THURSDAY, FEBRUARY 2, 1911.

THE ENCYCLOPÆDIA BRITANNICA.

The Encyclopaedia Britannica: A Dictionary of Arts, Sciences, Literature, and General Information. Eleventh edition. Vols. i.–xiv. (A—Italic.) (Cambridge: University Press, 1910.)

THE Encyclopædia Britannica is of Scottish birth. Its first edition appears in 1771. Its interesting and rather chequered history occupies some three pages of the present (eleventh) edition, and shows its intimate connection with the land of its birth until the reprint of the ninth edition issued by *The Times* in 1898. Under the same auspices the eleven-volume supplement to the ninth edition was issued, and, together with that edition, formed the tenth, in 1902, and it is not a little curious to observe that the impression created by that issue appears to have been so strong that few realise off-hand that the present new edition has occupied eight years in the making. Its preparation continued to be conducted from the office of *The Times* until 1909, when the rights of publication were taken over by the Cambridge University Press, a step generally acknowledged to be peculiarly appropriate to the character of the work. It is proposed in the present general notice to consider some of the most notable characteristics of the work, such as distinguish it from former editions and from other works of reference. For that it possesses such characteristics cannot be questioned; the new edition shows evidence of much more than a simple reliance upon traditional form.

Probably the two leading ideals before the editorial staff in preparing the eleventh edition have been (1) to make the whole work easy of reference and self-explanatory, and (2) to ensure that every article should possess, so far as possible, a permanent value, giving preference (within reason) to the established fact over the statement of the moment or over prophecy. The Encyclopædia Britannica has been traditionally distinguished for certain individual features, such as a high literary standard and the existence of "omnibus" articles—practically complete treatises—on each great main division of knowledge. The simple addition of many short separate articles, while sufficient to make reference easier, might have tended to obscure the literary standard and to duplicate the information contained in the omnibus articles. But the old omnibus article could not always be self-explanatory; it could not guide the unlearned reader along the main line of his subject without taking him incidentally along the branches, whereas the specialist, desiring to find a particular branch, must follow up the main line to reach it. It has now been assumed that the principal function of such an omnibus article as "geology" is to indicate the main lines of that science, with free reference to branches of the subject dealt with more fully under separate headings. Thus the reader desirous of studying the glacial period now finds that heading in its own place, instead of having to search the treatise on geology for it. Again, not even the glacial period and the glacier itself fall under one general head, but each has its own. By this method it has been sought to ensure that the elementary student may find his elements, and the specialist his special subject, unobscured the one by the other. The single illustration given is that of a principle which has been applied so far as possible in every department of the work.

The introduction of what has been called the "dictionary feature" is of a piece with this same principle. There are very many terms which a specialist uses naturally without considering that they may call for explanation; especially there are many the meaning and connotation of which vary in general and in particular application. For such terms, and for many others in commonest use, the origin of which is peculiar or obscure, definitions on an etymological basis have been introduced—often a short separate article has been inserted for this purpose alone. This feature is an expression of the ideal of making the work self-explanatory.

The attempt to make every article as nearly as may be of permanent value has imposed a heavy responsibility on the editorial staff. The system of employing statistics offers an illustration. In the previous editions they were used very freely, and in many cases simply for their own sake, the reader being left to draw his own conclusions from them. It has now been felt that this practice (subject, of course, to the inclusion of certain essential figures like vital statistics) is far rather the function of an annual register than of an encyclopædia, and that the proper encyclopædic function of statistics is to illustrate statements of fact, so that they ought not as a rule to stand alone. They have, therefore, been used much more sparingly than before, and in many cases even without reference to the latest figures available, when others better illustrate the particular point under notice.

On more general grounds, it is always difficult to appraise a current event at its historical value, with due allowance for its momentary appeal to the minds of men. Here again the editorial responsibility has been heavy, the heavier owing to the almost simultaneous publication of the complete work. For it may be assumed, and ought to be remembered, that the copy for twenty-eight textual volumes of nearly a thousand pages each cannot be kept under the editorial hand until one month, or two months, or three, before the date of publication, and the order be then given to the printers. It may be taken for granted, for instance, that the article on the kingdom of Portugal was in its final form when the revolution created a republic instead, and much of the article must be recast. The result of the last general election was due on a certain day; the proper alphabetical place must be held open in the text to include that result, while the presses continued their work on either side of the waiting page. We recognise something of the journalistic method here, in the judgment as to which events of the moment are to be dealt with in this way and which are not, and the journalistic experience of the editor, Mr. Chisholm, must have stood him in good stead.

The simultaneous publication of the eleventh edition is a remarkable achievement in various obvious ways; it has certain less obvious bearings on the character

of the book. It should be a guarantee, for instance, of a well-balanced treatment of all subjects from A to Z. Not a few great works of reference, including the encyclopædia itself in former editions, appearing volume by volume over the period of a generation, have shown signs (so to speak) of fatigue in about the last quarter of the alphabet. In some instances it may have been financial fatigue, in others merely the realisation that the proportions of the first few volumes, if maintained, would bring the completed work to an impossible bulk. But the promise of simultaneous publication disposed of any such possibilities in the present edition, for in order to carry it out the cost must have been counted and the scheme laid out, not volume by volume, but for the whole work at once. And this treatment of the whole connotes the similar treatment of every part, not merely as regards the laying-out of each group of main and subsidiary articles, but as regards questions of general policy. The illustrations are a case in point. The editorial ideal has been to illustrate where illustration is a genuine assistance or supplement to textual description, and only in that way, not including pictures simply for their own sake. So every suggestion or possibility of illustration has been brought, so to say, under one standard test.

It is the same with the maps. The tenth edition set the precedent of an atlas volume. The editors of the eleventh have put this precedent aside. Their view may be open to criticism; there are undoubtedly arguments in favour of an atlas volume. But the advantage of having the article on each important territory accompanied by its appropriate map has been considered stronger. Moreover, the possibility of allocating to each such territorial article its map according to a graduated scale—double-plate, single-plate, or small text map, coloured map or black only—has given the geographical editors an opportunity in the direction of proportional treatment which would have been precluded by the construction of an atlas, at any rate of the size of an encyclopædia scheme. At the same time, the proper indexing of the maps has been undertaken, so that they may fulfil the atlas-function. Here the editorial ideal has been to set before the cartographers either the actual text of the articles to be illustrated or the most precise instructions as the scope and orthography of each map, to carry out the indexing in the editorial office, and to apply as part of that process a careful system of checking and correction. This method presupposes the manufacture of a complete series of new maps for the book; there has been no use of cartographers' stock.

Mention of map-indexing leads to the subject of text-indexing. The indexing of the tenth edition was a great conception, and of course added enormously to ease of reference. But it was an after-thought, whereas the work of preparing the index entries for the eleventh edition has proceeded concurrently with practically the whole work, the pagination being added at the last. It has been possible, therefore, to put the indexing to an editorial use, in this way—that when the index-references on any subject were put together, they have been found sometimes to indicate the existence of unnecessary duplications or of inconsistencies of view or even of fact, between articles by different authors—such duplications or inconsistencies as could not possibly have been discovered by any other editorial method.

The eleventh edition bears a clear international imprint. If the conception of certain articles dealing with subjects of world-wide interest be compared in this and former editions, evidence will be found of another editorial ideal. For example, on matters of government, sociology, law and the like, it has been sought to explain not British practice only, but American and foreign as well. The work has an extra-British reputation already; it has palpably been attempted to justify and increase that reputation. The multinational list of contributors illustrates the same ideal.

It has been said above that one tradition of the Encyclopædia Britannica is a high literary standard. This has been preserved. No man reads a dictionary or ordinary book of reference for its own sake as literature. The editors of such works have no room to offer their contributors any literary opportunity. But while it would be unfair to forget that the problem of the best utilisation of available space must have been as constantly present to the editor of the Encyclopædia Britannica as to the printer of a finger-prayer-book, the fact remains that twenty-eight large volumes do offer a literary opportunity; if they did not, they would not justify their existence. On any subject capable of literary treatment (and few are not) the Encyclopædia appears to apply that treatment; it is impossible to turn many pages (except one should light on such a topic as higher mathematics) without reaching some subject or fact which is presented so as to arouse the casual, as distinct from the special, interest. The India-paper edition makes it possible to do this without physical discomfort, and the production of that edition is in itself an unprecedented achievement, for it must necessarily presuppose that paper-mills of some half-a-dozen countries have been laid under contribution to meet a demand of such magnitude, and that the printing must have been carried out with a rapidity the possibility of which, as applying to India paper, was probably unrealised before. On these grounds the manufacture of the book must be pronounced admirable.

Such, then, have been some of the ideals of the editors and publishers. There is every evidence that they view the finished work with enthusiasm, knowing more than others can of the difficulties which have been overcome; judged upon these general grounds, their enthusiasm appears justified.

ELECTROMAGNETS.

Solenoids Electromagnets and Electromagnetic Windings. By Charles R. Underhill. Pp. xix+342. (London: Constable and Co., Ltd., 1910.) Price 8*s.* net.

THIS is a book dealing generally with electromagnets, and so far as the author records experimental results will be found useful, but the explanation of the experiments is not given as fully as is desirable

in order that the reader may thoroughly understand the theoretical deductions, and the latter themselves are not always trustworthy. We find a good many quotations with due acknowledgment of articles that have appeared in the *Electrical World* of New York, and if the author had exercised some care in the selection his book could only have benefited by it. Unfortunately, however, the necessity of carefully probing the correctness and relevancy of any article before admitting it into his book does not seem to have occurred to the author, and the result is that we find statements in his book which often are quite useless and sometimes even unintelligible. To give only a few examples. On p. 152 is given a formula for the inductance of a solenoid for which an accuracy of half per cent. is claimed, but the author does not say whether the result is obtained in cm. or in Henry. Moreover, the formula is very cumbersome, and no proof is given. On the next page another formula is wrongly quoted from Maxwell, the exponent for the number of turns per cm. length being given as four instead of two. Also in this case the author does not state whether L is obtained in cm. or Henry.

Another example of the want of criticism on the author's part will be found on p. 32. Here he gives us Mr. H. S. Baker's method of expressing the degree of saturation of the core of an electromagnet. It is as follows:—Draw a tangent to the magnetisation curve at the point for which the degree of saturation is to be expressed as a ratio. Note the length cut off on the B axis by the point of intersection of this tangent. Then the ratio of this length to the value of B at the selected point gives the degree of saturation. Since the characteristic is nearly straight for high values of magnetisation, this method of expressing saturation leads to the absurd result that Baker's ratio becomes actually smaller for very high degrees of saturation. A rule of this kind is absolutely useless and even misleading, and a little consideration on the author's part would have shown him that he had better not include it in his book.

A very bad slip in scientific principles occurs on p. 16. There we are told in an equation that the "Intensity of magnetisation" divided by the magnetic moment gives the "Intensity of the magnetic field." This is quite wrong, for the ratio is simply the inverse of a volume. Again, on p. 25, we are told that

"the relation between the strength of a current in a wire and the intensity of the magnetic field or magnetising force is expressed by the equation $H=0{\cdot}2I/a$."

This is only true if the wire be infinitely long, but as in what precedes this statement not a word is said about the length of the wire the statement as it stands is misleading, and, in fact, meaningless.

Some of the terms used are not very familiar to English readers. The author talks of Maxwells, Gilberts, and Gausses, but these, although used occasionally by American writers, have never been sanctioned by the international committee on nomenclature. There is, moreover, no great necessity for multiplying such terms. It is just as easy to say two megalines as two million Maxwells, or an induction of 15,000 lines as an "induction of 15,000 Gausses." Why the "Oersted" as representing the magnetic reluctance of "one cubic centimetre of vacuum" should be introduced is also not very apparent. There is perhaps some excuse for the use of such terms in the fact that others have done so before, but the introduction of the term "activity" in substitution of the generally used and perfectly understood term "space factor" is surely quite superfluous. It will also puzzle the reader to say what a "water shield," a "stopped solenoid," and a "fringed insulation" are Such technical terms may be convenient for a particular workshop as short instruction to the workman, but a scientific book is not the place to use them.

On the very important question of heating of coils the information given is rather meagre. All we are told on p. 299 is that a

"coil of ordinary dimensions may remain in circuit continuously when the applied electrical power does not exceed 0·50 watt per square inch of superficial radiating surface."

A curious statement is made on p. 184 as regards the time constant of two coils in parallel. The author says that it is only one-quarter of the value for the coils in series, but he has evidently overlooked the fact that although the inductance is quartered, the resistance is also quartered and therefore the time constant remains the same. GISBERT KAPP.

ANALYSIS OF WINE AND OTHER SPIRITUOUS LIQUORS.

Traité complet d'analyse Chimique, appliquée aux essais industriels. By Prof. J. Post and Prof. B. Neumann. Deuxième edition Française, traduite d'après la troisième édition allemande. By G. Chenu et M. Pellet. Tome Second. Troisième Fascicule. Pp. 497–916. (Paris: A. Hermann et Fils, 1910.) Price 13 francs.

THIS part of Post and Neumann's work deals with alcoholic beverages and some allied products. Chiefly it is concerned with wine and beer, and the original German text has been largely supplemented by details of the French practice in the chemical surveillance of these articles. Thus Gallicised, the work is of special interest for those concerned with its subject, inasmuch as it represents the experience of two great wine-making countries and of one, at least, famed also for its beer.

Dr. P. Kulisch, of Colmar, is responsible for the original section dealing with wines; but in view of the importance of the subject in France considerable additions have been made by the French translators. The result may therefore be taken to indicate the best practice in the two countries. At the outset are given the definitions of wines and the descriptions of usual manufacturing operations adopted by the International Congress for the Repression of Food Adulteration (Geneva, 1908, and Paris, 1909). Then follow directions for the chemical determinations required during the preparation and fermentation of the grape-juice, and the official methods prescribed in France and in Germany for the analysis of the fermented product. Detailed notice would be unprofitable here; it must suffice to say that full directions are given for appraising the various vinous constituents. Numerous illus-

trations of apparatus are shown, as well as tables needed for the estimation of alcohol, sugar, and "extract."

For the benefit of local authorities and others in this country who are inclined to begrudge their analyst his fees, it may be remarked that the French prescriptions for the analysis of wine involve no fewer than nineteen separate experiments or determinations, whilst the German regulations require twelve for an ordinary full analysis and twenty-six in special cases.

Having carefully obtained his analytical results in any instance, how is the operator going to interpret them? Some data for this purpose are given in the text, but they are meagre, and might usefully be supplemented. Even to the experienced, a record of maximum and minimum values yielded with given methods by genuine wine of different types would often be of service.

One rather humiliating reflection is suggested on looking over the various modes of examining wine. The liquor "which maketh glad the heart of man" holds yet some secrets which elude his skill as a chemist. Much as chemistry has advanced since the days when Pasteur carried out his "*Etudes sur le vin*," the palate is still an indispensable aid to such studies. Just as the chemistry of the living plant transcends in delicacy that of the laboratory, so the senses of smell and taste can discern, and in some sort evaluate, differences far too subtle for demonstration by balance, test-tube, or polarimeter. Not only for the finer distinctions between vintage wines, but even sometimes for detecting relatively gross adulteration, the organoleptic test of bouquet and aroma remains the best or the only criterion.

As regards beer, there is little described that would be new to a well-trained brewers' chemist. The section, however, gives a concise account of the operations necessary for the chemical control of brewery procedure, including the examination of water, barley, malt, hops, and wort, as well as the finished beer.

The various distilled spirits and the liqueurs are dealt with in an important division, which includes also an account of pressed yeast—now a notable by-product of alcohol distillation. Cider, perry, vinegar, acetic acid, and methyl alcohol are other subjects treated in the volume.

C. SIMMONDS.

PRACTICAL PATHOLOGY.

Practical Pathology. A Manual for Students and Practitioners. By Prof. G. Sims Woodhead. Fourth edition. Pp. xxii+798. (London: Henry Frowde and Hodder and Stoughton, 1910.) Price 31*s.* 6*d.* net.

THE practical pathology of to-day is very different from the practical pathology of twelve or fifteen years ago, when the third edition of this book was published. Nevertheless, the present edition, as regards the scope embraced by it, remains much as it was, viz., it is a guide for the post-mortem room and a manual of practical morbid anatomy and histology; general pathology, with the exception of inflammation, is almost untreated. Prof. Woodhead has, however, deliberately chosen this course, and in the preface explains that in its present form "Practical Pathology" has been found helpful to the medical student in his class and ward work, and to the practitioner who desires readily accessible data on the methods and information which it contains.

The first 150 pages are devoted to post-mortem examinations, and the methods of preparing tissues for microscopical investigation. A judicious selection has been made of the multitudinous methods for fixing, hardening, and staining that have been devised, and this part of the book should be most useful.

After this the phenomena occurring in inflammation are discussed, and then the morbid changes met with in the various tissues and organs are dealt with. This method, while having the advantage of taking the student through the principal alterations which occur in a particular organ when diseased, has the disadvantage that descriptions of processes which are very similar in the various organs, *e.g.* tuberculosis, are repeated again and again, with a consumption of space which might perhaps have been better utilised for other subjects which have been omitted.

On the whole, the descriptions of the histological appearances of morbid tissues are ample and accurate, and all the commoner conditions are dealt with. We fail to find any reference to endotheliomatous tumours, which of late have assumed some importance, and no mention is made of the differentiation of ovarian cystomata into two varieties, nor of the fact that the pseudo-mucinous cystadenoma on rupture frequently gives rise to metastatic growths of the peritoneum, which may become carcinomatous.

Nearly two pages are devoted to a description of the so-called parasites of cancer, but the student is not warned that the parasitic hypothesis of the genesis of cancer is now largely discredited, and that these so-called parasites may be peculiar forms of cell degeneration. Nor is any mention made of modern work on the cytology of malignant growths or of the apparent transformation of carcinoma into sarcoma by a metamorphosis and overgrowth of the connective-tissue stroma.

With a little amplification on these and other points by the teacher, the work should prove a most useful class book on practical morbid histology. The beautiful coloured drawings by Mr. Richard Muir and others are much to be commended, though occasionally (*e.g.* Fig. 265, Tertian malaria) more is depicted than will ever be found in any one specimen.

SYLVESTER'S MATHEMATICAL PAPERS.

The Collected Mathematical Papers of James Joseph Sylvester, F.R.S., &c. Vol. iii. (1870–83). Pp. xvi+688. (Cambridge: University Press, 1909.) Price 18*s.* net.

