblatt* for April, Dr. A. Bethe makes a further contribution to the discussion as to the nature of the "homing" instinct of bees and ants.

PART vi. of the second volume of the *Annals* of the South African Museum is devoted to a revision of the species of certain groups of the scorpions of the country, in the course of which several new forms are described.

IN the April number of *The Entomologist*, Miss Sharpe completes her list of the butterflies and moths collected by Dr. Christy in Nigeria. It is remarkable that a species hitherto believed peculiar to Aden should recur in West Africa.

THE annual report of the Indian Museum, Calcutta, for 1900–1901, states that important progress has been made in the improvement of the exhibited series, in the cataloguing of the reserve collections, and in the exchange and distribution of duplicate specimens. The acquisitions have been numerous, and, for the first time, the exhibited specimens have been adequately labelled in large type. The plan of replacing stuffed and spirit specimens of snakes by coloured casts is being carried out as rapidly as possible. A gallery has been reserved for economic zoology. Mr. T. H. Holland, of the Indian Geological Survey, has joined the board of trustees, in place of Mr. R. D. Oldham, retired.

THAT acquired characters may be inherited is suggested by Dr. Kidd's investigations into the arrangement of the hair on the human forehead, of which an account is given in the April issue of the *Journal of Anatomy and Physiology*. Certain lines of divisions appear in most cases, which are regarded as derived from the style of "parting" adopted by the parents. In the same publication, Mr. W. L. H. Duckworth, from the study of certain peculiarities in the skulls of a gibbon and an aboriginal Australian, is led to believe that in certain respects the man-like apes have attained a higher platform of specialisation than man himself.

IN the *Entomologist's Monthly Magazine* for April, Mr. C. W. Dale gives an account of the occurrence of the "mazarine blue" butterfly (*Lycaena acis*, or *Nomiades semiargus*) in Britain. According to the author, no specimens have been taken in our islands for more than twenty years; it is suggested that its extermination there may have been due to the attacks of hymenopterous parasites, although there is no evidence that this was the case. Never abundant, the species has been recorded from twenty-one English and Welsh counties, in several cases only on the evidence of a single specimen.

A MEMOIR in the *Quarterly Journal of Microscopical Science* describes the results of an investigation into the morphology of the skull of the bony fishes, based on an examination of its development in the three-spined stickleback. In addition to noting many points connected with the details of skull-structure, the author, Mr. H. H. Swinnerton, finds that his study of the anatomy and developmental history of the head-skeleton shows that the sharks and rays on the one hand, and the bony fishes and ganoids on the other, appear to have had a common ancestor, whose chief structural features are briefly indicated. It is added that the term "hyostylic," commonly used to indicate the mode of suspension of the lower jaw to the cranium in the latter group, does not adequately express the true state of the case. In another paper in the same journal dealing with what are commonly called "fishes," Dr. E. Warren discusses the structure of the teeth of the lampreys and hag-fishes. He remarks at the outset that those who regard these creatures as degenerate descendants of ordinary fishes would expect to find in their horny teeth remnants of the calcified structure of those of other vertebrates. He finds, however, no definite evidence of such degeneration, but adds that if they are actually degenerate they have reverted to a condition which probably preceded the development of the "placoid" scales of the sharks and rays.

AN interesting article in the March number of the *American Naturalist*, by Dr. H. P. Torrey, describes a peculiar phenomenon seen on the Californian coast during the past summer. Early in July a red streak was noticeable in the sea off San Pedro Harbour, which during the next few days approached the shore and divided into several patches of many acres in extent. On the 16th these patches reached the shore, where they were the cause of a most unusual display of phosphorescence. The discoloration and phosphorescence of the water were due to the presence of swarms of flagellate animalcules. "On the 20th, four days after the red (characteristically a muddy vermilion) streak had reached the shore, a most sickening odour arose from the water along the beach. During the night, on a beach about 400 feet long, a large number of animals were lef

by the tide. Among them were several hundred holothurians, several specimens of two species of sting-ray, two species of guitar-fishes (Rhinobatus), two cestracionts, two dog-fishes, a red perch, a large number of smelts, and several octopi." The "red water" occurred for at least two hundred miles along the coast and extended several miles out to sea; it had not disappeared at the beginning of September. Wherever it occurred food-fishes were scarce; but the small harbour-fishes and invertebrates of the "plankton" were unaffected. Towards the end of July, the animalcule Noctiluca appeared in swarms and devoured the animalcules of the red water. A somewhat similar visitation is reported to have occurred five hundred miles further south in the seventies, but has never before been known in California.

AN interesting case of peloria was furnished by a Cattleya which Dr. Masters showed at a recent meeting of the scientific committee of the Royal Horticultural Society. This abnormal flower appeared on a plant produced by crossing *Cattleya Schröderae* with *Brassavola Digbyana*. It showed three regular sepals, and alternating with these three petals, alike in size, colour and shape. The column was normal.

A RECENT number of *Science* records the proceedings of a number of prominent American botanists, now organised under the name of "The Botanists of the Central States." The meetings were held at the University of Chicago, under the chairmanship of Prof. J. M. Coulter. Among the papers read were the following:—F. C. Newcombe, "The sensory area of the roots of land plants"; H. L. Lyon, "The phylogeny of the cotyledon"; C. A. King, "Fertilisation and some accompanying phenomena in *Araiospora pulchra*"; H. S. Reed, "The ecology of a glacial lake"; R. A. Harper, "Binucleate cells in certain Hymenomycetes."

A CATALOGUE of plants has been received from Mr. H. P. Kelsey, the proprietor of the Highlands Nursery, N. Carolina, U.S. Mr. Kelsey has successfully undertaken to bring before Americans the wealth and richness of their native flora. The nurseries are situated at a height of 4000 feet, and naturally lend themselves to the production of such alpine or subalpine genera as Rhododendron, Kalmia, Tsuga, Leucothoe and Andromeda. To the cosmopolitan grower of interesting or little-known plants, this list of hardy American specialities will suggest many future possibilities.

VARIOUS explanations have been put forward to account for the production of cleistogamic flowers. No simple explanation has been offered which would cover the phenomenon in all cases; indeed, it is much more probable that they are formed in response to different stimuli, or for different purposes. In the second volume of the *Publications of the University of Pennsylvania*, Dr. C. H. Shaw discusses the formation of cleistogamic flowers in two American species of Polygala. One of these, *Polygala polygama*, produces both aërial and subterranean forms. The latter occur in early summer at the same time as the normal flowers, while the former are found later, on shoots which may have borne open flowers and which at this time develop a geotropic tendency. The morphological differentiation of the aërial cleistogamic flowers is intermediate between that of the other two varieties. The formation of the cleistogamic flowers seems to be correlated with the economic and rapid production of seed, for the normal flowers fail to a great extent to set seed, and require a longer time to mature it.

FROM two leaflets which we have received we notice that Kodak, Ltd., have two novelties which they have recently brought out. One of these consists of a kodak made especially for the use of glass plates alone, and fitted with the usual neat and simple movements and adjustments, many of which can be operated with one hand. These cameras are made in two sizes, for quarter and 5 × 4 plates, and both are fitted with Bausch and Lomb's lenses and shutters. The other new announcement is the number two stereo kodak for taking stereoscopic or single pictures $3\frac{1}{2} \times 3\frac{1}{2}$ in. on cartridge film. The camera is of the box pattern, measuring $8 \times 4\frac{3}{4} \times 6$ in., and requires no unfolding when a photograph is about to be taken. The shutters are ever-set, and are simultaneously operated for time or instantaneous exposures by separate levers. A third lever actuates three stops, and its position indicates which stop is in front of the lens.

THE additions to the Zoological Society's Gardens during the past week include a Caracal (*Felis caracal*) from South Africa, presented by Mr. F. C. Longbourne; a Suricate (*Suricata tetradactyla*) from South Africa, presented by Miss Philippe Stephenson; three Common Vipers (*Vipera berus*), British, presented by Mr. A. Old; a Diana Monkey (*Cercopithecus diana*) from West Africa, deposited; two Alpine Choughs (*Pyrrhocorax alpinus*), European, purchased; six Shaw's Gerbilles (*Gerbillus shawi*), three Black Swans (*Cygnus atratus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

TOTAL ECLIPSE OF THE MOON (April 22).—There will be a total eclipse of the moon on the evening of Tuesday, April 22, which will be partly visible in England. The total phase will be reached before moonrise at Greenwich (7h. 5m.), so that only the latter part of the phenomenon can be observed. The following particulars are for Greenwich mean time:—

	h.	m.
First contact with penumbra	3	50·3
,, ,, shadow	5	0·2
Beginning of total phase	6	10·2
Middle of eclipse	6	52·8
End of total phase	7	35·4
Last contact with shadow	8	45·4
,, ,, penumbra	9	55·3

The first contact with the shadow occurs at 89° from the north point of the moon's limb towards the east; the last contact at 60° towards the west.

Magnitude of eclipse (moon's diameter = 1) = 1·337.

In consequence of the eclipse taking place near the time of moonrise, it will be interesting, wherever the surroundings permit, to observe the setting sun and eclipsed moon simultaneously at opposite points of the horizon.

NEW VARIABLE STARS.—4 (1902) *Geminorum*.—Prof. Ceraski announces the variability of the star BD + 20°·1875, determined from photographs taken at Moscow. Its position is

R.A. = 7h. 32m. 37s.·0
Decl. = + 20° 45′·3 } (1855).

The magnitude is usually stated to be 9·0, and at present the brightness is increasing.

5 (1902) *Lyrae*.—In the *Astronomische Nachrichten* (Bd. 158, No. 3783), Mr. A. Stanley Williams announces the discovery of a new variable in Lyra whose coordinates are

R.A. = 18h. 56m. 12s.
Decl. = + 37° 18′·7 } (1855).

All the observations up to the present time are photographic, from plates taken with a 4·4-inch portrait lens.

The magnitude appears to vary between 10·6 and 12·0. From the dates of the minima it would seem to have a period of about two-thirds of a year, and in this case the next maximum should occur in or about the month of July 1902.

THE PHOTOGRAPHY OF DISTURBANCES IN AIR.

IN a paper read before the Royal Philosophical Society of Glasgow on December 4, 1901, and published in the *Proceedings* of the Society, Mr. H. S. Allen, of the Blythswood Laboratory, gives an account of "The Photography of Sound Waves and other Disturbances in Air." The method of striæ (Schlieren Methode) was devised by Toepler more than thirty years ago. This method makes it possible by suitable optical arrangements to render visible disturbances in which the refractive index differs but little from that of air.

One form of these arrangements is shown in the diagram, Fig. 1. The light proceeds from a source L which is as nearly as possible a straight line. In the figure this line of light is seen only in section—it is supposed to be at right angles to the plane of the paper. The light issuing from this source falls on a large concave mirror, M, by which it is brought to a focus just in front of the lens of the camera at I. One half of the lens is covered with an opaque screen, having a straight edge parallel to the image of the source, and the apparatus is arranged so that the image falls exactly on this straight edge Then, if all the adjustments are ideally perfect, no light at all will enter the camera so long as the medium through which the light passes is homogeneous. But supposing there is a region in the path of the light having a density different from that of the surrounding atmosphere, some of the light may be bent aside so as to enter the lens of the camera. Such a region is represented in section by the circle in the figure. It is supposed to be of greater density than the air around. The paths of the rays which have been refracted in passing through it are represented by the dotted lines. It will be seen that light traversing the lower portion is bent upwards and enters the camera, while light passing through the upper portion is bent downwards and falls still further than before from the boundary of the opaque screen. If the camera is focussed on this region of greater density, the lower part (that

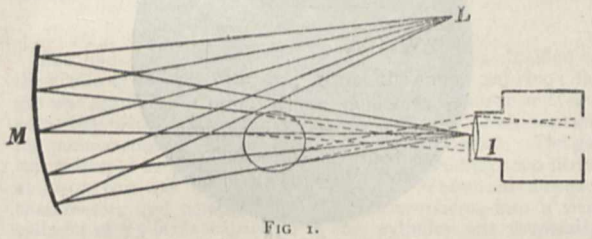


FIG 1.

is the upper in the camera, the image being reversed) will be illuminated, while the upper portion remains dark.