THE greater part of this volume consists of papers on the theory of algebraic forms, and their substance is now so familiar that it is needless to analyse them. But the reader who turns back to these classical memoirs is charmed, as ever, by the genius they display, and the extraordinary vivacity with which they are written. Moreover, Sylvester's habit of publishing in haste, while the hot fit was on

him, makes all his papers stimulating in a way which encourages research. His scattered hints and surmises, his digressions and scholia, his occasional fantastic notes, all add to the fascination of his work. Thus, to take an example quite at random, he concludes a paper on irreducible concomitants by remarking:—

"I have always thought and felt that beyond all others the algebraist, in his researches, needs to be guided by the principle of faith, so well and philosophically defined as 'the substance of things hoped for, the evidence of things unseen.'"

This might as certainly be ascribed to Sylvester as a characteristic passage of "Sartor Resartus" to Carlyle.

One of the memoirs on quantics deserves particular notice; it is that which represents concomitants by graphic symbols, such as those used in organic chemistry. It is curious that this method, which at one time engrossed Clifford as well as Sylvester, should have been so barren in results. Perhaps the most interesting things in the paper are Sylvester's remarks on the possibility of algebraic theorems having corresponding propositions in chemistry; for instance, he says,

"Hermite's law of reciprocity . . . amounts to affirming in chemical language that in any compound an arbitrarily selected group of m n-adic atoms may be replaced by a group of n m-adic atoms; but how far this law of replacement has objective validity in the chemical sphere, I am not able to say."

Among the arithmetical papers, of which there are several, the longest, and one of the most interesting, is that on the diophantine equation $x^3+y^3=Az^3$. Although Sylvester did not reach so definite a result as that stated by Lucas, he considerably extended the theorems of Pépin, and the way in which he does this is of a strictly elementary kind. Besides this, he gives a beautiful proof of a fundamental theorem connected with "residuation" of points on a cubic curve; by the application of elliptic functions this can be done in a line or two, but Sylvester's demonstration is far more instructive.

Another paper of interest is that on the distribution of primes, in which he extends the method of Tchébicheff, while several scattered notes on partitions, Farey series, and the theory of vulgar fractions, contain hints which may very likely admit of development.

One definite suggestion may be mentioned here (*cf.* pp. 414–25). It is well known that Sylvester proved, and generalised, Newton's rule for discriminating the roots of an equation $f(x)=0$. This rule employs the coefficients of f and also those of a derived function the coefficients of which are quadratic in those of f. Now the question is whether there may not be other derived functions, with coefficients formed by some simple rule, which may settle those cases in which Newton's rule is insufficient.

The care with which Dr. Baker performs his duty as editor again deserves cordial recognition; on pp. 357–8 the sign + in several places seems to be a misprint for −, and it is possible that a few other such mistakes may have been overlooked, but considering Sylvester's great inaccuracy in proof reading, the correctness of the text, so far as the present reviewer has been able to test it, is remarkable.

G. B. M.

NATURE-STUDY AND ROSE PESTS.

(1) *Battersea Park as a Centre for Nature Study.* By W. Johnson. Pp. 128+map. (Published under the direction of the Battersea and Wandsworth Educational Council.) (London: T. Fisher Unwin, 1910.) Price 1*s.* net.

(2) *How to Know the Trees.* By H. Irving. Pp. vi+179. (London: Cassell and Co., Ltd., 1910.) Price 3*s.* 6*d.* net.

(3) *Rosenkrankheiten und Rosenfeinde.* By Dr. K. Laubert and Dr. M. Schwartz. Pp. vi+59. (Jena: Gustav Fischer, 1910.) Price 1 mark.

THE pursuit of natural history observations on the part of children in towns can be in many ways more profitably directed in parks than in the open country, at any rate until such time as the children learn how and what to note. Proximity to the schools, the aggregation of many features within a small area, and opportunities for repeated visits all favour the systematic use of advantages offered by the London public parks. The chief opportunities for study in Battersea Park (1) are provided by the birds, both wild and cage-bound, insects, wild flowers, and trees. These themes are well elaborated by Mr. Johnson with a knowledge arising out of intimate acquaintance. In addition, there are chapters on history, geography, and set subjects for rambles, while other facts are collated in the outline calendar, and a map serves for general purposes, as well as for indicating the positions of the large trees. The volume represents an effective triple cooperation of an observant author, a well-guided educational council, and an interested publisher.

Although numerous books on trees are extant, it is doubtful whether any one of modest dimensions describes more precisely the ever-changing appearances and distinctive features of the trees than the volume provided by Mr. Irving (2). About sixty different kinds are described, some very briefly, when they are closely allied plants, as the various pines, others, as the ash, at great length, but in all cases full indications are furnished of distinguishing characters. The illustrations have appeared before, but they are so excellent that they bear repetition. The author introduces but few technical words, even to the extent of leaving out the scientific names of the trees; in the case of the Himalayan pine the scientific name is required for purposes of identification, and, generally speaking, they are desirable. The book can be thoroughly recommended.

In the volume on rose pests (3) Dr. Laubert deals with fungi, and distinguishes seven definite diseases. Rust, mildew, canker, and leaf blotch are the commonest, to which are added rot mould (*Peronospora sparsae*), a root disease (*Roesleria sp.*), and a Botrytis rot (*Sclerotinia Fuckeliana*). Two other diseases

of roses, leaf-spot (*Septoria rosae*) and tumour (*Botryosphaeria diplodia*) are not given. This part of the book might have been condensed with advantage. Dr. Schwartz has a more extensive task in describing the insect pests, of which more than a hundred are known. About fifty species are shortly described and tabulated according to the parts of the plants which they injure. The data given are as full as could be expected, and remedies are mentioned.

OUR BOOK SHELF.

Exercises in Metal Work. For Trade Preparatory Schools. By A. T. J. Kersey. Pp. x+70. (London: G. Bell and Sons, Ltd., 1910.) Price 1*s.* 6*d.* net.

TWENTY-SEVEN exercises in detail are contained in this book, and hints for continuing thereafter a course in metal-work suitable for pupils in trade preparatory schools. The exercises are carefully graduated, at first introducing the use of hand tools, and leading up to some simple exercises in the use of machine tools, such as drilling machines, shaping machines, and turning lathes. The drawings are good, and show in every case what is required of the pupil. Some little omissions occur here and there; for example, on p. 53 appear drawings of a V block as an example of the use of a shaping machine. It is customary to have a groove at the bottom of the V in order to facilitate finishing its faces; this has been omitted. It is not, however, a grave objection to find such details left out; students possessed of average intelligence will discover them, and, judging from the preface, it is more than probable that the author had this view before him in the production of the book.

We can commend heartily the reading of the author's preface to any teacher or other person having an interest in workshop classes. The value of a sympathetic teacher cannot be over-estimated; it is often difficult for an instructor who has been trained in an engineering works (and this is essential) to realise the difficulties of the boy who has just left the elementary school. Unless he bears in mind the mistakes and troubles of his own early apprentice days, he is apt to be impatient. Pupils should be encouraged to think out answers to home-work questions. Those appearing in the book are designed with the view of cultivating the spirit of inquiry and of teaching pupils to think about their work, as mere manipulative skill is of little value without this—the true aim of all education, technical or otherwise. We can commend this book as an intelligent attempt to assist in carrying out these broad-minded principles.

A Lecture on Mendelism. By Dr. H. Drinkwater, F.R.S. Pp. iii+31. (London: J. M. Dent and Sons, Ltd., 1910.)

IN this book is given a popular lecture on Mendelian heredity, printed apparently with hardly any alteration; and considered as a lecture it is distinctly good. It is very simply and clearly written, and with the help of the numerous diagrams and figures should make the main outlines of the subject clear to those who have no previous acquaintance with it. It has, however, the unavoidable defect of a lecture, that to avoid confusion essentials must be emphasised to the exclusion of the less important; it would probably have been improved by the addition of footnotes in some places, amplifying or qualifying the statements in the text. For example, the inference (p. 21) that "*plants and animals are built up of a number of indivisible unit factors upon which their characters depend*" (author's italics) surely requires a qualifying note to the effect that such unit factors may equally possibly be superposed on a basis which is different in nature.

The figures and diagrams are mostly clear and good, and there are well-reproduced portraits of Profs. Bateson and Punnett, in addition to a frontispiece of Gregor Mendel. The representation of a wrinkled seed in Fig. 5 is misleading, and the figure on the last page, illustrating the union of germ-cells, besides being rather obscure without further explanation, contains an inaccuracy in reproduction which might be confusing. Other small points which could be improved are the explanation of the 3 : 1 ratio, and the use of the symbols Fj, Fij, instead of the conventional F1, F2. We have perhaps unduly emphasised the small defects in what should prove an excellent introduction to the subject for those who read of it for the first time. L. D.

The Application of Logic. By Alfred Sidgwick. Pp. ix+321. (London: Macmillan and Co., Ltd., 1910.) 5*s.* net.

"THROUGHOUT this book 'formal' logic is identified not only with the logic which expressly calls itself formal, or 'deductive,' but with any logic which, like the ordinary 'inductive' logic, is, in fact, more formal than it professes to be. Wherever actual application and its difficulties are ignored, there is formality of a harmful kind."

Accordingly, Mr. Sidgwick discusses such matters as the ground of an inference, causal inquiries, ambiguity, indefiniteness, error, begging the question, distinction and definition, and the like, making constant use of well-chosen illustrative cases, and writing always in attractive and lucid style. There is some good protestation against slovenly modern usage of words. Why should "transpire" be allowed to mean "happen," "phenomenal" to mean "extraordinary"? We are much to blame in this; 'tis too much proved.

On general counts, Mr. Sidgwick views his subject from the point of view of Dr. F. C. S. Schiller.

Vergiftungen durch Pflanzen und Pflanzenstoffe: ein Grundriss der vegetalen Toxikologie für praktische Aerzte, Apotheker und Botaniker. By Dr. F. Kanngiesser. Pp. iv+49. (Jena: G. Fischer, 1910.) Price 1 mark.

THIS little work deals in a very concise form with the toxic nature and effects of various plants and plant-constituents; it is, in fact, a brief outline of vegetable toxicology.

In the first chapter the subject is dealt with from a general point of view, the symptoms that usually follow the ingestion of such poisonous or harmful substances being considered, as well as the means that may be adopted as remedies. In the following chapters a short account of the more important toxic plants and plant-constituents is given, accompanied in each case with the most striking symptoms it produces.

The author has certainly succeeded in compressing a large amount of information into a very small compass, and has produced a work that will be useful to physician and pharmacist, especially to such as reside in the country, where the accidental poisoning of children by eating toxic fruits and roots is unfortunately no rare occurrence. The book is remarkably free from error, but *Lobelia inflata, Tamus communis, Delphinium Staphisagria, Gratiola officinalis,* and some others might well have been included in the list of toxic plants, while Dr. Mitlacher's very useful work on toxic plants and vegetable drugs might have found a place in the bibliography.

HENRY G. GREENISH.

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.]*

Colliery Warnings.

DURING the past thirty years, the Colliery Warnings appearing from time to time in various leading newspapers in the British coalfields have been vigorously, even viciously, attacked by a few mining engineers and professors of mining. Two excuses have been advanced as an explanation of these onslaughts—warnings are held to be an insult to the intelligence of miners, and, although based upon recorded facts, they are diametrically opposed to theory, to the common view, and to educated opinion. It is the *theory* that forms the burden of a column article on the subject in the *Times* of January 4, and it is the *theory* which Prof. Henry Louis harps upon in NATURE of January 12, pp. 336–8.

One of the most remarkable features of the various discussions has been the refusal of the theorists to accept any facts unless these can be made, somehow or other, to support the common view. Of Darwin it has been said that "he would destroy his theory rather than ignore a fact." It is a pity that many prefer to adopt the opposite principle, and are ever ready to dismiss facts which do not support popular beliefs. When definite facts are stated showing that the Colliery Warnings are issued during the periods when nearly all our mining disasters occur, the usual retort is that the cases have little or no bearing on the matter, and yet if a misstatement is made as to the atmospheric conditions, the theorists claim that the accident is one that supports their view. Newspapers are a fruitful source of error, especially in scientific matters. The melancholy fact is that, with all the "education" of the past forty years, people appear to be more ready than ever before to swallow the most ridiculous statements appearing in the Press under the guise of scientific information.

Here is Prof. Louis entering upon a crusade against Colliery Warnings because they are not in accordance with his theory. Of course, the first impression the general reader entertains is that the professor has mastered the meteorology of the subject, but when, as a witness before the Royal Commission on Mines, on May 27, 1908, he was asked if he was acquainted with the official daily meteorological reports, his reply was: "I have seen them, but I am not familiar with them," an admission which puts him out of court. Books of newspaper cuttings, on the other hand, are far more entertaining than dry official reports, and it does not require much research to alight upon definite statements that colliery explosions have occurred under a low or rapidly falling barometer. The most glaring of them is connected with the greatest mining disaster the world has ever known—the explosion in the Courrières mine, within a few minutes of 7 a.m. on March 10, 1906, when about 1200 miners perished. Prof. Louis, doubtless, read the statement in the *Colliery Guardian*, the organ of the mining engineers, that that frightful calamity was accompanied by a "pronounced fall of the barometer." The assertion fitted in exactly with the theory, and therefore there could be no possible objection to it. The statement, however, was most inaccurate. At the very moment that the pit blew up, observations were being taken all over France and neighbouring countries, and almost before it was known that the disaster had occurred, the *Bulletin International du Bureau Central Météorologique de France* had been prepared showing the existence of a well-marked area of high pressure right over France; the barometer had been rising throughout the previous night, it was rising at the time of observation, and subsequent reports showed that it continued to rise for some time after the explosion. No amount of juggling with what was said in the papers can get over the cold, dry record of facts. The official information is public property, which Prof. Louis and all who support him can consult at leisure and at trifling cost.

In May and June, 1910, readers of the *Scotsman* were treated to a discussion of the subject, one of the critics giving the worst case in his long experience of such an issue of damp in a mine in the east of Scotland "that the airways, &c., became so foul, the miners had perforce to leave off work and clear out." This dangerous outburst was said to be associated with the glass falling an inch in the course of a few hours. It agreed precisely with the popular notion of the external fitness of things. In a subsequent communication the critic, to dispel the doubt about the barometer having dropped at an unheard-of rate, supplied readings said to have been obtained from the Kew and Glasgow records. Unfortunately for the theorists, the Glasgow values show that the decrease of pressure on each of the two occasions relied upon was exactly *an inch less* than was stated by the critic, the barometer standing very high, in the first case perfectly steady, changing only 0·005 inch (not 1·005 inches) in six hours, and in the second case declining 0·112 inch (not 1·112 inches) in six hours. These imaginary falls of more than an inch in six hours will have got into many a scrap-book for future reference.

How determined the theorists are not to attach any weight to evidence which is unfavourable to them is well illustrated by the rash condemnation of the Seaham records by a leading supporter of the low-barometer idea:—"As to Mr. Corbett's figures, they have given us much amusement, as he got results flatly contradicting simple scientific principles. The Germans at Saarbrücken similarly." Facts obtained by careful observers in different countries are thus not entitled to consideration; they only deserve to be laughed at because they are at variance with preconceived notions.

Prof. Louis and his supporters are afraid that if they give way on this question, a terrible fate awaits the world—nothing short of casting Boyle's law to the scrap-heap. But they can rest assured that no such dire calamity is indicated. Boyle's law will for ever remain unassailable; what must go by the board and to the scrap-heap is the method adopted by the low-pressure theorists to support their views. Who first started the curious idea that the barometer falls at the rate of 0·01 *inch per minute* is not known, but it is the rate used by many writers here and abroad. It was adopted by the Royal Commission of 1879–86, by Sir Frederick Abel, by the *Colliery Guardian*, and others, to show that an acre goaf charged with a yard in depth of gas would foul a ventilating current of 1000 cubic feet per minute to the extent of 4·4 per cent., and the current is consequently nearing the explosive point, which is from 5 per cent. to 7 per cent. of fouling. There are two very serious objections to this conclusion. In how many mines in the United Kingdom do the Government inspectors consider 1000 cubic feet of air per acre of gas as ample for ventilating purposes? Has anyone ever known, within the temperate zone, falls of the barometer at the rate of 0·6 inch per hour, or 14·4 inches per day? The alleged fall of an inch in six hours at Glasgow, referred to above, is a mere nothing compared with the stupendous rate beloved of mining engineers. Continental experts who have studied the subject have decided that 0·04 inch (1 millimetre) per *hour* is a very rapid fall. A rate of 0·06 inch per hour is far from being a common occurrence, and intervals of years may pass between falls of so much as 0·1 inch in an hour. To prove their case, the theorists have adopted a rate which is fifteen times greater than a very rapid fall. Even if we apply 0·06 inch per hour, or 0·001 inch per minute, and keep to the 1000-foot ventilating current, it reduces the fouling from 4·4 per cent. to 0·44 per cent., a proportion which the firemen would have very great difficulty in detecting. There is here no violation of Boyle's law, which teaches us that the expansion of the gas is proportional to the diminution of pressure, not ten or fifteen times greater. In general terms, it may be stated that with a normal ventilating current no diminution of pressure in our latitudes is sufficiently great to bring out from the open goaf a volume of gas large enough to foul the ventilation to the explosive point.

Now as to the high-pressure side of the question. Prof. Louis strongly objects to Warnings against danger during anticyclonic periods, for they upset his teaching; but the note in NATURE of December 29 last, p. 277, shows that

there is a preponderance of explosions about the time that the central areas of anticyclones lie over our own coal-fields. Until Prof. Louis can prove that this statement, made by an independent investigator, is wrong, those who study the question with an open mind will not readily acquiesce in his theory, which requires the presence of a cyclonic area to bring about a disaster. True, Mr. Dobson's report to the British Association, and the papers to the Royal and the Meteorological Societies by Messrs. Scott and Galloway, were based on the theory that a low and falling barometer was necessary; but a glance at their diagrams is sufficient to show that accidents under a high barometer were attributed to a falling barometer at some other time, Mr. Dobson going so far away as a fortnight from an explosion to get a barometric fall to satisfy the theory. But when Messrs. Scott and Galloway had completed their inquiry from the purely theoretical side, the diagrams were ready, and the percentages of accidents under different conditions had been worked out, recourse was had to the very simple device of looking up the facts. Mr. Galloway was permitted to examine a large number of report books kept at mines in Scotland in 1873. To the amazement of the authors, they "found that sometimes a sudden fall of atmospheric pressure has taken place without causing gas to appear, and sometimes gas has suddenly appeared in considerable quantity when the pressure was high and steady." Before the Royal Commission of 1879–86, an experienced mining engineer, Mr. F. Wardell, stated that from his own observation explosions occurred generally on a rising barometer; and Mr. (now Sir) Henry Hall, the well-known Inspector of Mines, declared:—"More of the large accidents that have happened in my hands have happened when the glass was high, than otherwise." Evidence in

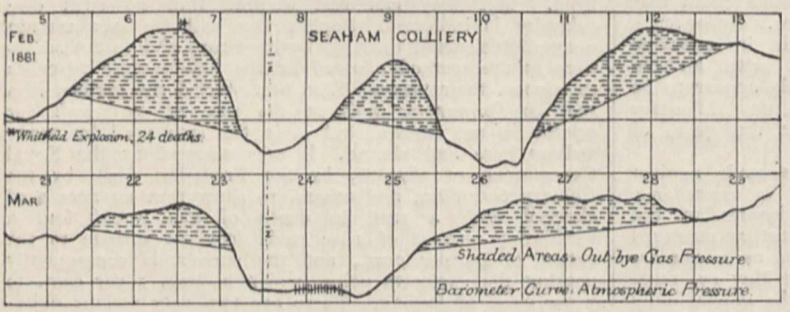


FIG. 1.

support of these statements could be multiplied to any extent, and those who are interested in the question, instead of treating the evidence as merely amusing, should seriously endeavour to arrive at a reasonable explanation of the appearance of dangerous volumes of gas in mines when the barometer is rising or stands high.

There was a time when no one guessed that the earth's crust was always on the move, wobbling like a jelly; but Darwin started a new idea, declaring that the time would come when scientific men would no more regard the earth as immovable for any length of time than they would believe in an everlasting calm in the atmosphere. Since that declaration we have advanced a long way on the road towards proving the earth's crust, no longer supposed to be a rigid mass, liable to rise and fall under the vast changes of atmospheric weight indicated by barometric variations. To miners it has been a matter of common observation that earth movements are of frequent occurrence, and the evidence before the Royal Commission of 1879 showed that strong rock-roofs are either actually forced down or become much curved, eventually recovering their normal position when the gas-pressure is diverted in some other direction. The great disaster at Abercarne on September 11, 1878, when 268 lives were lost, had been preceded by outbreaks of gas daily from September 5 to 10, consequent upon a squeeze or settling down. Since the beginning of the month high barometric pressure had ruled—30·25 inches at Abercarne on the day of the disaster.

The Seaham records demonstrate clearly that there is an intimate relationship between the movements of the barometer and the pressure of the gas existing in sealed-up places in the earth—not the gas in the open goaf, which is acted upon directly by the air-pressure. The gauge inserted in the sealed-up reservoir of the Hutton seam showed that on every occasion when the barometer rose, even as on March 24, 1881, when it was at a very low level, the imprisoned gas showed an out-bye pressure, indicating that it was being compressed (Fig. 1). When the barometer was at its lowest, the compression ceased, and the gauge indicated an in-bye pressure. Those who discussed the observations were mystified; they could not get over the facts disclosed, and the only escape from the dilemma was by deciding that it was all the fault of the barometer—that it was not sensitive enough to fall twenty, thirty, or forty-eight *hours* sooner than it does! No physicist who has studied the action of the instrument would admit that, even supposing there is any lag, it would amount to as many *seconds*. It is a more reasonable suggestion that the increase of barometric pressure weighs down the earth's crust, and this, acting upon the imprisoned gas, increases its pressure. It is under these high-pressure conditions that Colliery Warnings have been issued through three decades, and it is under these same conditions that the worst explosions take place, for they are associated with great outbursts of gas flooding the workings suddenly, and not with the almost inappreciable, regulated flow of gas from the open goaf under a low and falling barometer.

THE AUTHOR OF THE WARNINGS.

I AM delighted to find that my article on this subject has drawn a reply from the Author of the Warnings, though I must admit to disappointment at the character of his letter. In my article I stated certain facts as to the occurrence of firedamp in collieries, and showed how this gas must behave under varying barometric pressure in accordance with well-known physical laws; to my mind, there is only one proper way of controverting conclusions thus arrived at, and that is to show where I am mistaken in my statement of facts, in my enumeration of the natural laws, or in my deductions from these premises. This, however, is precisely what the Author of the Warnings has not even attempted to do; he has preferred to be guided by the old solicitor's maxim: "When you have no case, abuse the plaintiff's attorney."

I do not propose to follow the Author of the Warnings in the personal tone that he has introduced into the discussion, except to say that the theory—if theory it be—that a falling barometer is apt to correspond with an increase in the percentage of firedamp in the air of collieries is certainly not my theory, and originated long before my time. As the Author of the Warnings implies that these views necessarily connect colliery explosions with a low barometer, it seems worth while repeating that this is not my opinion; all that I maintain is:—

(1) Barometric variations are only a contributory cause, and a relatively unimportant one, of colliery explosions.

(2) A falling barometer, or, to be more precise, a flattening downwards of the barometric gradient, is apt to be accompanied by an increase in the percentage of firedamp in the air of mines.

Thus W. Köhler has shown that a slow increase in the percentage of firedamp may be due to a steady high barometer, or even to a slow rise following upon a very rapid one, *i.e.* to a flattening of the barometric gradient.

The Author of the Warnings appears to attach much importance to the Seaham Colliery records. Seeing how fiercely he has accused everyone else of only using such facts as suit them, it might be expected that he, at any rate, would be above reproach in this respect; unfortunately, however, it would be difficult to find a worse offender than he is in the use he has made of these records. In the first place, he ought to have made it clear that these records do not show gas pressure in a

mine under normal conditions; they were taken in a sealed-off portion of Seaham Colliery after an explosion and an underground fire, and thus represent what took place under an entirely abnormal condition of the mine. Apart from this point, the Author of the Warnings contrives to give his reader the impression that Mr. Corbett's Seaham Colliery records entirely favour his own views, that high barometric pressure causes an increase in firedamp in mines; so far from this being the case, however, Mr. Corbett's own words (Trans. North Eng. Inst. Min. Eng., vol. xxxii., 1882–3, p. 310) are:—"It is well known that gas is frequently found in colliery workings before any fall of the barometer commences. . . . The barometer, so far as an indication showing that gas may be expected, cannot be said to be reliable." In the discussion of this paper, Mr. J. Daglish (*ibid.*, p. 311) said that he had made experiments at Hetton Colliery, and that "the results he arrived at were precisely such as were given by Mr. Corbett, namely, that there was no connection whatever between the variations of the barometer and the prevalence of gas in the galleries of the mine." The chief witness cited in his favour by the Author of the Warnings is thus seen to give evidence quite directly against him when he is quoted correctly. Further, if the Author of the Warnings attaches the importance that he appears to do to these records of pressure, why does he not quote the very well known and much more applicable experiments of Sir Lindsay Wood, who determined the pressure of firedamp in normal coal seams by boring holes into them and inserting pressure gauges? His general conclusions (Trans. North Eng. Inst. Min. Eng., vol. xxx., 1880–1, p. 224) are:—"There is no connection between the variations of the barometrical column and the temperature with the quantities of gas evolved"; only in one set of tests, namely, at Eppleton Colliery, was any connection traceable, and, respecting these, Sir Lindsay Wood (*ibid.*, p. 182) states:—"With the barometer steadily rising, the gas pressure (with one or two exceptions, when there was an increase) steadily decreased."

Personally, I attach relatively little importance to records of pressure alone, even to such careful ones as those of Sir Lindsay Wood, Nasse, Broockmann, &c.; in the absence of analyses, it is only a conjecture that the pressure was caused by firedamp, and in the case of Seaham Colliery it is quite likely that other gases were present in large quantity. I hold that there is only one correct method of attacking this question, as has already been pointed out by Oberbergrat G. Köhler, and that is by systematic chemical analyses of the return mine air combined with barometric observations, as has been done on several occasions on the Continent, *e.g.* by Hilt at the Gemeinschaft and Alt-Gourley pits at Aachen, and, above all, by W. Köhler at the Grand Duke Frederick pits at Karwin. All the observations corroborated each other, and agree with the summary of W. Köhler:—"The proportion of firedamp in the air of the mine decreases in general with rising atmospheric pressure, and increases with falling atmospheric pressure. The proportion of firedamp increases the more rapidly the more steeply the curve of atmospheric pressure descends, and decreases the faster the more steeply the curve of atmospheric pressure rises." Harzé in Belgium and Behrens in Westphalia have confirmed these conclusions in their elaborate works on the subject. All this is the result of accurately observed facts, into none of which "theory" enters. All workers and observers in this subject have come to one of two conclusions, either that barometric variations have no decisive influence on the evolution of gas, or else that a falling barometric gradient increases the outflow of gas. Not a single writer, so far as I know, shows that a rising barometer increases the evolution of firedamp. Whilst most English authorities hold the first view, the universally held opinion in Germany is summed up thus by the well-known Saxon authority, E. Treptow:—"Im besonderen ist es als erwiesen anzusehen, dass nach einem schnellen Fallen des Barometers stärkere Gasentwickelungen stattfinden. Es ist daher die fortlaufende Beobachtung der Barometerstände von grosser Wichtigkeit; tritt ein Barometersturz ein, so ist besondere Vorsicht geboten. Ein Barometerfall von 1 mm. in einer Stunde ist schon sehr bedeutend." (In particular, it may be looked upon as demonstrated that, after a rapid fall of the barometer, stronger evolutions of gas take place. The continual observation of the height of the barometer is therefore of great importance; if a drop of the barometer takes place, special caution must be observed. A fall of the barometer of 1 mm. per hour is already very serious.)

It is facts like the above-quoted analyses that alone can decide this question; it is quite useless to inquire whether the barometer was high or low at the time of any particular colliery explosion, because a serious colliery explosion can only be brought about by the fortuitous coincidence of a number of contributory conditions, only one of which (and in all probability a relatively unimportant one) can be ascribed to the state of the barometer. The Author of the Warnings implies that my views have been influenced by newspaper statements as to the height of the barometer at the time of the great Courrières disaster; but not only do I, as I have said, regard such evidence as useless, but, above all, I would not commit the crowning absurdity of quoting in a discussion on firedamp the Courrières explosion, which is perfectly well known to have been a coal-dust explosion in a non-fiery pit.

Perhaps the most interesting point in the letter of the Author of the Warnings is his explanation of the reason why high barometric pressure must increase the percentage of gas in a pit; he believes that the increased pressure of the air squeezes down the earth's crust, and squeezes the gas out of it. I presume that he wishes this explanation to be taken seriously; but surely he has overlooked the very obvious fact that any increase of pressure on the surface of the earth, tending to squeeze gas out, is counterbalanced by an exactly equal increase of pressure upon the face of the coal in the mine, tending to keep the gas in, and that no variation of atmospheric pressure can thus disturb the previously existing *régime*. Even if this were not so, and if the crust of the earth could respond to such pressures, they are too insignificant to have any practical effect. An enormous fluctuation of barometric pressure, such as a rise of 1 inch, would correspond to a pressure on the earth's crust of only 70 lb. per square foot, or a good deal less than that of an ordinary crowd of people standing on the ground; the very suggestion that such a trifling weight can have any effect through thousands, or even hundreds, of feet of strata is so absurd as to require no refutation, and least of all to the mining engineer who has had to timber underground workings, and who knows that the roof pressure in a mine must be gauged, not in pounds, but in tons on the square foot, and that 70 lb. more or less will make no practical difference whatever. That such a theory should be relied on in defence of the Colliery Warnings surely justifies their opposition by mining engineers, and forms an emphatic endorsement of the verdict of the last Royal Commission—which, by the way, was not composed of professors of mining or theorists—upon these Warnings as *misleading and serving no useful purpose.*

H. LOUIS.

The Afterglow of Electric Discharge in Nitrogen.

IN a paper published in the current number of the Physical Society's Proceedings, I showed that the yellow afterglow produced by the electric discharge in rarefied air is due to the oxidation of nitric oxide by ozone, both substances being formed in the discharge. In a second paper, in course of publication, it is shown that several other oxidisable gases or vapours inflame spontaneously when mixed with ozone at a low pressure, and burn with phosphorescent flames of low temperature.

An afterglow in nitrogen has been recorded by Mr. Perceval Lewis (*Phys. Zeit.*, v., p. 546, 1904) which is obtained only with condenser discharges. This glow is orange in colour, and possesses a visual spectrum of three bright bands in the green, yellow, and red regions, in contrast to the continuous spectrum of the glow which I have traced to nitric oxide and ozone.

I have recently experimented with Lewis's nitrogen glow, using the method, introduced by Dewar in 1888, of drawing a continuous current of the gas through the vacuum tube into another vessel on its way to the pump.

I succeeded at once in obtaining it, when the condensed discharge was used. This glow has many interesting properties, of which a preliminary publication seems desirable.

I believe it to be due to pure nitrogen. Lewis states that it cannot be obtained from atmospheric nitrogen, but this does not agree with my experience. I have used atmospheric nitrogen exclusively.

The glowing nitrogen is unaffected by silver gauze, which quenches the ozone glows. It is destroyed by mixing oxygen with it, but merely diluted by hydrogen or ordinary nitrogen. When acetylene is led in, a bright flame is produced at the point of confluence. This flame replaces the original glow. It has a spectrum consisting of the swan and cyanogen bands, along with others not identified. If the nitrogen glow is led over iodine a magnificent blue flame is produced, contrasting sharply with the original orange glow. With sulphur the original orange glow is quenched, but no other replaces it. The sulphur becomes hot, and a metallic-looking sublimate is formed along the tube.

The most remarkable phenomena, however, are with metallic vapours, which give line spectra when the glowing nitrogen is led over them. Sodium, potassium, thallium, mercury, zinc, cadmium, and magnesium have all yielded line spectra in this way.

Investigation is being pushed on as fast as possible, but the facts so far obtained seem to point to the production of a chemically active modification of nitrogen. It is suggested, provisionally, that the spectra are developed by the chemical union of this active nitrogen with the various metals and with iodine and acetylene. The orange glow obtained with nitrogen only would, on this view, be due to the transformation of the hypothetical active nitrogen into ordinary nitrogen.

R. J. STRUTT.

Imperial College of Science and Technology,
January 30.

Singularities of Curves.

I HAVE not, at present, access to the books referred to by "T. J. I'A. B." in his letter of January 12; but he is altogether wrong in thinking that the singularity he mentions cannot be investigated by the methods explained in my "Geometry of Surfaces." An arbitrary line through the origin has sextactic contact thereat; but since the axis of x has 12-tactic contact at the origin, the latter cannot be an ordinary sextuple point, because no line through such a point can have a higher contact than septactic. The singularity is either a singular point of the sixth order or one of lower order with coincident branches passing through it, and it illustrates the necessity of drawing a distinction between ordinary multiple points and singular points. The trilinear equation of the curve can be obtained by eliminating t between $\beta=\alpha t^6$, $\alpha\gamma-\beta^2=\beta^2(t^3+t^4)$. The factor $\alpha\gamma-\beta^2$ suggests the existence of tacnodal or other branches of a similar character, and that the singularity might be transformed into a simpler one lying on a curve of lower degree than the sixteenth by using Cremona's transformation,

$$\frac{\alpha}{\alpha'\gamma'+\beta'^2}=\frac{\beta}{\beta'\gamma'}=\frac{\gamma}{\gamma'^2}$$

before applying the methods of chapter iv. of my book.

But it would have been foreign to the plan of my treatise to have introduced parametric methods when discussing singularities; moreover, the method of which the example is an illustration is only applicable to unicursal curves, whereas my own methods are independent of the deficiency. For example, the various singularities the point constituents of which are nine nodes could not be investigated by means of a unicursal curve without complicating the problem by introducing additional nodes isolated or in combination sufficient in number to reduce the deficiency to zero; and this might limit the generality of the investigation, for when the nodes exceed a certain number they are not arbitrarily situated, but lie on one or more dianodal curves.

A. B. BASSET.

January 14.

MR. BASSET now admits that he has seen neither Zeuthen's two papers of 1876 nor Jordan's book of 1893, thus practically acknowledging the accuracy of my criticism—that the treatment of singular points in his "Geometry of Surfaces" is incomplete. With this admission from Mr. Basset the matter ends, so far as I am personally concerned.

But I must enter a protest against Mr. Basset's inference that the methods of Zeuthen and Jordan are only applicable to unicursal curves; since Mr. Basset has not read the work in question, his only reason for this statement is the fact that the example in my first letter happens to be a unicursal curve. This example was made up so as to provide a simple illustration of the general methods; but these methods hold good for curves of any deficiency.

It is absurd to suggest that parametric methods cannot be used for any algebraic curve; of course, the coordinates are expressed in the form of infinite series (convergent near a particular point of the curve) instead of terminated series. Mr. Basset's objection to using parametric methods would be quite justified if he had provided us with a satisfactory substitute; but he gives no *systematic* plan for resolving an assigned singularity, and this is the main object of the parametric method as used by earlier writers.

T. J. I'A. B.

FRANCIS GALTON.

FEBRUARY 16, 1822—JANUARY 17, 1911.

THE death of Francis Galton marks, not only the removal of another link with the leaders of the great scientific movement of the nineteenth century—represented by Darwin, Kelvin, Huxley, Clerk-Maxwell, and Galton in this country—but something far more real to those who have been in touch with him up to the last, namely, the cessation of a source of inspiration and suggestion which did not flag even to the day of his death. The keynote to Francis Galton's influence over the science of the last fifty years lies in those words: suggestion and inspiration. He belonged to that small group of inquirers, who do not specialise, but by their wide sympathies and general knowledge demonstrate how science is a real unity, based on the application of a common logic and a common method to the observation and treatment of all phenomena. He broke down the barriers, which the specialist is too apt to erect round his particular field, and introduced novel processes and new ideas into many dark corners of our summary of natural phenomena.