In working the method, the source of light and its image on the diaphragm must necessarily be of finite width, and the adjustments are made so that a certain fraction of the width of the image falls on the screen while the light from the remaining portion passes through the lens and gives rise to a uniform field. In these circumstances, the upper part of the region of greater density would appear dark against a light field. The sensitiveness of the method depends on the relative proportion of the light stopped by the screen and the light that enters the lens. For photographic purposes there must be a moderate amount of light to produce any effect even with the most sensitive plates, so that eye observations are considerably more sensitive. When it is desired to view the disturbances directly the camera is replaced by a telescope, or the image formed by the camera lens is examined by a suitable eyepiece.[1]

The mirror used was originally designed for a reflecting telescope. Its diameter was 18 inches, and it had a radius of curvature of 30 feet 3 inches.

One of the most striking applications of the method is the photography of sound waves—waves of compression set up by sudden electric discharges. Prof. R. W. Wood has taken a large number of photographs showing the behaviour of these waves (*Phil. Mag.* xlviii. p. 218, l. p. 148).

The arrangement of the apparatus is shown in Fig. 2. At the lower part of the diagram are the terminals, which supply an electric current at a high potential. The source of the current

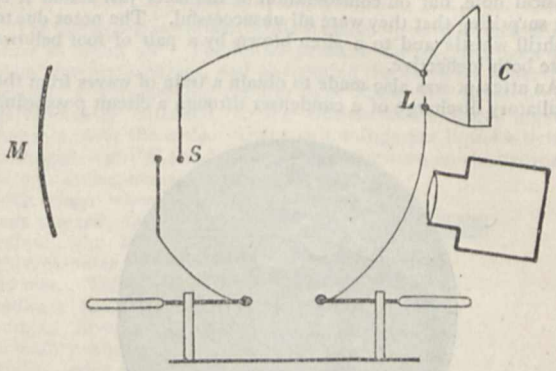


FIG. 2.

may be either an induction coil or an influence machine. From one terminal a wire is led to the spark gap placed in the path of the light travelling from the mirror to the camera. It is this spark which gives rise to the wave of compression to be observed, for convenience it may be termed the sound spark. The terminals are brass balls $\frac{3}{8}$ inch in diameter, and they are placed one behind the other, so that the light from the spark may not enter the camera. From this spark gap a wire is led to a second, which serves as the source of illumination, and is therefore provided with magnesium terminals. The circuit is completed by a wire from this point to the second terminal of the electrical machine. It is necessary that the light spark should take place somewhat later than the sound spark, in order to give the sound wave time to travel a sufficient distance from the terminals to be observed. To effect this a condenser is placed in parallel with the light spark, so that the light spark is delayed by the time necessary to raise the potential of the condenser high enough to spark across the gap.

A number of photographs were taken illustrating the reflection of a sound wave at surfaces of various forms and the effect of a diffraction grating. The original negatives were $\frac{7}{8}$ inch in diameter. They were enlarged to about three times this diameter for use as lantern slides.

The compression in one of these waves must be considerable compared with that due to an ordinary musical note. We may, perhaps, form a rough estimate of the amount of compression from the fact that the wave-fronts are seen at least as clearly as

FIG. 3.

the jets of carbonic acid gas which are described later. The refractive index of carbon dioxide is 1·000454, while that of air is 1·000294. Let us assume that the density of the compressed air is the same as that of carbon dioxide. According to the law of Gladstone and Dale, the ratio of the densities is the same as the ratio of the refractive indices less unity, that is, in this

[1] A somewhat curious effect is observed with the optical arrangements just described which might form the basis of an optical illusion. If the eye is placed close behind the back of the camera (the ground glass screen being removed), the source of light with the apparatus for producing the light is distinctly seen, but when an eyepiece focussed on the back of the camera is employed, the apparatus for producing the disturbances in the air is seen with the mirror as a background. In the former case, the eye sees the real image of the source just in front of the lens and so close to it as to be practically unaffected by it, while the image which can be seen with the aid of the eyepiece is so near the eye as to be invisible.

case the ratio of 454 to 294, or, roughly, of 3 to 2. Thus, with these assumptions, the density in the wave-front is half as great again as the density of the undisturbed air. The wave resembles that caused by an explosion rather than that due to an ordinary sound.

Several attempts were made to see the train of waves due to a musical note, but on consideration of the facts just stated it is not surprising that they were all unsuccessful. The notes due to a shrill whistle and to a siren blown by a pair of foot bellows were both ineffective.

An attempt was also made to obtain a train of waves from the oscillatory discharge of a condenser through a circuit possessing

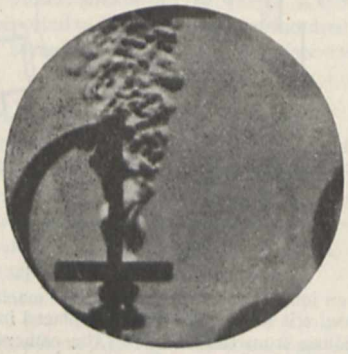


FIG. 4.

self-induction. A large Leyden jar and a coil of wire were inserted between the main terminals in Fig. 2. The frequency of the oscillation lay between the limits 7920 and 1800 vibrations per second, the wave-length of the corresponding sound-wave lying between 1·3 and 7·3 inches.

A number of photographs were obtained in which the first wave-front had travelled to such a distance that the second wave should have been clear of the terminals. But in none of them is any trace to be seen of a second wave. Thus, as an attempt to photograph a train of waves, this method too proved a failure.

Even as a failure the result is not without its interest, as it brings out very clearly the difference in character between the first discharge and the surgings that follow it when the spark is an oscillatory one.

In the words of Prof. Trowbridge, who has made a special study of oscillatory discharges:—"Photographs of powerful

FIG. 5.

electric sparks lead one to conclude that a discharge of lightning makes way for its oscillations by first breaking down the resistance of the air by a disruptive pilot spark—through the hole thus made in the air the subsequent surgings or oscillations take place."

In the language of the modern ionic theory this would be interpreted by saying that the first disruptive discharge results in the production of a large number of free ions, and these ions offer an easy passage to the subsequent oscillations.