The present writer remembers being asked some years ago to provide a list of Francis Galton's chief scientific achievements for use on a public occasion. It did not seem to him that a list of isolated contributions, such as the establishment of anthropometric laboratories, the introduction of the composite photograph, the transfusion experiments to test pangenesis, the meteorological charts and improved nomenclature, the practical realisation of the possibilities of finger-print identification, the demonstration of the hereditary transmission of the mental characters in man, the law of regression, the idea of stirps, or the foundation of the novel science of Eugenics, fully represented the nature of the man. What is the spirit of the contributions—large and small, almost two hundred in number—which Francis Galton made to the science of the last sixty years?[1] The unity of those contributions lay largely in the idea that exact quantitative methods could be applied, nay, rather must be applied, to many branches of science, which had been held beyond the field of either mathematical or physical treatment. In this manner his inspiration and suggestion tended to give physical and mathematical precision to a large number of outlying sciences, to meteorology, to anthropology, to genetics,

[1] His first contribution dates from 1849 and concerns a method of printing telegraphic messages at the receiving station.

and to sociology. In this idea itself there is nothing novel; many of the world's great minds have realised the same truth. What did Roger Bacon say towards the middle of the thirteenth century?

"He who knows not mathematics cannot know any other science, and what is more, cannot discover his own ignorance or find its proper remedies."

How was it echoed again, full two hundred years later, by Leonardo da Vinci?

"Nessuna humana investigatione si po dimandare vera scientia s'essa non passa per le mattematiche dimonstrationi." *Libro di pittura* i. 1.

We wait another century and hear Lord Bacon's aphorism :—

"The chief cause of failure in operation (especially after natures have been diligently investigated) is the ill-determination and measurement of the forces and actions of bodies. Now the forces and actions of bodies are circumscribed or measured by distances of space, or by moments of time, or by concentration of quantity, or by predominance of virtue; and unless these four things have been well and carefully weighed, we shall have sciences, fair perhaps in theory, but in practice inefficient. The four instances which are useful in this point of view I class under one head as *Mathematical Instances* and *Instances of Measurements*."

The words actually used by Lord Bacon for his third and fourth instances are "per unionem quanti aut per prædominantiam virtutis." They cover very fully the sociological, psychological, and genetic phenomena which Francis Galton kept so closely in view.

Another hundred years, and again a great thinker echoes the same idea :—

"Ich behaupte aber, dass in jeder besonderen Naturlehre nur so viel eigentliche Wissenschaft angetroffen werden könne, als darin Mathematik anzutreffen ist." Kant: *Metaphysische Aufangsgründe der Naturwissenschaft.* Sämmtliche Werke, Bd. iv., S., 360. Leipzig, 1867.

Lastly, coming down to our own age, the great contemporary of Galton, Lord Kelvin, wrote :—

"When you can measure what you are speaking about and express it in numbers, you know something about it, but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind."

Clearly, then, Francis Galton was far from originating the idea that exact quantitative methods are applicable far beyond the range of the physical sciences. Wherein lies then his significance for the science of to-day and, perhaps, more still for the science of the future? Not solely in the fact that he sketched in broad lines the manner in which quantitative methods could be applied to many branches of descriptive science, but that without being a professor or teacher of students, he succeeded in creating a school of enthusiastic disciples who, inspired by him, have carried his work and his suggestions into practice in craniometry, anthropology, sociology, genetics, and medicine. The elements in Galton's character and life which made this achievement possible for him are manifold. Heredity, tradition, education, economic independence, all played their parts, and not least among these stands hereditary temperament. No younger man who knew Francis Galton at all intimately failed to be influenced by his marvellous keenness, his wide but wise generosity of suggestion and practical help, and above all, his equable and lovable personality. His manifest pleasure and gratitude for the simplest little thing done for him; his complete respect for the time and duties of others, whether they were his friends or the servants of his own household, produced a reverence which worked its effect, not only on his immediate environment, but upon the men who carried his inspirations and suggestions into practical science.

The exact biological bearing of religious differentiation upon the creation of human types has, perhaps, never been fully studied. The doctrines of George Fox drew together many men and women of a kindred spirit, and the stringent regulations as to outside marriage led not only to a union of similar natures, but, we venture to think, almost created a biological type. Not only did the Society of Friends unite men religiously, but it produced special temperaments genetically. Even to this day it is strange how men whose families have ceased to be Quakers, yet find that their common sympathies and temperaments arise from Quaker descent. Galton owed the evenness of his temper, his placid acceptance of criticism, but his power of steady persistence in his own work and his own views, very largely to his Quaker ancestry, to the Galton and Barclay blood. The fact that Galton was never in controversy was, of course, partly due to the novelty of many of his methods and ideas; they were beyond his generation, which left them largely on one side. Even his work on the heredity of the mental and moral characters in man was looked upon as merely academic, and its real bearing on social habits is only now being realised and pressed home.

For one man who had read "Hereditary Genius" (1869), "Human Faculty" (1880), and "Natural Inheritance" (1889), there were ten who had studied "The Origin of Species" or "Man's Place in Nature." But the former were the natural sequel to the latter, and Galton realised at once not only, as Darwin and Huxley did, that the new doctrines applied to man, but also that they must eventually be preached as a guide to human conduct in social activities. Looked at from this aspect, his labour to make anthropometry in both its physical and psychical branches an exact science; his discovery that new types of analysis are wanted to replace mathematical function in biological and social studies, and lastly, his advocacy of Eugenics—the science of the right breeding and training of man—are seen to be successive steps in a continuous ascent. The positive conception that science exists to serve man, and that its highest function is not merely to supply his material wants, but to show him how to elevate himself by obedience to biological principles, was the crowning conception of his life. He lived to see the wide appreciation of his teaching in both Germany and America, and, to perhaps a lesser extent, in Great Britain. But he did not live to see the controversies which will inevitably arise, as the world in general more clearly realises that not all its customs, not all its beliefs, not all its supposed morality and charity, are consonant with scientific knowledge.

But if the fact that Galton was never in controversy had partly a basis in the historic evolution of ideas, it was also deeply rooted in his temperament, the temperament of one portion of his stock. He considered criticism, not as it affected the reputation of his own work, but as it affected his own estimate of the validity of his own work, and he adopted it or passed it by accordingly. Only once do I remember on a public occasion a slight severity in his usually gentle tone. A medical man of distinction, speaking obviously without any knowledge of the literature of the subject, had asserted that the supposition that the children of parents with certain mental and moral peculiarities would reproduce these features, arose from a totally false conception of what the laws of heredity are. The mental and moral aptitudes were for the speaker

outside the purview of hereditary investigation. Galton's reply was very simple: Much of what his critic had said "might have been appropriately urged forty years ago, before accurate measurement of the statistical effects of heredity had been commenced, but it was quite obsolete now."

That is the extreme limit to which Galton's Quaker temperament ever, in the presence of the present writer, allowed him to reply, and here it was a question of checking a vague assertion which swept away the best part of a man's life work unexamined. That this calmness of mental attitude was very largely innate and not due to environment, is well brought out by a quaint little biography of the first eight years of his life, written by his mother (Violetta Galton—half-sister of Charles Darwin's father) when he went to a boarding-school in 1830.[1] His after-tastes and temperament, his great good nature, his calm temper, his resourcefulness and courage,[2] are sufficiently indicated by a mother who was closely observant, but who could have no knowledge of the future distinction of her youngest child. A further fundamental factor of Galton's mental outfit was his extraordinary mechanical ingenuity. This may also have been a Darwin heritage, for it has been shown by other members of the stock. At the same time his paternal grandfather, Samuel John Galton, was not only a statistician, but a man of mechanical tastes and a friend of Boulton and Watt, and the same form of ability was markedly evidenced in another grandson, Sir Douglas Galton.

Francis Galton had the mechanical ingenuity which makes a great engineer or experimentalist; his suggestions were always of the simplest kind, and he used the simplest constructions and the simplest materials. Most of his friends will remember his delight in some almost primitive solution of a mechanical difficulty, that possibly they had themselves pondered over and brought to him in despair. Nothing worries the secretary of a scientific society or the editor of a journal more than the vagaries of an author who provides diagrams wholly unsuited to the page-size of their publications; Galton would be ready with a photographic method of modifying the linear scales in different ratios in two directions. Nothing is more trying at lecture or theatre than the tall person or hat; Galton had his "hyperscope"—a simple tube with two reflecting mirrors at 45° by which he saw over or round them, and he would use it in a crowd when he wished to see what was going on beyond it. Or he would carry a wooden brick in a parcel with a long string attached to it; slowly lowering it in a crowd, he would stand on his block of vantage, and raise it again by its string afterwards without attracting observation. Elsewhere it has been said that, if one wanted to put a saddle on a camel's back without chafing it, to manage the women of a treacherous African tribe, to measure a snail's shell, or to work a theodolite in the midst of London traffic, Galton would tell you how it might be done.

Beyond mechanical ingenuity[3] he had great wealth of illustration; what he could possibly represent to the eye, he would do, for he had a firm belief that graphic representation is more impressive than mere numbers. Within a fortnight almost of his death, seated outdoors in a shelter, he was discussing with the present writer as eagerly and keenly as he would have done twenty years ago, the best method of graphically representing and comparing typical racial crania.

Through the last years of life, apart from his eugenic work, he was very busy in trying to deduce quantitative measures of general likeness; evidences of this were given in his letters on portraiture to this *Journal*, and in his attempts to make a graduated scale of "blurrers," which like a photometric wedge would equalise divergence until differentiation of the two compared portraits became impossible. Photographs of members of the same family—"similar and similarly situated," as the mathematicians have it—"blurred" more readily than those of strangers in blood. These things amount, not to complete fulfilments, but to suggestions and inspirations. But Francis Galton realised among the earliest that a comparison of the individual organs and characters of local races needs supplementing by a comparison in some manner of two "index" numbers, which by their deviation shall measure the similarity or diversity of these races, each as a unit complex of many individual characters.

Judged from the modern specialist standard, Galton was, perhaps, not a "mathematician," but he had enough mathematics for most of the purposes of scientific observation, and he knew how to enlist mathematical aid when he required it. Few of those who have really studied his work or come in contact with his singularly clear and logical mind, would have wished his education other than it was. The training in observation provided by hospital clerking under a good clinical teacher, could never have been replaced with profit by years spent over symbolic analysis; the man who would patiently watch the workman in a foreign country plying his chisel or trowel in order to learn differentiation of method in craftsmanship, and then take a lesson himself in handling the tool in the native way, was a born observer, whose talents lay in other fields than the higher abstract analytic. Yet the essential feature of his work was, and his reputation with the future will largely depend on, his extension of analytical methods to the descriptive sciences. Without Gauss the work of Quetelet would have been impossible. Without Quetelet we should perhaps have missed Francis Galton, and from Galton and his school the new methods have spread, and are spreading into the most varied branches of science; in medicine both treatment and diagnosis will be influenced by them, in physiology and psychology their advantages are being admitted, in biology, anthropology, sociology and its latest offspring—eugenics—their importance has been fully recognised. And wherein does the validity of this new treatment consist? It lies very simply in this, that Galton following Quetelet recognised that causation expressible in terms of mathematical function was not the only, or even the chief category, under which men of science can work; that exact methods were applicable to that looser relation or association, which now passes by the name of correlation. To Galton is due the honour of having reached the first simple measure of this relationship, and in the earlier writings of his keen disciple Weldon, we find it called "Galton's Function," a name which had to be dropped as the conception became more general and its types differentiated and classified. It ceased to be possible to call after its discoverer a philosophical category wider than that of causation, and embracing causation as a subclass.

The history—at least, the formal history—of his discovery is very suggestive of the man and his method. He had been studying the size of organs in parents and their offspring, and he formed what is now termed a correlation table; that numerical table he sought to

[1] Would it be safe to suggest that Galton inherited from his Darwin mother his views on family history? Is "The Life History Album" (Macmillan, 1884 and 1903) with its spaces for observations and photographs of the child, a lineal descendant of this biography with silhouette illustration?

[2] This was of much value to him in his later travels. When five years old his mother took him into a field where the servants were trying to catch some geese. Francis immediately ran among them and seizing the old gander by the neck brought him to his mother muttering at the same time to himself the lines from "Chevy Chase":

"Thou art the most courageous knight,
That ever I did see —— ——"

[3] Many of the contrivances devised for his first Anthropometric Laboratory are still in current use.

represent graphically, and to his delight and surprise the rough contour lines, which he drew on the table itself, had the appearance of a family of similar and similarly situated ellipses. The line which joined the means of the organs of the offspring for a given organ in the parent was seen to be straight, and to be the locus of the points of contact of a system of parallel tangents to the ellipses. Galton had reached from his graph the fundamental idea of the simplest type of correlation surface—the generalised Gaussian with linear "regression," and he was not slow to realise its great importance and its wide application to the inter-relationship of contemporaneously varying or associated phenomena. He summoned mathematical aid, and with the help of Mr. Dickson determined the form of the Gaussian frequency surface. Years afterwards it was discovered that the mathematics of that surface had been worked out by Bravais, in considering the distribution of shots over a target. Nowadays we know that there are frequency surfaces which are not Gaussian. Wherein then does the transcendant importance of Galton's work lie? Why, in the fact that he was *not* considering shots at a target, but that he was seeking for a key to open a door for exact quantitative methods into the whole wide range of vital phenomena. From Bravais' mathematical treatment of the Gaussian surface nothing followed, until Galton independently rediscovered it with no idea of shots at a target in his mind, but with the idea of investigating problems in genetics, in evolution, and in sociology.

His work first pointed out to us how the whole field of nature lay open to exact numerical treatment, if we dropped the category of causation and adopted that of correlation.[1] Not from Bravais' mathematics, but from the suggestion and inspiration of Galton's contour lines on his table of observations, has sprung the whole body of modern statistical theory. The problem of evolution, and the study of heredity, were for Galton actuarial problems. Needless to say, he did not place on one side the study of individuals, he was ever in sympathy with individual observation and experiment. But, as the late Prof. Weldon expressed it in a sentence which had Galton's hearty assent, "the actuarial method must be an essential part of the equipment of any man who would make and understand such experiments." It was in this very sense that Galton initiated the Royal Society "Committee for conducting Statistical Inquiries into the Measurable Characteristics of Plants and Animals." And for a long time he had in mind the eventual foundation and endowment of an experimental station for variation, heredity, and selection, treated by statistical methods. If his gift to posterity be now found to have taken another form from his original idea, the change is not unassociated with his views on the need for adequate statistical treatment, or with the change of purpose and method which led to his withdrawal from the Evolution Committee.

If we turn from the inspiration and suggestion provided by Galton in many varied forms of inquiry to his actual contributions to our knowledge, two will occur to the minds of most readers, not necessarily because they are the most important, but because some statement of them has crept into elementary text-books and popular works on science. The first of these is the oft-quoted "Law of Regression"; it was not originally a theoretical deduction but deduced by Galton from his own measurements and observations on individuals. It amounts to the statement that if in a stable population—*i.e.* one in which no selection is taking place, and which is mating at random—a group of all the parents be selected which have a character of a given intensity, then the average of the same character in their offspring will be nearer to the mean of the whole population than the parental value. As Galton stated this statistical result, it has been over and over again verified by mass-investigations. But it has been singularly often misinterpreted by commentators. One group of them extended it into a general law that all populations tend to regress to mediocrity, if we suspend natural selection; they quite overlooked Galton's statement that the population was *stable*. No such general regression to mediocrity was involved in Galton's law of regression; it was a statistical law of distribution of offspring resulting from the *stability* of the population. Another group of critics selected certain special parents, overlooking Galton's word "all," and endeavoured to show that the law did not apply to their offspring, and must therefore be erroneous. The fact is that the very law itself, when applied to the offspring of somatically selected ancestry and not to all parents of the class, shows the cessation of regression, and it is upon this very cessation of regression for selected sub-classes that the general stability of the Galtonian population depends.

The second contribution to the theory of heredity with which Galton's name has been generally associated is that termed the "Ancestral Law of Heredity." The conception Galton had in mind was the following one: in a population mating at random and stable in character, what would be the *average* relation of each class of individuals in the new generation to each grade of their ancestry? Naturally, he measured the relation by his new method of correlation, practically by aid of the steepness of his regression lines. The degree of resemblance to successive grades of the ancestry was found to diminish in a geometrical progression. The exact numbers reached by Galton from his data ($\frac{1}{4}$, $\frac{1}{16}$, $\frac{1}{64}$, &c.) have not been verified by further observation. But the fundamental features of his method, the idea of applying multiple regression and the diminution of the degree of resemblance in a geometric series, have been found correct. Indeed, we now realise that almost any determinantal theory—including that of Mendel—leads directly to Galton's Law of Ancestral Heredity as stated above. No direct test of adequate[1] character has yet been made on Galton's Law, as it is commonly cited—a form which he originally stated himself with great hesitation ("Natural Inheritance," p. 136), and which does not appear wholly in accord with other parts of his observational or theoretical treatment. Strange as it may seem, no one has yet worked out the relationship corresponding to the usually stated form of Galton's Law for a simple Mendelian population breeding at random; the theoretical investigation of it is beset with many analytical difficulties and not a few logical pitfalls. All the criticisms of this law have turned on results deduced from selected gametic ancestors.

It has been asserted with some plausibility that Galton's deductions would cease to be of any value

[1] "The conclusions: . . . depend on ideas that must first be well comprehended, and which are now novel to the large majority of readers and unfamiliar to all. But those who care to brace themselves for a sustained effort, need not feel much regret that the road to be travelled over is indirect and does not admit of being mapped beforehand in a way they can clearly understand. It is full of interest of its own. It familiarizes us with the measurement of variability and with curious laws of chance that apply to a vast diversity of social subjects. This part of the inquiry may be said to run along a road on a high level, that affords wide views in unexpected directions, and from which easy descents may be made to totally different goals to those we have now to reach. I have a great subject to write upon, but I feel keenly my literary incapacity to make it easily intelligible without sacrificing accuracy and thoroughness."—(Francis Galton, "Natural Inheritance," 1889, p. 2). It is those "easy descents" to "totally different goals" which have proved very arduous, not because they were not obvious and easy so soon as the "high level road" had been made, but because they turned out to lead into strictly preserved but largely untilled "strays."

[1] Certain investigations have been made, but in every case they will be found not to fulfil the conditions as to average relations, which Galton laid down. Galton's own material for "Basset Hounds" is really inadmissible, for there is scarcely any doubt about the fictitious character of many of the putative sires.

if we could discover the physiological causes of heredity. To this, we think, answer may be made that Nature does not work like the breeder by testing gametic qualities. She proceeds by selecting with stringency certain grades of somatic qualities, and the intensity of quality, not the gametic value of the individual is her index to survival. Without some degree of correlation between somatic character and gametic value, the Darwinian theory must collapse. This point Francis Galton had ever in mind, and his views on heredity, and his treatment of the subject, always turned on the effect of somatic selection of the ancestry in modifying the somatic characters of the offspring. Hence the establishment of a definite theory of physiological heredity would at once have to be followed by a theoretical deduction from that theory of the degree of resemblance between somatic characters in ancestry and offspring in a population living under natural conditions. The questions of fertility and death-rate in such a population are actuarial studies. No physiological inquiry as to heredity can supersede those studies, but such an inquiry may well confirm, or it may modify, the laws originally stated by Francis Galton for populations mating at random. So far as it is possible to judge at present, current physiological theories of heredity tend rather to confirm than refute Galton's conclusions.

Of the work of the last decade of Galton's life, it is possibly too early yet to speak with any decisive judgment. Darwin, writing to Wallace in 1857, uses the following words:—

"You ask me whether I shall discuss 'man.' I think I shall avoid the subject as so surrounded with prejudices, though I fully admit it is the highest and most interesting problem for the naturalist."

Darwin's later writings testify that he did not avoid the subject, but probably the existence of the prejudices to which he refers prevented him from accentuating the direct practical bearing of the doctrine of evolution on human conduct. The result of this attitude of the earlier evolutionists was that their strength was opposed to one wing only of the army of intellectual inertia. Their critics were theologians and metaphysicians; there was no question raised of the bearing of evolution on social habit. Evolution appeared merely as a problem of a man's intellectual attitude towards the universe, it was a philosophical belief, not a practical code of conduct. Francis Galton's Huxley lecture of 1901 "On the possible Improvement of the Human Breed under existing conditions of Law and Sentiment," slender as it seemed at the time, was really the clarion call which told us that the time was ripe for the recognition that the doctrines of evolution and heredity were more than intellectual belief, they were destined to control the conduct of men in the future and determine the relative efficiency of nations. Others may have thought, some may have said, the same thing before;[1] but to Francis Galton belongs the credit of having said it at the psychological moment, and said it with the emphasis that made many earnest men and women understand its gravity. Later, in his paper of 1904, "Eugenics: its Definitions, Scope, and Aims," Galton more closely defined the lines of development he had in view for the new science:—

"Persistence in setting forth the national importance of eugenics. There are three stages to be passed through: *firstly*, it must be made familiar as an academic question, until its exact importance has been understood and accepted as a fact; *secondly*, it must be recognised as a subject the practical development of which deserves serious consideration; and *thirdly*, it must be introduced into the national conscience, like a new religion. It has, indeed, strong claims to become an orthodox religious tenet of the future, for eugenics cooperate with the workings of Nature by securing that humanity shall be represented by the fittest races. What Nature does blindly, slowly, and ruthlessly, man may do providently, quickly and kindly. As it lies within his power, so it becomes his duty to work in that direction; just as it is his duty to succour neighbours who suffer misfortune. The improvement of our stock seems to me one of the highest objects that we can reasonably attempt. We are ignorant of the ultimate destinies of humanity, but feel perfectly sure that it is as noble a work to raise its level in the sense already explained, as it would be disgraceful to abase it. I see no impossibility in eugenics becoming a religious dogma among mankind, but its details must first be worked out sedulously in the study. Over zeal leading to hasty action would do harm, by holding out expectations of a near golden age, which will certainly be falsified and cause the science to be discredited. The first and main point is to secure the general intellectual acceptance of eugenics as a hopeful and most important study. Then let its principles work into the heart of the nation, who will gradually give practical effect to them in ways that we may not wholly foresee."

We have cited the whole paragraph, for it is essentially typical of the man, and some word of his message to his nation may fitly appear here. Conspicuously moderate in tone, the study at each point placed before the market-place, it was, indeed, a wonderful appeal for a man more than eighty-two years of age to make from the public platform. It signified that the time was ripe for the labours of the biologist to be turned to the breeding of man. Galton called upon the biologist, the medical man, and the sociologist to grasp what evolution and heredity mean for man, to make out of their science an art, and work thereby for the future of their nation. Nor has that appeal miscarried; its effect may be traced even amid the din of controversy and clash of diverse opinions in almost every recent book, or discussion of heredity or evolution. Those of us, who initially doubted the wisdom of propagandism beyond the academic field, have lived to see a very wide public impression made, not only in this country, but notably in Germany, America, and some of our colonies. If that movement remains within the lines Galton assigned to it—"no overzeal leading to hasty action" which will "cause the science to be discredited"—then we firmly believe that to the future Galton's life will appear as a rounded whole—the youth of experience and observation, the manhood of development and discovery of method, the old age of practical application.

His school and disciples have lost a leader, but not before he had lived to put the final touches to his work. Of his generosity and helpfulness, his personal modesty and simplicity of nature, many of those who came in touch with him can bear evidence by remembered talk, by letter, and by act. Someday, perhaps, these things may be put together as a memento of

[1] For example, Sir W. Lawrence wrote in 1819:—"The hereditary transmission of physical and moral qualities, so well understood and familiarly acted on in the domestic animals, is equally true of man. A superior breed of human beings could only be produced by selections and exclusions similiar to those so successfully employed in breeding our more valuable animals. Yet, in the human species, where the object is of such consequence, the principle is almost entirely overlooked. Hence all the native deformities of mind and body, which spring up so plentifully in our artificial mode of life, are handed down to posterity and tend by their multiplication and extension to degrade the race. Consequently the mass of the population in our large cities will not bear a comparison with that of savage nations, in which, if imperfect or deformed individuals should survive the hardships of their first rearing, they are prevented by the kind of aversion they inspire from propagating their deformities." What finer text for the eugenist? But Lawrence spoke to a nation still flushed with Waterloo, while Galton, eighty-five years later, appealed to its grandchildren still smarting from South African defeats, and dimly conscious that all was not well with either its physical or mental vigour.

the man whose teaching has just ended, but whose life-work has only begun to run its course. Rewards came to Francis Galton—medals, honorary degrees, corresponding memberships of many learned societies—they came unsought, but not unappreciated. His very modesty made him take an almost childlike joy in these recognitions of his worth, and the present writer remembers with what pleasure, but a few weeks ago, Galton showed him his recently received Copley medal. But these things were not of the essence of his life. Few men have worked so little for reputation and so much for the mere joy of discovering the truth. His three chief pleasures in life were first to discover a problem, secondly to solve it by a simple but adequate process, and thirdly to tell a congenial friend of the problem and its solution. What he cared chiefly for was the sympathy of men who appreciated his special type of work and understood its relation to human progress. Had he spoken of himself and his feelings, which he rarely did, he would, we think, have described his purpose in life much in the words of Huxley :—

"To promote the increase of natural knowledge, and to further the application of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction which has grown with my growth and strengthened with my strength, that there is no alleviation for the sufferings of mankind except veracity of thought and action, and the resolute facing of the world as it is when the garment of make-belief, by which pious hands have hidden its uglier features, is stripped off."

But in the fulfilment of his purpose Francis Galton was an optimist. He believed that man can not only physically control his environment, but with fuller biological knowledge his future development. Not on this or that contribution to the records of science, but on the justification of this belief, will depend his fame in the roll of the ages. There are some of us who believe that among the great names cited at the commencement of this paper, Galton's will not be the last, for he has given an inspiration which will grow to full fruition. Our country has been the land of dominant scientific ideas rather than of massive contributions to the records of science—gravitation, the survival of the fitter, the electromagnetic theory—may we yet add—the biological control of human development? If so, the name of Francis Galton will be closely associated with the coping-stone of the edifice, which had its foundations first securely laid by his half-cousin, Charles Darwin.

MEGALITHIC MONUMENTS AND PREHISTORIC CULTURE IN THE WESTERN MEDITERRANEAN.[1]

AMONG the many questions to which the attention of the British School at Rome is now directed none is of more interest and importance than the exploration of the megalithic remains and primitive culture of the western Mediterranean which is now in progress.

Sardinia, much the most promising field of study, is in the hands of Dr. Mackenzie, the value of whose report is greatly increased by the admirable plans prepared by Mr. F. G. Newton. First among these remains come the Nuraghe or fortified towers, of which more than one type has been identified. The most primitive form is perhaps the simple strong tower of circular shape, to which succeeded the type represented by that of Voes, a massive triangular building, having four circular chambers on the ground floor and a central unroofed courtyard opening into a massively constructed corridor leading to smaller inner rooms. Above this was a second storey, now ruined, which may have formed the living part of the house and the abode of the women, while the lower floor was occupied partly by guards and attendants and partly used as storehouses. These forms soon develop into more complex types, until we reach an elaborately fortified enciente with massive corner towers, like that of Nossia. Dr. Mackenzie reasonably suggests that in the Bronze age the lords of these Nuraghe may have possessed only limited sovereignty, and that these elaborate fortifications were designed in the event of incursions by the neighbouring local chiefs.

The chief interest of the report lies in the fact that for the first time a seriation of the dolmens is attempted, and that these are now brought into relation with the Nuraghe. First comes the dolmen in its primitive form, familiar in western Europe—a massive slab resting on upright supports and forming a rude chamber. The next stage is illustrated by the monument at Maone, which, instead of being a mere cella with vertical supports, is partly hewn into the sloping rock, partly built up with rough coursed masonry, on the top of which rests the cover-slab. Then comes the form, represented by the dolmen of Su Covecco, which is on the point of being elongated and becoming a so-called "Giants' Tomb." In the latter the apse-like arrangement persists, but the cella and well of the enclosure are much extended, and exhibit a whole series of cover-slabs instead of the single massive stone in the primitive dolmen type. The structure thus often simulates the form of an inverted boat, like the Naveta tombs of the Balearic Islands, which gained their name from this fact. They were perhaps designed to symbolise the boat which conveyed the souls of the people, immigrants from beyond the sea, to a place of rest across the ocean. But the original dolmen type seems to have survived into this later period, and in one case the tomb is provided with a secret entrance, which may have been intended for subsequent interments, while the smaller portal hole in the front was reserved for the periodical rites in honour of the ancestral spirits.

Mr. Peet's report on the prehistoric period in Malta is mainly devoted to a criticism of the views of Albert Mayr, who regarded the culture of prehistoric Malta as mainly Ægean. Mr. Peet, dealing in succession with the arguments based on the use of overlapping or splayed masonry, the occurrence of the spiral form of ornament, and the baetylic or pillar worship, points out that none of these have special Ægean or Mycenæan provenience, and while not denying the existence of Ægean culture in Malta, he regards it impossible to attribute all that appears in the island to this source.

It may be hoped that the establishment of a new society for the promotion of Roman studies will give a fresh impetus and supply increased resources for the survey which has been so well started by Dr. Mackenzie and Mr. Peet.

[1] "Papers of the British School at Rome." Vol. v. Pp. xiv+471+47 plates. (London: Macmillan and Co., Ltd., 1910.) Price 42*s.* net.

THE FLIGHT OF BIRDS.

TO *La Nature* for December 11, 1910, M. Lucien Fournier contributes a well illustrated article on the flight of birds. One of the pictures, showing various positions taken by the wings of gulls in flight, is here reproduced. Three other of the illustrations, namely

a flight of gulls, a stork leaving its nest, and a flying vulture, are particularly good.

The author separates birds into four groups, according to the characteristics of their flight, as follows:—(1) Wings always flapping; (2) flapping alternating with downward gliding; (3) Flapping and gliding with maintained level; (4) gliding and soaring only.

This classification can hardly be considered satisfactory. It is suggested that a bird can fly without any expenditure of work provided that there is even a slightly variable wind, and the article concludes with the hope that the day is not far distant when (by proper automatic devices to take advantage of wind variation) flying machines will be able to do without engines.

In reality no bird or flying machine can maintain its level or rise in still air or in a uniform horizontal wind without the expenditure of power, and although it is true that power may be gained from the air by a proper utilisation of the differences of the horizontal velocity in the different regions traversed, these differences would have to be large even for the sustenance of long-winged birds, and there is no direct evidence that this kind of flight is habitual with them.

It is not improbable, however, that with their long experience birds have found out its possibility, and the skimming of some birds near the surface of the waves, where the variations of velocity are great, may be a case in point, but there can be little doubt that when flying at a considerable height birds depend for their support on an upward component in the velocity of the wind.

A. MALLOCK.

A group of Gulls in flight, showing various positions of the wings of birds.

SCIENCE AND LITERATURE.

AN eloquent address on language and literature was delivered on January 27 by Lord Morley of Blackburn, as president of the English Association. Parts of the address dealt with the relation between science and letters, with particular reference to the use of scientific knowledge in poetry, and the antithesis between documentary fact and artistic style. Science aims at concise and truthful expression; and while Lord Morley testified to the value of its influence upon literature, he doubted whether scientific ideas had inspired even Tennyson to the best verse, whether the desire for fact scientifically recorded is not a misfortune in the treatment of modern history, and whether concentration upon scientific truth has not a deadening effect upon emotional conceptions and pleasures.

Lord Morley's tribute to some scientific masters of clear and simple exposition resigns us to his subsequent conclusions. Keats could not forgive optics for robbing the rainbow of its wonder and mystery, and Lord Morley seems to suggest that the literary art which deals with scientific studies and results is not of the highest. But poetry is imagery, and new images of Nature are made possible by every discovery of the attributes and meaning of the things around us. The poetry which neglects advances of natural knowledge becomes conventional in form and substance, concerning itself only with the wonders of childhood because it does not understand the higher and grander mysteries which science has failed to penetrate. His-

tory is concerned with the accumulation and consideration of facts with the view of arriving at correct conclusions from them; and in this respect it must be studied by the methods of science, though the human factor makes the problems more difficult than when material things only are involved. There is, however, no intrinsic reason why Gibbon's majesty of historic conceptions, and the symmetric grandeur of his design, should not be combined with such great learning as was displayed by Lord Acton. Accurate knowledge must surely not be considered as antithetic to perfection of style.

The instance of Darwin's loss of interest in poetry and music proves little. A wide search through the biographies of distinguished men of science will only reveal two or three cases in which devotion to studies of Nature has resulted in the atrophy of æsthetic faculties. Close concentration upon any particular subject often leads to indifference to the aims and work of others; but this is as true of art, or poetry, or music, as it is of science. There is less reason for believing that the man of science has usually no taste for literature, music, or other forms of refined and imaginative expression, than there is for concluding that artists, musicians, and poets have no interest in the attentive study of natural objects and phenomena. If science and documentary evidence are responsible for an age of prose, it is because the poets have been spinning cobwebs from their brains when they ought to have been learning something of the spirit and achievements of science. These are they who, having never entered upon scientific pursuits, are, to use Herbert Spencer's words, "blind to most of the poetry by which they are surrounded."

Subjoined are some extracts from Lord Morley's address—

Let me offer a few words on the effects of the relations of letters and science. We may obviously date a new time from 1859 when Darwin's "Origin of Species" appeared, and along with two or three other imposing works of that date launched into common currency a new vocabulary. We now apply in every sphere, high and low, trivial or momentous, talk about evolution, natural selection, environment, heredity, survival of the fittest, and all the rest. The most resolute and trenchant of Darwinians has warned us that new truths begin as rank heresies and end as superstitions; and if he were alive to see to-day all the effects of his victory on daily speech, perhaps he would not withdraw his words. That great controversy has died down, or at least takes new shape, leaving, after all is said, one of the master contributions to knowledge of nature and its laws and to man's view of life and the working of his destinies.

Scientific interest has now shifted into new areas of discovery, invention, and speculation. Still the spirit of the time remains the spirit of science, and fact and ordered knowledge. What has been the effect of knowledge upon form, on language, on literary art? It adds boundless gifts to human conveniences. Does it make an inspiring public for the master of either prose or verse? Darwin himself made no pretentions in authorship. He once said to Sir Charles Lyell that a naturalist's life would be a happy one if he had only to observe and never to write. Yet he is a writer of excellent form for simple and direct description, patient accumulation of persuasive arguments, and a noble and transparent candour in stating what makes against him, which, if not what is called style, is better for the reader than the finest style can be. One eminent literary critic of my acquaintance finds his little volume on earthworms a most fascinating book even as literature. Then, although the controversial exigencies of his day affected him with a relish for laying too lustily about him with his powerful flail, I know no more lucid, effective, and manful English than you will find in Huxley. What more delightful book of travel than the "Himalaya Journals" of the great naturalist Hooker, who carried on his botanical explorations some sixty years ago, and happily is still among us?

Buffon, as man of science, is now, I assume, little more than a shadow of a name, and probably even the most highly educated of us know little more about him than his famous pregnant saying that the style is the man—a saying, by the way, which really meant no more than that, while nature gave the material for narrative, it is man who gives the style. Yet the French to this day count him among the greatest of their writers for order, unity, precision, method, clearness in scientific exposition of animated nature, along with majestic gifts of natural eloquence. Then comes the greatest of all. Whatever the decision may be as to the value of Goethe's scientific contribution, this, at least, is certain, that his is the most wondrous, the unique case of a man who united high original scientific power of mind with transcendent gifts in flight, force, and beauty of poetic imagination.

As for science and the poets, only the other day an attractive little book published by Sir Norman Lockyer shows how Tennyson, the composer of verse unsurpassed for exquisite music in our English tongue, yet followed with unflagging interest the problems of evolution and all that hangs upon them. Whether astronomy or geology—terrible muses, as he well might call them—inspired the better elements of his beautiful work, we may doubt. An English critic has had the courage to say that there is an insoluble element of prose in Dante, and Tennyson has hardly shown that the scientific ideas of an age are soluble in musical words. Browning, his companion poet, nearly universal in his range, was too essentially dramatic, too independent of the scientific influences of his day, too careless of expression, to be a case much in point. Tennyson said of him, he had power of intellect enough for all of them, "but he has not the glory of words." Whether he had or not, science was not responsible.

I should like to name in passing the English poet who, in Lowell's words, has written less and pleased more than any other. Gray was an incessant and a serious student in learned tongues; and his annotations on the "Systems of Nature," by Linnæus, his contemporary, bear witness to his industry and minute observation as naturalist.

In prose fiction was one writer of commanding mind, saturated with the spirit of science. Who does not feel how George Eliot's creative and literary art was impaired, and at last worse than impaired, by her daily associations with science? Or would it be truer to say—I often thought it would—that the decline was due to her own ever-deepening sense of the pain of the world and the tragedy of sentient being?