Since the refractive power of a gas is proportional to its density, and that in turn depends on the temperature, the method will reveal the presence of any region in the air whose temperature differs materially from that of the surrounding atmosphere. Such a case arises in every flame; the products of combustion rise from the flame as a column of heated gas, and this is revealed to the eye as a pillar of fire, or in the photograph as a pillar of cloud. The photograph shows the effect due to the flame of a spirit lamp (Fig. 3).

In order to impress the fact that what is here seen is not the flame, but the heated gas rising from the flame, a small fan was arranged which could be set in rapid rotation and so drive the hot gas all over the field of view (Fig. 4). The photograph (Fig. 5) shows the effect when it has been set rotating.

The flame of a Bunsen burner gives rise to a disturbance similar to that due to the spirit lamp, but more voluminous in character. The peculiar spiral form in which the column of gas rises before breaking up into a cloud is very noticeable in some of these photographs of flames.

A number of photographs were taken of jets of gas issuing from a narrow orifice. In one case the jet is formed by blowing heated air through a brass tube; in another it consists of carbonic acid gas issuing from the generating flask. In consequence of its great density, the gas begins to fall downwards soon after leaving the nozzle.

Several photographs were taken to show the mode of formation of a vortex ring of heated air. These rings were produced in the usual way by means of a box with an aperture in one side, and the opposite side formed of some elastic material. On giving this side a sharp tap, some of the enclosed air rushes out with the formation of a ring. In this case the air in the box was heated by placing a spirit lamp inside it so that the rings,

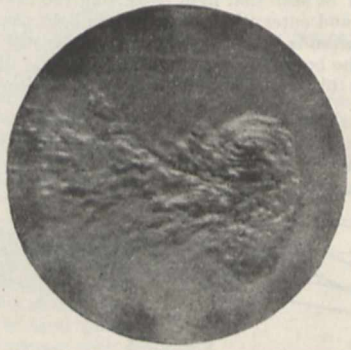


FIG. 6.

being formed of hot air instead of smoke, were quite invisible save by the use of the method of striæ. Some of these photographs are reproduced in the paper and are very instructive as showing the way in which the vortex motion is produced. The air appears first of all to issue from the orifice in the form of a column, but the tail is gradually left behind while the whirlpool motion of the head is accentuated. Finally, little is to be seen but the section of the ring itself, the spiral structure being strongly marked (Fig. 6). In some cases a circular, in others an elliptic orifice was used.

The appearance of some of these photographs showing vortex motion strongly recalls the published photographs of the nebulæ of the heavens.

THE TEMPERATURE OF INVERSION OF THE JOULE-KELVIN EFFECT FOR HYDROGEN.[1]

IN the year 1854 it was proved by Joule and Lord Kelvin that hydrogen on free expansion behaved differently to all other gases. Air, when allowed to expand from a higher to a lower pressure without performing external work, became cooled, the fall of temperature being proportional to the difference of pressure; hydrogen, on the other hand, became warmer. As is well known, the Joule-Kelvin effect has been applied by Hampson and Linde to the liquefaction of air in quantity, but since for hydrogen the effect is of opposite sign, it was obvious that the Hampson-Linde apparatus could not be directly applied

[1] By K. Olszewski. Translated from the *Bulletin* de l'Académie des Sciences de Cracovie. (December, 1901.)

to the liquefaction of that gas ; a conclusion which is confirmed by this research. There seemed no doubt,[1] however, that after due modification the Hampson-Linde method would be applicable to the liquefaction of hydrogen, the necessary condition being that the gas should be cooled to below the temperature at which the Joule-Kelvin effect changes sign before entering the regenerator coil of the apparatus. Below this temperature the gas would become cooled on free expansion ; as in the case of air in the ordinary Hampson apparatus, the cooling would be progressive and, were the heat insulation sufficiently perfect, would result in the partial liquefaction of the gas.

As is well known, Dewar and Travers (*Phil. Mag.*, 1901) have both succeeded in applying this principle to the production of liquid hydrogen. Both investigators employed as a preiminary refrigerant liquid air boiling under reduced pressure, and by this means cooled the hydrogen to $-200°$ C. The question now arises as to whether this is really necessary, or whether it would not be possible to liquefy hydrogen by allowing it to undergo free expansion after cooling it to a temperature less difficult to attain. The following investigation was undertaken in the hope of throwing some light on the subject and of determining the temperature at which the sign of the Joule-Kelvin effect changes.

Witkowski (*Roz. pr. Akad. krak.*, W.M.P. xxxv. 247 ; *id.* 1898) has applied two methods to the calculation of this temperature. The first method, based on the theory of corresponding states, gave $-46°$ C. as the temperature ; the second method, in which Rose-Innes' formula was applied to the extrapolation of Joule and Lord Kelvin's experimental values at temperatures between 0° and 100° C., gave $-79°{\cdot}3$, a result which is nearer to that obtained by me experimentally, viz. $-80°{\cdot}5$. Rose-Innes' formula (*Phil. Mag.* [5], xlv, 228),

$$e = \frac{a}{T} - \beta,$$

is purely empirical, but employing 64·1 and 0·331 as values for the constants, it reproduces the experimental results with remarkable accuracy.

Description of the Apparatus.

The hydrogen employed in these researches was obtained by the action of pure dilute sulphuric acid on commercial zinc ; the gas was purified by passage through solutions of caustic soda and potassium permanganate, and finally through a tower containing pumice-stone soaked in mercuric chloride solution. The gas was collected in a zinc gasometer capable of holding 1200 litres, and from this was taken directly into the Whitehead torpedo-compressor, and compressed at 180 atmospheres into a steel cylinder of 13 litres capacity ; in this cylinder was suspended a wire net containing sticks of caustic potash. During these operations every care was taken to remove all traces of air from the apparatus.

The expansion apparatus is shown in the accompanying figure. The steel cylinder, which contains the hydrogen under pressure, communicates by means of a copper tube with a manometer and with the tube *a* of the apparatus. The tube *a* is bent into a spiral *b*, which terminates in a valve *c*. The valve consists of a jet enclosed within a steel tube, perforated at the sides for the escape of the gas, which serves as a support for it. The valve spindle *d* passes through a gland packed with asbestos at *o*, and is screwed below *o* to fit the opening through which it passes, so as to allow of the valve being opened or closed. The valve is enclosed in a thin metal box *hh*, which is lined with chamois leather ; the gas can escape by a tube *pi*, through the vertical portion of which an electric resistance thermometer is introduced. This instrument has previously been employed in the determination of the critical and boiling points of hydrogen (*Phil. Mag.* [5], xxxix. 199 ; xl. 202) ; the electrical connections are made by means of binding screws at *f* and *g*.