Let us look at the invasion of another province by the spirit of the time. The eager curiosity of all these years about the facts of biology, chemistry, physics, and their laws has inevitably quickened the spread both of the same curiosity and the same respect, quickened by German example, for ascertained facts into the province of history. Is the pure scientific impulse—to tell the exact truth with all the necessary reservations—easy to combine with regard for artistic pleasure?

The English writer of our own immediate time, with the fullest knowledge and deepest understanding of the fact and spirit of history, would, I think, be pronounced by most critics with a right to judge to be the late Lord Acton. Acton's was a leading case where knowledge and profundity was not matched by form. His page is overloaded, he is often over-subtle, he has the fault—or shall I call it the literary crime?—of allusiveness and indirect reference—he is apt to put to his reader a riddle or a poser, and then to leave him in the lurch. Here is Acton's own account of the historian's direct debt to the methods of science:—"If men of science owe anything to us," he says, "we may learn much from them that is essential. For they can show how to test proof, how to secure fulness and soundness in induction, how to restrain and employ with safety hypothesis and analogy. It is they who hold the secret of the mysterious property of the mind by which error ministers to truth, and truth irrecoverably prevails."

Where the themes and issues are those of scientific truth, that prose should be unemotional is natural. Every-

body knows Darwin's own account, how, as the laborious years passed, he so lost his taste for poetry that he could not endure to read a word of it; Shakespeare became so dull it nauseated him, and music set him thinking too energetically on what he had been working at, instead of giving him pleasure. If all this loss was the price of years of fruitful concentration in the master, who can wonder if the scientific and documentary age is an age of prose?

NOTES.

WE are delighted to learn that the sum of 25,000*l.* required for the purchase of the site for new chemical laboratories at University College, London, has now been obtained, thanks to a generous gift of 4500*l.* from Mr. Ralph C. Forster, The Grange, Sutton, Surrey. He is a member of the firm of Messrs. Bessler, Waechter, and Co., merchants, of Salisbury House, E.C. He was Sheriff for the county of Surrey in 1906. The total sum required for the purchase of the site and the erection of the laboratories was 70,000*l.* It is estimated that a sum of between 45,000*l.* and 50,000*l.* is still required for the erection of the buildings. It is hoped that this object will commend itself to the generosity of some public-spirited citizen, who will come forward with what is required to complete the scheme.

THE Chemical Society of France has recently elected the following foreign honorary members:—A. v. Baeyer, Munich; Emil Fischer, Berlin; P. Guye, Geneva; L. Henry, Louvain, Belgium; C. Istrati, Bucharest; A. Lieben, Vienna; Louguinine, St. Petersburg; Raphael Meldola, London; Paternò, Rome; Sir Wm. Ramsay, London; and Ira Remsen, Baltimore. The late Prof. S. Cannizaro had also been nominated by the council, but his death prevented his nomination being confirmed by the general meeting of the society.

AN international committee of representative men of science of distinguished eminence has been formed to raise the funds necessary to celebrate appropriately the jubilee of Prof. Gaston Darboux's connection with French university education, the distinguished work he has done for mathematics, and his services as permanent secretary of the Paris Academy of Sciences. Donations may be sent to Prof. Guichard, the general secretary of the international committee, at the Sorbonne, Paris. It is proposed to present Prof. Darboux with a medal, reproducing his portrait, together with an address signed by the subscribers. Subscriptions of 25 francs will give the right to a medal in bronze, and of 50 francs to a medal in silver, which will be reduced reproductions of that to be offered to Prof. Darboux.

THE death is announced, in his seventy-first year, of M. E. A. Léveillé, formerly president of the French Entomological Society.

THE president of the Bureau des longitudes in Paris for the present year is M. G. Bigourdan. M. B. Baillaud is the vice-president, and M. H. Andoyer the secretary.

ON Wednesday next, February 8, a portrait of Prof. W. Boyd Dawkins, F.R.S., will be publicly presented to the University of Manchester by the subscribers. The presentation will take place in the Whitworth Hall of the University at 4 p.m.

AT a meeting of the research department of the Royal Geographical Society on Thursday, February 16, Prof. Edgeworth David, C.M.G., F.R.S., who was geologist on Sir Ernest Shackleton's Antarctic expedition, will submit his views on certain important Antarctic problems, namely, climate, physical structure, tectonic relations with the Andes, &c.

FOUR lectures on plague will be delivered on February 14, 15, 16, and 17 by Dr. F. M. Sandwith, Gresham professor of physic, at the City of London School, Victoria Embankment, E.C. The lectures are free to the public, and will begin each evening at six o'clock.

AT a recent general meeting of the Liverpool Astronomical Society it was resolved to raise a special fund for the purpose of a memorial to the late Mr. R. C. Johnson, whose long connection with the society, in which he filled the positions of secretary and president, and his services in the interests of astronomical science, suggest that some permanent recognition of his work should be made.

A MEMORIAL in marble to the late Sir John Evans, K.C.B., has been placed by his friends in the parish church of Abbot's Langley, Herts—a parish in which Sir John resided for sixty years of his life. The inscription on the tablet records not only the eminence of Sir John Evans in science, but likewise the high administrative and judicial positions he held in the county.

DURING the last fifty years Profs. Luiji Palmieri, M. S. di Rossi and others, have, with tromometers, microphones, and various other contrivances, endeavoured to record the internal murmurings and thunderings of Vesuvius, Etna, and other volcanoes. One of the last professors of vulcanology at the Royal University of Naples was H. J. Johnston-Lavis, whose work has been chiefly directed to the mineralogy and petrology of volcanoes. Now it is rumoured that Italy is to have a Vulcanological Institute, for the establishment of which the chief governments will be invited to contribute 60,000*l.* Mr. Immanuel Friedlaender, who resides in Naples and has recently published a work on the volcanoes of Japan, has promised, it is said, 4000*l.* towards this fund..

THE centenary of the foundation of the publishing firm of B. G. Teubner, of Leipzig, will be commemorated on Friday, March 3. A large number of representatives of science and education have been invited to take part, and hotel accommodation is being arranged on behalf of those who have accepted the invitations.

AN oversea flight of about a hundred miles was made by Mr. McCurdy on January 30 with an aëroplane of the Curtis type, weighing 750 lb. and possessing a 60-horse-power motor. Mr. McCurdy attempted to fly from Key West, Florida, to Havana, a distance of about 110 miles across the Florida Straits. When about ten miles from his destination he had to descend on account of the lubricating oil having been exhausted. The aëroplane was equipped with pontoons, which enabled the descent upon the sea to be made without injury to it or the airman.

THE British South Africa Company, Reuter's Agency states, has decided upon the despatch of a special commission to investigate sleeping sickness in Rhodesia. The commission will consist of Dr. Aylmer May, principal medical officer of northern Rhodesia; Dr. A. Kinghorn, of the Liverpool School of Tropical Medicine; Dr. Leach, of the Northern Rhodesian Medical Service; Mr. O. Silverlock, entomologist; and Mr. Jollyman, bacteriologist. As explained in NATURE of December 1 (p. 147), it is believed that in north-eastern Rhodesia and Nyasaland sleeping sickness is not transmitted by *Glossina palpalis*, but is probably carried by *G. morsitans*, a species which, unlike *G. palpalis*, is not confined to well-defined and

limited areas in the neighbourhood of water, but is distributed over large districts.

ACCORDING to a *Times* correspondent at Tiensin, a slight earthquake shock was experienced there at 8.45 a.m. on January 25. A Reuter message says that on January 28 the eruption of a volcano at Taal caused at Manila three strong earthquakes, and nearly a hundred lesser shocks. A later message states that towns for a radius of twenty miles are suffering from a rain of mud and stones, due to the volcanic eruption at Taal. Five small villages in the Taal district appear to have been destroyed by a great wave, and no fewer than 400 lives were lost in that region.

THE preliminary reading of the Bill for making official time in France coincide with Greenwich time was accepted in the French Senate on January 26, on the understanding that the Paris meridian should still be adopted for naval, astronomical, and cartographical requirements. Decided advantage will accrue from the introduction of uniform time in western Europe, and the Bill before the Senate will be widely welcomed. The essential article of the Bill reads:—"Official time in France and in Algeria shall be Paris mean time put back nine minutes and twenty-one seconds."

ON Thursday next, February 9, Dr. P. Chalmers Mitchell will begin a course of three lectures at the Royal Institution on "Problems of Animals in Captivity," and on Saturday, February 11, Dr. Thomas G. Jackson will deliver the first of three lectures on "Architecture: the Byzantine and Romanesque Period." The Friday evening discourse on February 10 will be delivered by Sir Sidney Colvin on "Robert Louis Stevenson," on February 17 by Prof. Henry E. Armstrong on "The Stimulation of Digestive Activity," and on February 24 by Prof. Jean Perrin on "Mouvement Brownien et Realité Moleculaire" (in French).

THE theatre of the Museum of the Yorkshire Philosophical Society in York has for several years been a subject of concern to the council. Though larger than most of the theatres belonging to the principal London societies, it is often inconveniently overcrowded. This state of things, we learn from the *Yorkshire Herald* of January 19, is now in a fair way of being remedied. The president of the society, Dr. Tempest Anderson, has decided to apply to the building of a new theatre a sum of money left to him by his sister, the late Mrs. Percy Sladen, to be used for some scientific purpose. The well of the present theatre will be boarded over with either a permanent or movable floor, and this hall will thus become available as a reception room for use before or after the lectures, and also for smaller meetings. The new theatre will be built at the west side of the present building, space being reserved in front of it for a further enlargement of the museum. The proposed theatre will be about 79 feet long and 47 feet wide, and will comfortably seat nearly 400 people. Between the higher tiers of the seating and the basement hall a workroom (39 feet by 26 feet) will be provided.

THE Research Defence Society was founded three years ago to make generally known the facts as to experiments on animals in this country, and the regulations under which they are conducted: the immense importance of such experiments to the welfare of mankind, and the great saving of human and animal life and health which is already due to them. Under the presidency of Lord Cromer, and by the untiring efforts of the honorary secretary, Mr. Stephen Paget, the society has done and is doing excellent educational service in the cause of science and humanity. From a short statement just issued of its work during the past year, it appears that since January last twenty-one pamphlets and leaflets have been published by the society upon such subjects as Pasteur, science, and medicine; plague in India; diphtheria and antitoxin; sleeping sickness; Malta fever; and humanity and science. There has been a very great increase during the year in the quantity of pamphlets and leaflets distributed, and in the number of addresses and popular lectures, and lantern lectures, given by members of the society in all parts of the country. A large number of the publications has been distributed among public libraries and similar institutes, and also sold in the ordinary way of publication. There are now nearly four thousand members, but it is hoped that many more people in sympathy with its aims will become members or associates of the society, and help to extend its educational work.

MANY attempts have been made to synchronise the phonograph or gramophone with the kinematograph, so as to be able to reproduce simultaneously the sounds of the voice, as in singing and speech, while the movements of the face and the bodily gestures of the singer or speaker are depicted on the screen. The difficulty has been twofold: how to obtain the exact synchronism and how so to intensify the vocal sounds, or rather the mechanism for recording the vocal sounds, as to allow the sound-recorder to be placed at something like the same distance from the speaker as that between the speaker and the kinematograph. The difficulties, however, appear to have been surmounted by M. Gaumont. In *La Nature* of December 31 last, an interesting description is given of a meeting, on December 27, of the Paris Academy of Sciences, at which, by means of M. Gaumont's method, there appeared on the screen an image of M. d'Arsonval which made gestures and delivered an explanatory speech. The details of the method are not fully developed, but they are to be made public without delay. It appears that M. Gaumont has been struggling with experimental difficulties for more than eight years. We may soon have in our homes the *chefs-d'oeuvre* of our theatres played by our best actors, and even lectures by famous professors may not be restricted to their class-rooms, but the speakers may be both seen and heard at so much a yard. Such reproductions are to be called *phonoscenes*. We may well say with Dominie Sampson—"prodigious"!

THE syllabus for the first half of the present year of the North London Natural History Society provides plenty of opportunities for those members who wish to do serious out-door work in their subject, as well as to attend lectures and meetings for discussion. The session opened on January 10, when Mr. M. Greenwood, the president, delivered his presidential address, taking for his subject "Science from the Non-professional Standpoint." He laid great emphasis on the value of amateur science, and reminded the members that it has been said the amateur is the glory of British research. "Remember that the greatest biologist our country has produced, Charles Darwin, was an amateur." Mr. Greenwood summarised the leading principles of a great man of science as patience in labouring, impartiality in judging, absolute candour in stating the conclusions to which his researches lead him, and a resolute scorn of the idols of the market-place. The function of science in the life of a non-professional student is of high importance, he said, and that to draw the utmost advantage from his work it is well for such a student to concentrate his energies upon a limited number of subjects, and, above all, to devote original, independent

thought to whatever he undertakes. "The fundamentally valuable thing in scientific study is the mental attitude it engenders. It is doubtless true that we, as a nation, do not spend enough money on pure research and technical instruction; but behind and beyond all this lies our chief national sin—a contempt for scientific reasoning, a striving after short cuts to knowledge, and a slovenly omniscience, as witnessed in our love for examinations and worship of success, *qua* success." Particulars concerning the society may be obtained from the secretaries, Messrs. S. W. Bradley and T. R. Brooke, 12 Warren Road, Chingford, N.E.

Dr. F. Grön makes some remarks in *l'Anthropologie* (Tome xxi., p. 625) on the prehistoric operation described by Prof. Manouvrier by the term "T sincipital." This is a T-shaped groove of variable depth that is found in certain Neolithic skulls, which extends along the sagittal and lambdoidal sutures. Skulls of all ages, from prehistoric to recent times, and from many countries, have been collected which show indubitable evidence of trepanation. These perforations are generally admitted to be surgical operations in order to alleviate pain or to cure certain diseases. Celsius, speaking of malaria of the eyes, refers to a curative operation of cutting the skin by sagittal and frontal incisions, but Dr. Grön does not consider that this is the same operation as that under consideration. He directs attention to the fact that all the skulls found in France with the "T sincipital" are those of women, and puts forward the view that it was not a prehistoric operation undertaken for medical reasons, but a form of punishment of which the vestige is found in the stigmata of historic times. The author adds:—"Certainly this opinion is only a hypothesis."

In an interesting paper presented to the research department of the Royal Geographical Society on January 19, Messrs. A. J. B. Wace and M. S. Thompson discuss the distribution of early civilisation in northern Greece in relation to its geographical features, and in particular the communications through the mountain passes and the forests of Thessaly, which in ancient times seem to have extended over a much wider area than that which they occupy at present. These remains generally take the form of high or low mounds, most of them situated in the plains, but a few are to be found in the foothills. Both of these types must be distinguished from the conical mounds covering Hellenistic tombs, which extend into the prehistoric area. The civilisation of the race occupying these sites is of a primitive type, widely different from the more advanced Minoan culture of the south, which apparently reached northern Greece in its latest phase, and did not replace the local cultures. The co-existence of this northern Neolithic culture with the use of bronze further south must be taken into account in considering the usually accepted view that the Achæans were invaders from the north.

The expedition of the Duke of the Abruzzi to the Karakoram Himalayas is described by Dr. Filippo de Filippi in the January number of the *Geographical Journal*. In spite of many difficulties, much useful and important work was accomplished. Sedimentary and crystalline rocks were found, constituting different portions of the region traversed, and peaks rising well above 20,000 feet occurred in each. Measurements at the beginning and end of the expedition on the Baltoro glacier gave the average movement as 5½ feet a day during June and July; some articles of equipment left on the upper Goodwin-Austen glacier by the Eckenstein-Wessely-Guillarmod expedition in 1902 furnished another means of measurement, and here the movement was less than a mile in seven years, or an average rate of barely 2 feet a day. Aneroid observations were found to be unsatisfactory, but valuable work was done by photogrammetry supplemented by theodolite observations, and in this way much was accomplished in spite of the unfavourable weather.

Bulletin No. 19 of the Agricultural Research Institute at Pusa is devoted to a list of the vernacular, scientific, and English names of the commoner Indian insects.

The *Scientific American* for January 7 contains a long illustrated article on the New York Zoological Park, which embraces an area of 264 acres, and contains at the present time more than 5000 wild animals. That the park is highly appreciated by New York people may be inferred by the fact that 1,614,953 persons passed the turnstiles last year. Attention is specially directed to a huge open-air bird-cage, with a ground-area of 152 by 75 feet, and a height of 55 feet, and enclosing three fair-sized forest trees and a pond of 100 feet in length. Naturally, the authorities have endeavoured to exhibit a representative series of the animals of North America, among which at the present time a special feature is the show of the various forms of huge brown bears inhabiting Alaska. A new and noteworthy exhibit is the herd of six musk-ox calves, five of which were recently received from Ellesmere Land, Greenland, as the gift of Paul J. Rainey. "Miss Melville," the sixth specimen, arrived a year ago from Melville Island. These six constitute the only live herd of these animals in captivity.

In its January issue, the *American Naturalist* prints an address on "organic response," delivered by Dr. D. T. Macdougal, the president, before the meeting of the Society of American Naturalists held at Ithaca, N.Y., on December 29, 1910. The article is of such length that it is difficult to give a *prècis* of its scope within the normal limit of a note in this column. The chief subject is, however, the changes undergone by animals and plants under different conditions of environment, especially as the result of artificial transportation or transplantation. After alluding to the peculiar suitability of micro-organisms with a short life-cycle to experiments of this nature, and the results obtained therefrom, Dr. Macdougal refers to the difference in the breeding habits of the spotted salamander according as to whether it lives at high or low levels, the species being viviparous under the former and ovoviviparous under the latter conditions. It is added that if the Alpine black salamander be kept in a high temperature, its larvæ resemble those of the spotted species when in its lower habitat, whereas if the spotted kind be kept in a low temperature, its reproductive habits and young approximate to those of its black relative. Attention is next directed to the results obtained by transporting beetles to habitats unlike their own, after which comes a fuller account of the American experiments in regard to growing selected kinds of plants at different elevations and under different conditions of climate and soil. These experiments are being conducted on a very extensive scale, large "xero-montane," "montane," "maritime," and other types of plantations having been established in California, Arizona, and elsewhere. For the results of these our readers must refer to the address itself.