So as to be able to surround the coil *b* and the metal box enclosing the jet and thermometer with different refrigerants, the metal cap *nn* is cemented to the top of a thick-walled glass vessel *ll*. This in turn contains a thin glass vessel *mm*, insulated from the former at the top and bottom.

The refrigerating substances, liquid air, liquid ethylene, and solid carbonic acid and ether, can be introduced into *mm* through a T-tube passing through the cover of the apparatus, and by connecting one branch *k* with an exhaust pump the substance can be evaporated under reduced pressure and the temperature varied considerably. The temperature of the coil and jet can be roughly determined from the readings of a mercury manometer attached to the apparatus.

Method of Experiment.

The first experiments were made at about $-190°$ C., the temperature of liquid air. The initial pressure on the hydrogen was about 170 atmospheres, and on opening the valve for about five seconds a considerable cooling took place, the beam of the galvanometer attached to the electric thermometer moving 200 mm. over the scale. Using as a refrigerant liquid ethylene boiling at $-003°$ C., and with an initial pressure on the hydrogen of 150 atmospheres, cooling took place when the valve was opened, but to a less extent, the ray from the galvanometer moving only 30 mm. This was taken to indicate that the temperature of inversion lay considerably above $-100°$ C., and a series of experiments was next made about the temperature of solid carbonic acid and ether.

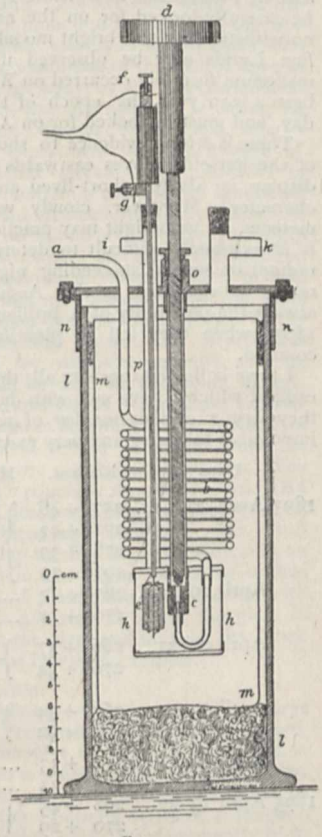


FIG. 1.

In this series twenty-five experiments were made, starting in each case with a temperature of $-78°$ C. and an initial pressure of between 117 and 110 atmospheres. To regulate the expansion, a small steel cylinder of 0·6 litre capacity was introduced between the main cylinder and the tube *a* ; by filling the small cylinder from the main cylinder and closing the communication between the two before each expansion, the quantity of gas which escaped from the valve, and consequently the temperature change, was always the same. It appeared from these experiments that at $-78°$ hydrogen becomes warmer on free expansion, but only very slightly so, the ray from the galvanometer moving 3 mm. over the scale.

By reducing the pressure on the carbonic acid by careful pumping, the temperature was slowly reduced. At $-83°$, decided cooling took place on expansion, the galvanometer beam moving 5 mm. over the scale. By numerous trials it was found that the temperature at which the Joule-Kelvin effect became zero appeared to be at about $-80°{\cdot}5$ C.

Conclusions.

From these experiments it appears that the temperature of the inversion of the Joule-Kelvin effect for hydrogen lies about $-80°{\cdot}5$ C., a number which agrees very closely with that arrived at by Witkowski from the Rose-Innes equation ($-79°{\cdot}3$). This agreement makes it worth while considering the further application of this equation to other substances, particularly to air, and the application of the results to the calculation of the critical temperature of hydrogen on the basis of the theory of corresponding states. We have the following data :—

	Temperature of inversion of Joule-Kelvin effect.	Critical temperature.
Air	633° Abs.	133° Abs.
Hydrogen	192°·5 Abs.	—

[1] Kammerlingh Onnes (Leyden *Communications*, xxiii. 1896, 16) pointed out the possibility of liquefying hydrogen by means of Linde's apparatus, and stated the conditions, based on the theory of corresponding states, under which liquefaction can occur.

From this it follows that the critical temperature of hydrogen is 40°·4 or −232°·6 C., which is not far from the value which was found for it experimentally, viz. −234°·5 C. (*loc. cit.*).

From these researches it also appears that it is possible to liquefy hydrogen by the method of free expansion without cooling the gas to −200° C. Provided the heat insulation were sufficiently perfect, it should be necessary to cool the apparatus only to −100°, a temperature which could be attained by means of solid carbonic acid evaporating under reduced pressure, before allowing the hydrogen to expand. M. W. T.

THE RADIANT POINT OF THE APRIL LYRIDS.

THE moon being full on the evening of April 22 this year there is little prospect that the shower of Lyrids will assume prominence as a visible spectacle. It should, however, be carefully looked for on the night following April 21, for, notwithstanding the bright moonlight, it is probable that a few fine Lyrids may be observed if the weather is clear. The maximum formerly occurred on April 20, but 1900 not having been a leap year, the epoch of the shower has advanced one day, and must be looked for on April 21.

There is strong evidence to show that the radiant, like that of the Perseids, moves eastwards with the time, but the Lyrid display is always short-lived and frequently of very feeble character. Moreover, cloudy weather sometimes hides the meteors, or moonlight may practically obliterate them, so that it is extremely difficult to determine the exact place of the radiant on several succeeding nights. The April meteors are rarely as abundant as the August Perseids, though there is always the possibility of a brilliant return of the former as in 1803, when they fell so plentifully that they could not be counted.