In the latter part of the article on sexual dimorphism in plants, published in the *Biologisches Centralblatt* (November 15, 1910), Prof. Goebel describes some anomalous features observable in flowers of the Compositæ. Generally, as in Calendula, the female ray florets

are larger than the hermaphrodite or the male tubular florets. But in *Homogyne alpina*, *Cotula coronopifolia*, and species of Xanthium the female flowers are smaller. In *Petasites niveus*, which is dicœcious, the inflorescence of female flowers grows considerably after the flowering period, while the inflorescence of male flowers remains small; yet the female flowers individually are much smaller than the male, especially in the corolla. The author suggests that these anomalies may be explained as the result of two opposite tendencies, the one to enlarge the corolla for show, as in the ray florets, the other, frequent in unisexual flowers, to reduce the corolla.

A VIVID sketch of two botanical excursions in the south-west region of West Australia is communicated by Captain A. Dorrien-Smith to the Journal of the Royal Horticultural Society (vol. xxxvi., part ii.), where the author says that the magnificence of the flora surpasses that of any other region he has visited. In the neighbourhood of Cape Naturaliste, *Banksia grandis*, *B. attenuata*, a blue Leschenaultia, and *Templetonia retusa* were conspicuous. The finest display was encountered at Warrangup Hill (2800 feet), in the Stirling Range, where a giant white Epacrid, *Lysinema ciliatum*, tall bushes of a pink-flowered Protead, *Isopogon latifolius*, and the golden-flowered *Dryandra formosa* attracted special attention. Another vegetation sketch, ecological rather than floristic, in the same number deals with rare wild flowers in the west of Ireland, in which Mr. Lloyd Praeger describes, and in some measure explains, their peculiar distribution. The article is recommended to students as an admirable essay on a unique and instructive combination of ecological problems.

HAVING regard to the recent consummation of the Union of South Africa, Prof. H. W. Pearson took advantage of an opportune occasion to lay before the biological section of the South African Association for the Advancement of Science during last November, in his presidential address, the great desirability and advantages of a South African National Botanic Garden. In the first instance, Prof. Pearson, while assigning due credit to the work of existing institutions, notably the Natal Botanic Garden ably administered by Mr. Medley Wood, pointed out that none of these provides sufficient area or is situated in a suitable locality for an establishment or State department, which should comprise not only horticultural departments, an experimental garden and herbarium with library, but also a museum of economic products, research laboratories and a staff of technical assistants and plant collectors. Chief among the arguments advanced are the non-existence of a garden where the unique plants of South Africa are grown and investigated, the necessity for the study of the veld vegetation with a view to the improvement of the fodder grasses, and the desirability of extended botanical exploration.

THE REV. M. SADERRA MASÓ, who has for many years studied the earthquakes of the Philippine Islands, is now turning his attention to the subterranean noises known in other countries under various names, such as mist-pœffeurs, marinas, brontidi, retumbos, &c. In the Philippines many terms are used, generally signifying merely rumbling or noise, while a few indicate that the noises are supposed to proceed from the sea or from mountains or clouds. Most of the places where they are observed lie along the coasts of inter-island seas or on enclosed bays; very few are situated on the open coast. The noises are heard most frequently at nightfall, during the night and in the early morning, especially in the hot months of March, April, and May, though in the towns of the Pangasinan province they are confined almost entirely to the rainy season. They are compared in 70 per cent. of the records to thunder. With rare exceptions, they seem to come from the mountains inland. The instances in which the noises show any connection with earthquakes are few, and observers usually distinguish between them and the low rumblings which occasionally precede earthquakes. It is a common opinion among the Filipinos that the noises are the effect of waves breaking on the beach or into caverns, and that they are intimately connected with changes in the weather, generally with impending typhoons. Father Saderra Masó is inclined to agree with this view in certain cases. The typhoons in the Philippines sometimes cause very heavy swells, which are propagated more than a thousand kilometres, and hence arrive days before the wind acquires any appreciable force. He suggests that special atmospheric conditions may be responsible for the great distances to which the sounds are heard, and that their apparent inland origin may be due to reflection, possibly from the cumulus clouds which crown the neighbouring mountains, while the direct sound-waves are shut off by walls of vegetation or inequalities in the ground.

THE Berne correspondent of the *Morning Post* (January 20) states that a fall of what has been called "black" snow, which occurred recently in the Lower Emmen Valley, has caused a great deal of interest in Switzerland. The most reasonable explanation put forward is that in certain conditions of weather snow may take an appearance of blackness which is quite deceptive. It appears that after the snowfall there was a slight thaw, and a very fine rain fell. While it was still raining, the "Bise," a piercing cold and dry north or north-east wind, set in, and froze the rain on the surface of the snow. Underneath the crust of pure ice thus formed there was a small air-filled space, and the light when reflected from the snow beneath produced to the eye a dark appearance. We find that in the "Glaciers of the Alps" (p. 204) Tyndall refers to another optical effect caused by the condition of the snow on the Montanvert in winter, in which "the portions most exposed to the light seemed least illuminated, and their defect in this respect made them appear as if a light-brown dust had been strewn over them."

ACCORDING to usual practice, Dr. H. R. Mill has communicated to the *Times* (January 17) a preliminary statement of the general character of the rainfall of 1910, and also an abridged summary of the same to *Symons's Meteorological Magazine* for January. As we have already referred (January 5) to statistics prepared from another source, we need only quote here some of the leading features shown by Dr. Mill's first examination of about 3000 records of the British Rainfall Organisation. The results, which are exhibited by maps, and by carefully prepared tables for stations and districts, show that the British Isles, as a whole, had an excess of 8 per cent.; Wales had an excess of 17 per cent.; southern England, 16 per cent.; Ireland, 9 per cent.; northern England and Scotland, less than 5 per cent. The relatively wettest area was in portions of Somerset and Monmouth, where the excess exceeded 30 per cent. A very wet area extended through Devon and Cornwall, along Dorset, Wiltshire, Hampshire, and Sussex, also to Hereford and part of Wales, but in many places the rainfall was below the average, especially on the coasts. The year had one of the wettest Februaries and one of the driest Septembers on record. Dr. Mill remarks that the relation of two dry

years followed by a wet year, which prevailed for England and Wales for twenty-one years, including 1909, has now completely broken down, and that it seems possible that the swing of the pendulum is carrying us into a period of predominating wet years, corresponding to the wet period of 1874–83.

In the *Memorie del R. Istituto Lombardo di Scienze e Lettere* Signor A. M. Pizzagalli has published a memoir, "La cosmogonia di Bhṛgu," an investigation of the relation of the cosmogonic myth to the epics of India. The cosmogony of Bhṛgu is part of one of the subdivisions of the twelfth book of the Mahabharata; it is in the form of a dialogue between two legendary persons, Baradvāja and Bhṛgu, the former asking questions, the latter answering them. It deals with the origin of all things in the animal as well as in the vegetable world, which are supposed to have the same composition and to be essentially identical. It shows how the vital flame combines with the earth-element to form the body of the individual, while the soul, an efflux of the Supreme Being, pervades and rules the body and endows it with various qualities. A complete translation of the dialogue is given; there is nothing astronomical in it.

"The Structural Design of Aëroplanes" forms the title of a paper read before the Institution of Civil Engineers of Ireland by Prof. Herbert Chatley about a twelvemonth ago, and now reprinted (Dublin: John Falconer, 1910). In it the author endeavours to apply exact mathematical methods to the calculation of the stresses in the sustaining framework of an aëroplane, as well as in the supporting surfaces. In view of the number of deaths that have resulted in the past year from breakages of aëroplanes, the alternative causes frequently being instability, it ought to be evident that the only way of placing the problem of aviation on a satisfactory basis, and of preventing future fatalities, is by encouraging the further development of investigations such as Prof. Chatley's, and by determining exeprimentally the unknown data which such investigations show to be necessary in order to complete the solutions of such problems—the latter being evidently a comparatively easy task. In the discussion on the paper, however, we notice the usual want of appreciation of the methods of exact science on the part of so-called "practical men."

M. Gilbert Maire contributes to *La Revue des Idées* for November 15, 1910, an account of an interesting medico-psychological study of Prof. Henri Poincaré undertaken by Dr. Toulouse. Owing to the wide public interest which has been aroused, especially in France, by Poincaré's writings on the philosophy of science and on the concepts of mathematics, many readers will wonder how and under what conditions Poincaré originates his investigations. It is evident from the present account that when absorbed in a problem Poincaré has often, like many another genius, become oblivious to matters of everyday life. What seems, however, to have most impressed Dr. Toulouse was that Poincaré's discoveries were not arrived at as the result of a concentration of mental effort, but that they have come on him spontaneously, often when his thoughts have been turned in quite different directions. For this kind of faculty Dr. Toulouse has proposed the name "auto conduction." Whether a new name was really needed, or whether the same faculty has already been recognised and described under other names, is a matter on which there may be more than one opinion. At the same time, the fact that Poincaré, and probably many other philosophers, and especially mathematicians, became suddenly inspired by new ideas (and, indeed, find it impossible to throw these ideas on one side, even temporarily, until they have developed them), affords an interesting problem for the psychologist, and Dr. Toulouse's examination may well direct attention to this problem.

The four numbers of the Journal of the Royal Society of Arts ending with that of January 13 contain the text of the Cantor lectures on industrial pyrometry which have been delivered before the Society by Mr. C. R. Darling. The last two lectures concern themselves mainly with the simplified forms of the platinum thermometer, the thermo-junction, and the radiation pyrometer, which have been constructed for use in works where observational skill on the part of the users cannot be taken for granted. Several of the methods described have received attention in these columns as they have been developed from those suitable for more accurate work.

More than forty pages of the number of *Himmel und Erde* for December 30, 1910, are devoted to addresses on the principle of relativity which have been delivered before scientific societies in Germany during the past year. The first of these, delivered by Prof. E. Cohn, of Strassburg, before the Scientific and Medical Society of that city, aims at a clear exposition of the principle to an audience to whom it was comparatively unknown, and it succeeds admirably in its object by the help of experiments performed with an ingenious model designed for the purpose. The second, delivered by Prof. H. Poincaré, of Paris, before the Scientific Society of Berlin, goes somewhat more fully into the reasons which have led to the extension to general physics of a principle as old as Galileo and Newton, that our knowledge of the motion of any body can only be of its motion with respect to some other body. When this principle is traced to its logical conclusion in relation to the known facts about the speed of light, it leads to the denial of most of the laws of the old mechanics. The units of mass, length, and time on one moving body will differ from those on another moving body by amounts which depend on the relative motions of the bodies with respect to each other. Prof. Poincaré is not disposed to accept the principle as fundamental throughout physics, and points out many of the difficulties which still have to be overcome before it can be regarded as altogether satisfactory.

We have just had the opportunity of trying the "tabloid" preparations of Messrs. Burroughs Wellcome and Co. as specially arranged for colour photography by the single-plate (or screen-plate) processes. They give excellent results, and the uniformity which the use of tabloids ensures eliminates a fruitful source of uncertainty that too often spoils the work of those who use such plates at irregular intervals. The formulæ given are suitable for the Autochrome, Thames, Ominicolore, and Dufay plates. The cartons are three only—the developer, the reversing compound, and the intensifier, the last often being unnecessary.

A paper on the inversion of cane-sugar under the influence of acids and neutral salts, by Mr. Noël Deerr, has been issued as Bulletin No. 35 of the Agricultural and Chemical Series of the Experiment Station of the Hawaiian Sugar Planters' Association. The author has determined the influence of twenty-three different salts upon the rate of inversion of cane-sugar by hydrochloric and other acids.

The *Bio-Chemical Journal* of January 17 contains an article, by Prof. B. Moore, "In Memory of Sidney Ringer"

[1835–1910]. Some Account of the Fundamental Discoveries of the Great Pioneer of the Bio-chemistry of Crystallo-colloids in Living Cells." This may be regarded as supplementing the biographical notice of Ringer's career, and of his work as a clinician, which is to be found in the *British Medical Journal* of October 29, 1910.

WE have received from Messrs. E. Merck, of Darmstadt, a copy of the third German edition of their "Index" of pharmaceutical preparations. Eight years have elapsed since the second edition was issued, and the index now forms a handsome volume of nearly 400 pages. Copies of the new edition can be procured from the London agent of the firm.

THE properties of binary mixtures of some liquefied gases are described in the Journal of the Chemical Society by Dr. B. D. Steele and Mr. L. S. Bagster, of Melbourne University. The mixtures chosen were those of sulphur dioxide with hydrogen bromide, and hydrogen sulphide with hydrogen bromide and with hydrogen iodide. The vapour pressures were plotted for a series of temperatures from $-35°$ to $-75°$. A mixture of hydrogen sulphide and hydrogen bromide in the proportion of 60 to 40 was found to have a minimum vapour pressure (or maximum boiling point, analogous to those observed in mixtures of water with the halogen acids), in spite of the fact that the solutions are non-conductors and have given no evidence either of ionisation or of association. Mixtures of hydrogen sulphide and hydrogen iodide, on the other hand, gave direct linear relationships between total vapour pressure and composition (of liquid) and between the vapour pressures of the two constituents and the concentration of the liquid, thus adding another to the very short list of pairs of liquids which obey Raoult's law throughout the whole range of compositions.

THE fourth volume of the Journal of the Institute of Metals is now available. It has been edited by Mr. G. Shaw Scott, the secretary of the society, and copies may be purchased at the offices of the institute, price 21*s*. net. The greater part of the volume consists of the papers of scientific interest read at the annual autumn meeting of the institute held in Glasgow last September, abstracts of which were published in NATURE of September 29 (vol. lxxxiv., p. 421). These papers are in the volume supplemented by written communications from eminent authorities after the papers were read. The first May lecture, which was delivered by Prof. W. Gowland, F.R.S., is also included, together with a series of abstracts of papers relating to the non-ferrous metals and the industries connected with them.

OUR ASTRONOMICAL COLUMN.

SPLENDID METEOR ON JANUARY 25.—Mr. W. F. Denning writes:—"St. Paul's Day, January 25, has been noted in past years for occasionally supplying very large meteors, and it has maintained its character this year.

"A fireball was seen at 7h. 5m. p.m. by Mr. J. L. Haughton, of Birmingham, falling very slowly from the region of Aldebaran in Taurus to κ Orionis. The meteor was more brilliant than Venus at her best, but there were some clouds in the sky, which prevented the best effects being observed and interfered with the accuracy of the record. Near Leeds, Mr. J. H. Park witnessed the meteor sailing very slowly along from the north-west to south-east, and passing south-west of the Pleiades. The heavens were much overcast, and only a few stars visible.

"The probable radiant of the fireball was in Cepheus at $330°+58°$, and it apparently belonged to the same stream as that which supplied the magnificent fireball of January 25, 1894. The recent one passed from over Monmouth to Wiltshire at a height of about 83 to 46 miles, but additional observations are required."

NOVA LACERTÆ.—In No. 4466 of the *Astronomische Nachrichten* Dr. Max Wolf publishes a reproduction of the region about Nova Lacertæ from a photograph taken on January 2 with an exposure of thirty-one minutes. The reproduction covers a circular region of 1° diameter, with the nova at the centre, and shows stars to about the fifteenth magnitude; the B.D. comparison stars are especially marked. The earlier plates on which a star of magnitude twelve or thirteen is shown in the nova's position were taken on July 15, 1904 (exposure 3h. 46m.) and January 9 and 11, 1894 (2h. 30m. exposure), the former with the Bruce and the latter with the 6-inch telescope. In No. 4467 of the same journal the result of a comparison of positions of this faint object and the nova is announced, and it seems reasonably certain that they are identical—that the star took part in the catastrophe producing the nova.

The identity is confirmed by Prof. Barnard, who, in No. 4468 of the *Astronomische Nachrichten*, states that he has found the image of a fourteenth-magnitude star in the place of the nova on plates taken on August 7, 1907, August 22 and 24, 1909, and October 11, 1893. On the first-named plate the position of the image agrees within 0·01*s*. in R.A. and 0·1″ in dec., with the nova's position as determined with the 40-inch micrometer. In the 40-inch telescope the nova has two distinct and sharp foci, such as were also exhibited by Nova Geminorum (1903), the one being 8 mm. further from the object-glass than the other. Prof. Barnard has never noted this peculiarity in other stars, and ascribes it to the great brilliance of the crimson Hα line of hydrogen, as shown on the Yerkes spectrograms.

For January 10 and 16 Prof. Millosevich gives the magnitude of the nova as 7·4 and 7·7 respectively.

Dr. Münch obtained a spectrogram with a 15-cm. objective prism used with the Zeiss triplet of the Potsdam Observatory on January 6 and 7, and the same prism was used, by Dr. Eberhard, in connection with the 30-cm. reflector on January 8. The plates show a continuous spectrum crossed by a number of bright lines. The hydrogen lines Hα–Hη are bright and very broad, and there is a very bright band at λ 4654. A broad absorption band appears on the more refrangible side of Hγ, a bright emission line is seen at λ 4056, and near it, at λ 4045, there is a distinct absorption line; the K line is much fainter than would be expected from the brightness of the emission lines.

A plate taken by Prof. Hertzsprung on May 22, 1910, shows no trace of the nova, which was then certainly fainter than the eleventh magnitude.

M. Felix de Roy, Antwerp, found the magnitude of the nova on January 7 to be 7·8, and the colour was about 6^e on Osthoff's scale. A telegram from Herr Mewes, Breslau, states that the nova was exceedingly red on January 14.

ABSORBING MATTER IN SPACE.—In No. 5 of the Transvaal Observatory Circulars Mr. Innes discusses the blank region of the sky around the star S. Corona Aust., and suggests that the apparent vacuity may be the result of the interposition of an absorbing medium which cuts off the light of the stars behind it. Messrs. Innes and Worssell find that in one part of the region the field of the 9-inch refractor (25′) includes no star of any magnitude. The latter also considers that he is able to detect a distinct difference in tint on passing the border of the blank and starry parts of the sky; the region is probably unique. Some of the stars appear to be surrounded by nebulous matter, but the small dark patches—seen on a photograph reproduced on Plate xxii.—are the most remarkable objects. Mr. Innes suggests that all the phenomena could be best explained by supposing that irregular sheafs of gas, some of which are dark and opaque, others slightly luminous at their extremities, cover the region. Where this gas is impenetrable no stars are seen; rifts in it allow other stars to appear; and where it is slightly luminous the stars behind it appear with circumjacent nebulosities.

In 1899–1901 the tenth-magnitude star Cor.D.M. $-36°$ 13208 was recorded by Mr. Innes as "not seen,"

but Mr. Worssell found it visible—and probably variable—in 1909–10, its magnitude ranging from 11·0 (1909 July 21) to 12·2 (1909 September 5). This star lies on the border of the abnormally tinted patch of the sky, and it is suggested that its disappearance in 1899–1901 may have been due to a slight extension of the obscuring medium, which is now retreating.