I have collected together all the determinations of the Lyrid radiant which I have met with during the last nine years, and they form a curious medley of positions from which it seems impossible to derive any very exact results :—

Date.	Radiant.	Meteors.	Observer.
1893 April 20 ...	257 +46 271 +42 278 +39 292 +39	47	A. A. Nijland, Utrecht.
April 20–21...	267 +37	15	H. Corder, Bridgwater.
	276 +34	10	
April 20–21...	266 +37	—	E. R. Blakeley, Dewsbury (reduced by Corder).
	276 +34		
April 20–21...	265 +34	—	F. H. Ferrington, Shrewsbury (reduced by Corder).
	275 +32		
April 20 ...	272 +33	7	W. F. Denning, Bristol.
21 ...	273 +33	8	
1895 April 13–27...	268 +45 270 +29 274 +33 285 +32	20	H. Corder, Bridgwater.
April 19 ...	269 +37	9	E. R. Blakeley, Dewsbury.
21 ...	274 +36	8	
23 ...	280 +35	4	
1896 April 17–21...	263½ +40	8	A. A. Nijland, Utrecht.
	271 +36	14	
April 18–19...	271 +36	5	H. Corder, Bridgwater.
	284 +32	—	
April 10–22...	275 +38	6	A. S. Herschel, Slough.
1898 April 20 ...	271 +36	22	A. A. Nijland, Utrecht.
	280 +27	13	
April 21–24...	272 +41	9	
April 19 ...	268 +36	4	E. R. Blakeley, Dewsbury.
April 19–21...	268 +25	5	J. H. Bridger, Farnborough.
April 21–22...	273½ +32½	12	W. E. Besley, London.
April 12–22...	270 +40	5	A. S. Herschel, Slough.
April 20 ...	268 +37	7	J. A. Hardcastle.
1899 April 19 ...	253 +13	5	A. A. Nijland, Utrecht.
	277 +39	6	
1900 April 20–21...	273 +34	8	J. H. Bridger, Farnborough.
April 20–21...	266 +26	5	A. King, Leicester.
	274 +33	8	
April 18–24...	268 +38	14	A. A. Nijland, Utrecht.
	277½ +40	19	
	302 +54	8	
April 16–21...	255 +37	12	A. S. Herschel, Slough.
	255 +27		
	275 +35	23	
1901 April 18–23 ..	266 +30	30	A. S. Herschel, Slough.
	271 +30		
April 12–22...	268 +28 273½ +28 274½ +33½ 278 +31 278 +37 280 +33½	32	J. C. W. Herschel, Cambridge.
April 18 ...	266 +33	4	W. F. Denning, Bristol.
April 21 ...	270 +33	25	
April 18–21 ..	261 +36	8	

It will be noticed that some of the observers give a multiple radiant, but that the individual positions compared from year to year do not present a good agreement. At Bristol the radiant has usually been very sharply defined, when the true Lyrids have been sifted from the large number of other meteors directed from showers in nearly the same region of the heavens. The position of the radiant on April 20–21 is at 271° + 33°, and presents a perfect agreement with the radiant point of Comet I 1861, with which the Lyrids have long been supposed to be associated.

Some of the positions included in the list represent showers in Hercules and other contemporary streams. Mr. J. C. W. Herschel, from his observations in 1901, regards the radiant as decidedly multiple, but I believe that further observation will negative this conclusion. There are a considerable number of other meteoric systems in play at the same epoch as the Lyrids, and these, combined with unavoidable errors of observation, must sometimes give rise to apparently scattered radiation and multiple radiants. W. F. DENNING.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AT the annual graduation ceremonial of the University of Edinburgh on April 11, Prof. MacGregor, who delivered an address, stated that the suggestion to found a laboratory in memory of the late Prof. Tait had taken practical shape, and that a subscription of 1000*l.* towards this object had been received from an anonymous donor.

SCARCELY a week passes without the announcement in *Science* of generous gifts to institutions for higher education in the United States. The following are among the gifts recorded during the past few weeks :—Mr. J. D. Rockefeller has given 1,000,000 dollars toward the general endowment fund of the University of Chicago, and 250,000 dollars for the general needs of the University during the present academic year. He promised a gift to the Harvard Medical School of 1,000,000 dollars on the condition that 765,000 dollars were collected to meet the sum required for the removal and rebuilding of the school. About 600,000 dollars were subscribed in two weeks, and this was quickly increased to 821,225 dollars, which was more than sufficient to make Mr. Rockefeller's gift available. Mrs. Collis P. Huntington has given 250,000 dollars to the Harvard Medical School to erect a laboratory of pathology and bacteriology in memory of the late Mr. Huntington. Mr. J. Stillman has given 100,000 dollars for the establishment of a chair of anatomy in the same school. Mr. Rockefeller has given 5000 dollars to Washington and Lee University, thus completing the fund of 100,000 dollars for a memorial to the late President William L. Wilson, in the form of an endowment for the chair of economics and political science. Barnard College, Columbia University, has added 500,000 dollars to its endowment, one half having been given by Mr. Rockefeller and the other half having been collected as a condition of this

gift. Harvard University has received three large bequests: 450,000 dollars from the late Mr. George Smith, 100,000 dollars from the late Mr. Robert C. Billings, and 100,000 dollars from the late Mr. Jacob Wheelock. Mr. Wheelock also bequeathed 100,000 dollars to Clark University, and Mr. Billings bequeathed 100,000 dollars each to the Massachusetts Institute of Technology and the Boston Museum of Fine Arts. The University of Wooster, Wooster, O., successfully completed a campaign to raise 140,000 dollars in order to secure two large conditional gifts, 100,000 dollars by Mr. Andrew Carnegie and 50,000 dollars by Mr. L. H. Severance, of Cleveland. By the will of Mrs. Lila Currier, 50,000 dollars will go to Columbia University and 100,000 dollars to Yale University upon the death of Mr. Edward W. Currier.

AN address on "The Profession of Teaching," delivered recently at Kendal by the Ven. J. M. Wilson, Archdeacon of Manchester and formerly head-master of Clifton College, has been issued by the Kendal *Mercury and Times*, and it will do a good service by directing attention to desirable objects of education. A school preparation should be of a kind which will foster the desire and develop the power to overcome difficulties; it should give self-reliance and sufficient knowledge of scientific principles to enable the pupil in after life to understand changing conditions and see their trend. Above all, school work should encourage the spirit of inquiry which finds delight in making new observations and experiments with whatever resources are available. The principle upon which Humboldt constructed Prussian education a century ago was: "Whatever we wish to see characteristic of our nation we must first implant in our schools." Remembering this, the teacher's aim should be to give the pupil an observant eye, alert curiosity that inquires into phenomena and their causes, the habit of accurate expression, and varied interests; for then whatever work is afterwards taken up will be satisfactorily done. Archdeacon Wilson strikes the fundamental note of true education in the following remarks from his address:—"The soldier may know all the campaigns of great commanders, from Alexander the Great to Lord Kitchener; but his knowledge avails little unless he has cultivated inventiveness and resource that meets wholly new conditions. The existence of our nation may depend some day on the nerve and originality of the officers of our navy. Every war is a new one; and the next will be utterly unlike the last or the present. It is the same in commerce. The new problems, with combines and international unions, with a shrunken world and new modes of transit, are not like the old. It is the same with agriculture, with mechanical and chemical industries, with engineering. Everything is new, and new every day. It is the same with philosophy and critical studies and theology. It is emphatically the same with statesmanship, municipal and imperial. What utterly new problems in international politics, in international economics and in domestic finance does the world present to-day. Assuredly if we would prepare our scholars for life, the supreme intellectual preparation is found in methods which evoke the faculty, the originality, the mental resourcefulness of our pupils." It is for us to see that the subjects and methods of teaching in our schools are such as promote the development of these qualities, for national progress depends upon them.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, April 11.—Prof. S. P. Thompson, president, in the chair.—Dr. R. A. Lehfeldt exhibited an electric heater. The apparatus consisted of a vacuum jacketed glass tube, containing water which was boiled by passing a current through a platinum spiral immersed in the liquid. Tap water is preferable to distilled water, because the small electrolytic action in the former case causes the boiling to proceed quietly. Different temperatures can be obtained by using other liquids.—Mr. Grant exhibited and described an apparatus for vapour pressure measurements. The liquid of which the vapour pressure is required is introduced into the vacuum of a syphon barometer. This is mounted alongside an ordinary syphon barometer, and the upper extremities of both are surrounded by a bath, which can be kept at any desired temperature. The levels of the mercury in the open tubes are then adjusted until the upper mercury surfaces are at the same level. The vapour pressure is then measured by the difference of level in the open tubes. By a simple modification it is easy to investigate the vapour pressure of a liquid in the presence of air. The two chief advantages of the method are (1) the simplification of the temperature correction and (2) the wide range of temperature over which it can be employed with the use of a small bath. Prof. Callendar referred to the advantages of the apparatus, and said that it appeared specially suitable for elementary laboratory measurements.—Mr. J. T. Morris showed an experiment illustrating the use of kathode rays in alternate current work. The usual form of Braun tube was used, the rays falling upon a luminescent screen and forming a blue spot. A solenoid conveying an alternating current was fixed near the tube. The varying magnetic field caused the spot to oscillate about its mean position. To determine the maximum value of an alternating current, a switch should be arranged to rapidly replace the alternating current by a continuous one. The continuous current is then adjusted until the maximum excursion of the spot is the same as before and the value of the current read off from an ammeter in the circuit. For accurate work, the frequency of the discharge from the induction coil exciting the tube should be adjusted until it is almost exactly in synchronism with the alternating current. The unsteadiness of the spot of light in the zero position limits the accuracy of the measurements. Mr. Morris has tried to reduce this unsteadiness by using an earthed aluminium diaphragm instead of a glass one.—Mr. Morris then showed an experiment on the growth of electric currents in an inductive circuit. An E.M.F. of 0·8 volt was applied to a coil wound on a ring-shaped laminated iron core. When the current had attained its steady value, the E.M.F. was reversed and the variations of the current strength shown by an ammeter. About twenty seconds were required for the current to attain its maximum value in the opposite direction. A secondary coil was also wound upon the same core, and the effect produced upon the growing current by the closing of this secondary circuit was shown. Mr. Morris has determined curves of growth for different currents, and he showed how similar curves could be used to determine experimentally the hysteresis loss in transformers.—Mr. Croft showed some apparatus and devices useful in teaching. The method of determining graphically the focal length of a lens from the distances of conjugate foci from the centre was illustrated. The graphical solution of a quadratic equation was also shown. An apparatus for producing and demonstrating the properties of three-phase currents was exhibited and described. Mr. Croft then showed crystals illustrating the five regular solids, and an electric lamp with the filament in one plane useful for optical work. The flatness of a piece of plate glass can be tested with a scribing block. The point is adjusted to touch the glass in one position. By breathing on the glass and moving the block about it is easily seen if the point leaves the surface.

PARIS.

Academy of Sciences, April 7.—M. Bouquet de la Grye in the chair.—Note by M. de Freycinet accompanying the presentation of a work on the principles of rational mechanics.—On the differentiation of Fourier's series, by M. Leopold Fejer. In general the trigonometrical series, which is obtained by differentiating term by term the Fourier's series of a function $f(x)$, is divergent in the cases which occur most frequently in its applications. A special case of Fourier's series is considered in the present paper, which, when differentiated term by term, is always simply indeterminate, and with the exception of the limits 0 and 2π has for its sum $f'(x)$.—On the conditions of stability of automobiles on curves, by M. A. Petot. Formulæ are developed showing the amount of time necessary to pass from one curvature to another. A study of the fundamental conditions arrived at in this paper leads to the conclusion that it is the neglect of these which is the true cause of a number of serious accidents which have been attributed to a faulty steering gear.—Oscillations peculiar to networks of distribution, by M. Brillouin. The theorem deduced by M. Pomey in a recent number of the *Comptes rendus* was announced and demonstrated fifty-one years ago by Helmholtz.—On the relation $L+S/T=Q/T=K$, by M. de Forcrand. The molecular latent heat of volatilisation of ammonia is calculated by the formula of Clapeyron from the data of Regnault, and this is applied to the proof of a theorem that in all physical and chemical phenomena the heat of solidification of a molecule of a gas is proportional to the absolute temperature of volatilisation under a pressure of 760 mm. of mercury.—On the classification of the atomic weights

of neon, argon, krypton and xenon, by M. H. Wilde. The author assumes, without proof, that the atomic weights of this series should be represented by the members of the series $7n$H, where n is 3, 6, or 9. This would give the atomic weights as neon, 7 (9·96); nitrogen, 14 (14); argon, 21 (19·96); krypton, 42 (40·78); and xenon, 63 (64), instead of the experimental numbers given in brackets.—On a type of compounds of glucinum, by M. H. Lacombe. The compounds are of the type A_6Be_4O, where A is the radical of a fatty acid. Particulars are given of the preparation and properties of the formate, acetate, propionate, isobutyrate, normal butyrate and isovalerate. All attempts to prepare the normal salts of the type BeA_2 were fruitless.—On the constitution of the chlorhydrins, by M. Marc Tiffeneau. The author has applied the synthesis of chlorhydrins from magnesium alkyl bromides and mono-chloracetone to determine the constitution of the chlorhydrins obtained from olefines and hypochlorous acid. The rule given by Markownikoff, that in the fixation of HClO on olefines the hydroxyl group attaches itself to the carbon possessing the least hydrogen, as generalised by Krassousky was verified in the experiments described.—On the nitration of furfurane, and on a derivative of nitrosuccinic aldehyde, by M. Marquis. The nitration of furfurane in solution in acetic anhydride opens up the ring with the formation of a monacetin of nitrosuccinic aldehyde. By the action of pyridine upon this, the ring is again closed and mono-nitrofurfurane is produced.—On a new mode of preparation of oxygen, by M. George F. Jaubert. The peroxides of sodium or potassium are compressed with the theoretical quantity either of a soluble permanganate or hypochlorite, or a trace of a nickel or copper salt. Oxygen is produced from these cubes in the cold by the action of water.—Mendel's law and the heredity of pigmentation in mice, by M. L. Cuenot. Up to the present all researches on Mendel's law have been carried out on plants, and it is not known whether this mode of heredity is met with in animals also. Experiments were therefore carried out with white and grey mice, and it was found that the progeny obtained by crossing these was invariably grey. The result of crossing with these grey mongrels was in complete accord with the theory.—On the structure and mode of multiplication of the flagellæ of the genus Herpetomonas, by M. Louis Leger.—On the *Daniellia* of Western Africa and on their resinous products, their relation with the *Hammout* or incense of the French Soudan, by M. Edouard Heckel.—On the seismic influence of the Armorican folds in the north-west of France and in the south of England, by M. F. de Montessus de Ballore.—On a new application of the principle of chrono-photography and on the construction of isonomal barometric charts, serving for the kinematographical study of the general movements of the atmosphere, by M. P. Garrigou-Lagrange. A series of charts showing the isobars over a given area at sufficiently short intervals of time may be regarded as instantaneous photographs representing the several phases of a movement. A series of charts issued by the Signal Office at Washington has been treated from this point of view, and a number of charts obtained which can be used in a hand kinematograph.

DIARY OF SOCIETIES.

THURSDAY, APRIL 17.

ROYAL INSTITUTION, at 3.—The Oxygen Group of Elements: Prof. J. Dewar, F.R.S.

SOCIETY OF ARTS, at 4.30.—Recent Developments in Punjab Irrigation: Sidney Preston.

LINNEAN SOCIETY, at 8.—The Anatomy of Todea with Notes on the Affinity and Geological History of the Osmundaceæ: A. C. Seward, F.R.S., and Miss Sybil O. Ford.—On the New Zealand Phyllobranchiate Crustacea, Macrura: G. M. Thomson.

CHEMICAL SOCIETY, at 8.—Oxonium Salts of Fluoram and its Derivatives: J. T. Hewitt and J. H. Tervet.—The Influence of certain Acidic Oxides on the Specific Rotations of Lactic Acid and Potassium Lactate: G. G. Henderson and D. Prentice.—(1) The Amounts of Nitrogen as Ammonia and as Nitric Acid, and Chlorine in the Rain-water collected at Rothamsted; (2) The Amounts of Nitrogen as Nitrates and Chlorine in the Drainage through uncropped and unmanured land: N. H. J. Miller.

FRIDAY, APRIL 18.

ROYAL INSTITUTION, at 9.—The Autocar: Sir J. H. A. Macdonald.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Smallpox Hospitals and the spread of Infection: Dr. Thresh.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Erewash Valley Widening and Toton Sidings: H. C. M. Austen.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Standardisation of Pipe Flanges and Flange Fittings: R. E. Atkinson.

MONDAY, APRIL 21.

VICTORIA INSTITUTE, at 4.30.—Iceland, its History and Inhabitants: Dr. J. Stefansson.

SOCIETY OF ARTS, at 8.—Glass for Optical Instruments: Dr. R. T. Glazebrook, F.R.S.

TUESDAY, APRIL 22.

ROYAL INSTITUTION, at 3.—Recent Methods and Results in Biological Inquiry: Dr. A. Macfadyen.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion*: Locomotive Fireboxes: F. W. Webb.

WEDNESDAY, APRIL 23.

INSTITUTION OF CIVIL ENGINEERS, at 8.—"James Forrest" Lecture: Metallurgy in Relation to Engineering: Sir W. C. Roberts-Austen, K.C.B., F.R.S.

SOCIETY OF ARTS, at 8.—Opto-technics: Prof. Silvanus P. Thompson, F.R.S.

THURSDAY, APRIL 24.

ROYAL SOCIETY, at 4.30.—*Probable papers.*—On Skin-currents. Part III.—The Human Skin: Dr. A. D. Waller, F.R.S.—Aptarctic Origin of the Tribe Schœneæ: C. B. Clarke, F.R.S.—A New Interpretation of the Gastric Organs of *Spirula Nautilus* and the Gastropods: J. E. S. Moore and W. B. Randles.

ROYAL INSTITUTION, at 3.—The Oxygen Group of Elements: Prof. J. Dewar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Problems of Electric Railways: J. Swinburne and W. R. Cooper. (Adjourned discussion).—Form of Model General Conditions, for use in connection with Contracts for Plant, Mains, and Apparatus for Electricity Works. As drafted by a Committee.

FRIDAY, APRIL 25.

ROYAL INSTITUTION, at 9.—X-Rays and Localisation: Dr. J. Mackenzie Davidson.

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