PHOTOGRAPHIC DETERMINATIONS OF STELLAR PARALLAX.—To No. 5, vol. xxxii., of the *Astrophysical Journal* Prof. F. Schlesinger contributes the first part of a paper on the photographic determinations of stellar parallax made with the Yerkes refractor. Previous parallax determinations have usually been made with short-focus instruments, and it occurred to Prof. Schlesinger, in 1902, that the errors of observation might be greatly reduced if much greater focal lengths were employed; the cooperation of the Yerkes authorities and the Carnegie Institution rendered this possible, and 327 plates, relating to twenty-five different regions, were secured, and have been reduced for the purposes of the present papers.

In this first paper Dr. Schlesinger describes in detail the apparatus and methods employed in securing the photographs. The question of using screens, for the sharpening of the stellar images, was considered, but it was decided not to use them, as difficulties might be introduced; also, it was found that, with the 40-inch objective used with Cramer Instantaneous Isochromatic plates, they were really unnecessary. A special movable plate-carrier, adjustable in two directions by means of screws, was employed, and the coincidence of the optical axis and the geometrical centre of the plate was investigated; it was found that they were separated on the plate by about 8 cm. (about fourteen minutes of arc), but the final effect was negligible, and, as the radical correction of the tilt would have interfered with other instruments used with the 40-inch, no attempt was made to correct it. The focussing each evening was done visually by means of an eye-piece sliding on a graduated scale. The "hour-angle error," produced by atmospheric dispersion, was eliminated, so far as possible, by choosing the hour-angle at which each plate was exposed; it was also deemed advisable to use the telescope on one side of the pillar only, in order to eliminate "optical distortion." After several experiments an ingenious "rotating disc" occulting shutter was employed for reducing the brightness of the parallax star to that of the surrounding comparison stars.

Many other interesting points are discussed by Dr. Schlesinger, but space does not permit of their being mentioned here. It may, however, be added that the scale of the plates is such that 1 mm. corresponds to 10·6″, and that 20 cm.×25 cm. plates were used.

LINES IN THE SPECTRA OF NEBULÆ.—No. 183 of the Lick Observatory Bulletins contains a list of nebula lines discovered photographically by Dr. W. H. Wright. In the great nebula of Orion he finds lines at λ 3734 (faint), λ 3722 (v. faint), λ 3712 (v.v. faint), and λ 3704 (v. faint), all of which he ascribes to hydrogen; another line is suspected at λ 4137.

In N.G.C.7027 lines were found at λ 6301, λ 6548, and λ 6583, the latter two making a conspicuous triplet with Hα, which is very bright in all the nebulæ that have been observed.

UTILISATION OF THE SUN'S HEAT.—In the January number of *L'Astronomie*—to which title the *Bulletin de la Société astronomique de France* has reverted—Prof. Ceraski describes and illustrates a very simple thermo-electric pile which he made and which gives sufficient current to ring an electric bell whenever the sun shines. He also suggests, hesitatingly, that if made up in sufficient numbers and placed in suitable localities, batteries of such piles might be employed in utilising the solar radiations.

PROPOSED CALENDAR REFORM.

PROPOSALS for reformation of the calendar have been somewhat numerous of late years, and few of the proposers appear to have a full sense of how much trouble and inconvenience any alteration would cause, and, of course, the more radical the change is the greater this would be. Mr. T. C. Chamberlin, indeed, who puts forth another scheme in the number of *Science* for November 25, 1910, admits that it is important that if any alteration is adopted, its advantages should be so great and so unique that no further modification of it would ever appear desirable.

Now all the alterations lately proposed, including the one before us, are of a far more drastic kind than the Julian and Gregorian reforms, which only aimed at securing that the monthly and other dates in the calendar should correspond to the season of the year, the whole length of the calendar year being of the same length as a tropical year. Even in the time of Julius Cæsar it was known that the length of the latter was a few minutes less than 365¼ days. Following the practice of the old Egyptians (and guided partly by the advice of Sosigenes), when he made the Roman calendar wholly solar, he probably thought that it would be better, because simpler, to take the length of the year as 365¼ days, and that this would secure the correspondence with the seasons for a sufficiently long period. As time went on, of course, the difference between this and the true length became more accurately known.

The ecclesiastical authorities, in arranging the cycles for the observance of Easter, considered it essential that, though that feast was movable on account of its being taken as dependent on the Jewish Passover, which was regulated by the moon, yet it was necessary to take the moon the full of which followed the vernal equinox, and to give that equinox the date which it had (or was supposed to have) at the time of the first great Council of the Church, that of Nicæa. To do this it was necessary, not only to alter in future the length of the calendar year, but to drop the days, then ten in number, by which the date of the equinox had changed since the time of the Council.

The Gregorian alteration, then, was introduced in 1582; but the Reformation of the Church, which had then been accepted in many countries in the north of Europe, led to this change being opposed by them, though it was ultimately adopted all over western Europe, and consequently in North America.

But the changes we are now called upon to discuss are of a very different nature. Most of the proposers seem to think there would be very special advantage in making artificial arrangements by which the days of the week should correspond to those of the month, which, of course, could only be effected by making every month 28 days (or 4 weeks) in length. Some would increase the number of months in each year to 13, and as 13×28=364, suggest that the correspondence might be maintained by treating one day as a *dies non*, which would have to be made two in leap-years. But it would not be possible to treat a day as *dies non* in any complete sense. It could, of course, easily be made a holiday, but even in holidays all must do something, and many a great deal.

The peculiarity of Mr. Chamberlin's plan seems to be to retain our 12 months, but at the end of each quarter, or period of three months, to insert a week with a special designation, the thirteenth week of the year to be called Easter week, the twenty-sixth Julian week, the thirty-ninth Gregorian week, and the fifty-second Christmas week. The idea seems to be that a week is needed at the end of each quarter for arranging accounts and other matters.

Having set forth the salient points in this fresh attempt at symmetry in the calendar, we leave it to our readers to form their opinion about whether changes of this drastic nature would procure advantages comparable with the trouble caused. Many, no doubt, will be reminded of the famous interrogatory of Lord Melbourne.

The same remark, in the writer's opinion, may be made of another proposal by M. Grosclaude, of Geneva, for which the approval of a congress at Brussels is claimed. According to this, the year would consist of four quarters, each containing thirteen weeks; but while the first two months of each quarter would have only thirty days, the third would have thirty-one. This would give the year 364 days; the remaining day (two, of course, in leap-year) would be made up as in Mr. Chamberlin's plan.

W. T. L.

MODERN ARGENTINA.[1]

FEW countries outside the British Dominions are more interesting to the inhabitants of Great Britain than the Argentine Republic. Enormous amounts of British capital are invested there—some 170,000,000*l.* in the railways alone, indeed Great Britain has financed most of the developments—about a quarter of our imported foodstuffs come from there, and a number of young Englishmen go out to find employment on the great estancias. At present the bulk of the population centres round Buenos Aires, the enormous hinterland being only thinly populated, and in many regions not thoroughly explored. And yet the country is not new; it has a history of three centuries, two of which, however, were under the old Spanish *régime*, when only Spanish emigration was permitted, and the few adventurers and officials who went out preferred the life of the town to that of the country.

The administration in 1907 very wisely determined to take stock of the present agricultural position, and a scheme for a census, or, more strictly, a great inventory, was drawn up. It was, however, necessary to proceed cautiously, and for some time an advertising campaign was conducted informing the people exactly what information was wanted, and why. The census was taken in 1908, and the results are now published; there are two volumes of figures, and one volume devoted to monographs dealing with the physical conditions, the agriculture, and the people.

From these volumes we learn that the Argentine is now growing at a good, but not very rapid, rate. Of its 4,500,000 inhabitants in 1900, about a million were foreigners, nearly half being Italians, followed by Spaniards and Americans; under 22,000 are English. The exports are wheat, maize, linseed (Argentine being the chief producer of this) and other cereals, meat, both chilled and tinned, hay, quebracho (used for tanning), and similar commodities, the total value being in 1909 79,000,000*l.* Formerly it was mainly a grazing country, but of late years crops have been grown extensively.

The wheat supply from the Argentine has an interesting history. As in other newly settled countries—*e.g.* Canada—wheat is one of the earliest crops the newcomer grows, because it requires but little capital and trouble, and is always saleable. But wheat does not necessarily remain the staple crop; in the more closely settled parts of Canada mixed farming comes into greater prominence, and in the Argentine wheat gives place to lucerne, which yields valuable hay, and is also excellent for cattle food. In improving land, the usual method is to plough it up and sow maize, then linseed, then wheat, and finally lucerne, which is left for hay and the cattle, the colonist moving on to break up more ground. There is this difference between the Argentine and other new countries, that in the Argentine much of the land is already owned by absentee landlords, who put in a manager—commonly an Englishman, who does well as a rule—but do not themselves take any part in the development. The system is admittedly bad, but it is a legacy from the old days, and is not easily displaced. The agriculture is, however, sound; lucerne enriches the soil in nitrogenous organic matter, and leaves it in a fertile condition for any subsequent arable crop that may be taken.

Geologically, the surface of the country is mainly derived from Tertiary and later formations; the Archæan occurs only in small and isolated patches; the Silurian occurs extensively in a few districts; the Devonian runs from north to south, and contains a certain amount of coal; the lower Triassic has not yet been found, but the Jurassic has, and agrees well with the formation as found elsewhere. It is, however, not prominent in the Argentine, and has not been found east of the Pampean ranges and on the plains. The Cretaceous system is well marked, running north to south, but does not cover a wide tract of country. The great plains and the Pampas are formed of loess, a fine-grained sand varying from light to dark grey in colour, and containing calcareous nodules; the origin of this deposit is not settled, but the current idea seems to be that sea water, fresh water, and wind have all played an important part in its formation. One general feature is that the soil is so rich in salts that it not infrequently deposits a white efflorescence containing sodium chloride and sulphate with other salts. Nine different groups of flora are distinguished: the Antarctic forest in the south, consisting mainly of beech with some cypress; the Patagonian, in a dryer region, comprising herbaceous plants, shrubs, and trees; the Pampean, in a moister region, absolutely without trees, consisting of Gramineæ, Compositæ, and Leguminosæ; then further north, in another dry region, the Chañar, or bush flora, especially mimosas; and further north again the sub-tropical region, the garden of the Argentine. Of the other four regions, one in the north-west is desert and one in between the rivers is bush. Why the Pampas should be without trees when trees occur in the surrounding dryer regions is not clear.

Turning again to the agriculture, cattle are of great importance, but sheep, as in other countries, are diminishing in number. The stock is being steadily improved; some of our best pedigree bulls and rams are imported, and the Argentine buyer never hesitates to secure what he considers suitable animals, whatever the price may be. The decrease in the number of sheep is considerable, and is attributed to two causes: certain "worms" have proved very fatal, and the sheep have been found to injure lucerne, and therefore have lost favour with the estancieros. This result can only be regretted; sheep are as much wanted as ever, and they are a very valuable support for the agriculture of a country. To cut them out is to narrow the basis on which the system of agriculture is built.

It is clear that the Argentine has some serious problems to face, but the rapid increase in its volume of trade and in its area of land under cultivation justifies the hope that continued progress will be made, and that the country will still retain its high rank among the food-producing countries of the world.

[1] Journal of the Royal Society of Arts, December, 1910.

Argentine Republic—Agricultural and Pastoral Census of the Nation. Stock-breeding and Agriculture in 1908. Vol. i., Stockbreeding, pp. xviii+425; vol. ii., Agriculture, pp. x+441; vol. iii., Monographs, pp. xcv+705+xliv plates.

Live Stock and Agricultural Census of the Argentine Republic, May, 1908. 5 maps. (Buenos Aires: Argentine Meteorological Office, 1907.)

METABOLISM IN DIABETES MELLITUS.[1]

THE depth of the tragedy into which the most recent investigators of the disease "diabetes mellitus," whose observations are described in the memoir referred to below, have inquired, is sufficiently indicated by the fact that seven of their ten "severe cases" have died since coming under observation in the early part of 1908. Diabetes is considered as being primarily a disturbance of nutrition tending to develop a condition of starvation, and yet it will be noted that in six of these cases the fatal result is attributed to "diabetic coma." Diabetic coma is in no sense due to any deprivation of nutriment experienced by the central nervous system, but rather to a very real poisoning assignable to an appearance in the blood of unusual chemical compounds or to an appearance of compounds in an unusual quantity which are normally present only in minute traces. Nutrition, in short, is not only deficient, leading to a great emaciation of the patient, but is also disordered, leading to death by internally developed poisons. Medical treatment of this disease, its causation having been fully developed prior to the arrival of the doctor, is therefore directed to maintain nutrition in very adverse circumstances by expert adjustments in the diet, and to secure the elimination, or at least neutralise, the effects due to the presence of these poisons. As a valuable contribution to our knowledge of the principles underlying such treatment, this account of the extremely precise and varied observations of Benedict and Joslin will meet with a wide welcome.

Everyone, taught by numerous and by no means reticent guides to the true ritual of diet, is aware that diets necessarily contain certain nitrogenous materials, "proteins" and certain non-nitrogenous materials, "fats and carbohydrates." Almost as many know that the diabetic patient is incapable of dealing with more than a minimal quantity of carbohydrate material. In his alimentary

[1] "Metabolism in Diabetes Mellitus." By F. G. Benedict and E. P. Joslin. Pp. vi+234. (Washington, U.S.A.: Carnegie Institution, 1910.)

canal carbohydrates are dealt with as efficiently as ever, and the sugar into which they are there converted is absorbed into the body-fluids in normal fashion. There is, however, reason to believe that, once in the body-fluids, this sugar has almost completely lost its normal significance. Instead of being the most readily available of the fuels that are oxidised, and together form the only source of energy for all the mechanical work performed by the body, and within the constituent parts of the body, this sugar is now an almost useless commodity, and is further a harmful adulterant tending to accumulate within boundaries through which it is swept at none too great a pace by mechanisms primarily adapted for the excretion of a different class of material.

In addition, too, there is the sugar which is formed within the tissue-cells by chemical change in the proteins that form another of the absorbed fuels of the body. This further quantity of sugar has the same character and meets with much the same alteration in significance, and so it follows that the proteins absorbed from the diet and the proteins formed within the body cease on this account to possess their original value to the economy. Nor is this all, since there is some reason to believe that the remaining class of fuel, the fats, is—this probably as a secondary consequence—not so well dealt with as normally. Incomplete oxidation of the fats is by some, at least, considered as in part responsible for that rancidity of the blood which finally determines the onset of diabetic coma.

The picture of trouble due to these manifold disturbances in the utilisation of fuel must be limned even still more gloomily if the conclusions of Benedict and Joslin are to meet with acceptance. They find that the diabetic patient is the site of more extensive processes of oxidation than the normal person in similar circumstances. Nothing that they say prevents us from continuing their statement into the necessary corollary, that the "efficiency" of the internal mechanisms of the diabetic patient is lowered. Within these patients a greater usage of oxygen and waste of heat accompanies such performances of mechanical work, such internal displacements of matter, as coincide with the periods of rest during which these observations were made. The diabetic patient, already handicapped by his incapacity to utilise fuel, is still further handicapped by the necessity for utilising a greater quantity of fuel.

Now, in the present writer's opinion, there is nothing in their experimental results to support such a conclusion further than the point where the same fact is seen as true for the normal person with the same relation between body-surface and body-weight. Benedict and Joslin do indeed themselves discuss the possibility that the peculiarity which they discover in the diabetic patient is no more than a peculiarity of the emaciated person, but they dismiss this possibility as incapable of explaining differences of the magnitude they observe. It is a pity, however, that they have not brought their opinion to the test of a quantitative calculation, since the point is of great importance to our knowledge of the normal person as to our knowledge of the diabetic patient. If it is true that in this respect the diabetic patient is no more and no less than an exaggerated normal person, then physiology is obviously in their debt for an extension of physiological inquiry to limits not readily attainable in the ordinary way.

This very definite statement of opinion is, it is held, based soundly upon the fact that their experimental results may be referred to several criteria other than the particular one used by the authors, which not only bring the diabetic patient on to the same level of value as the normal person, but also serve to make the results obtained from their normal persons far more congruous than the authors have made them appear. Indeed, their suspicions might well have been excited by the fact that their method of arranging the experimental results (per kilogram of body-weight) leads to greater discrepancies when dealing even with normal persons than are found when the results are left in the form they were actually obtained (per individual person).

The interested reader of these most valuable experimental data, and the authors themselves, will gain rather than lose respect for the exact outcome of prolonged, highly skilful, and enterprising labour when they observe the manner in which the results can be marshalled into line by the adoption of a new artifice. This will be found to be the case when the quantities of physical and chemical change observed per unit of time are divided, not by W (the weight) and expressed per kilogram, but by $H\sqrt[3]{W}$ (the height multiplied by the cube root of the weight). Whatever the meaning of this new divisor and form of expression, it is a fact that it places the diabetic patient upon the self-same level as the normal person so far as his dissipation of heat and oxygen requirements are concerned. A very probable meaning is that the results are thus referred to the extent of the body-surface, and that per square metre of surface the loss of heat is the same. Accepting for the time being this probability as a fact, then the surface of the body in the emaciated as in the normal person is equal to $2{\cdot}9\ H\sqrt[3]{W}$. Making use of this formula, we can express the results of these experiments as is found below:—

Examined in the "Chair Calorimeter."

	Heat (kalories) dissipated per kilogram and per hour	Heat (kalories) dissipated per square metre of surface per hour.
Severe cases of diabetes	1·40	40·21
Mild cases	1·21	38·83
All cases	1·33	39·76
All normal persons	1·21	39·96

J. S. MACDONALD.

THE ICE AGE IN CORSICA.[1]

DR. LUCERNA has made an elaborate study of the physiography of the mountains which occupy so large a part of Corsica, and culminate about 2700 m. above sea-level. Brought up, evidently, at the feet of Prof. Brückner, he has no difficulty in recognising the pre-glacial valley floors and the successive deepenings due to the advancing glaciers of the Günz, Mindel, Riss, and Würm times. The existing moraines, of course, chiefly belong to the last of these, and he is able to identify, as has been done in the Alps, the Bühl, Gschnitz and Daun stages of retreat. The height of the snow-line appears to have varied with the locality, but was generally rather lower than in the southern parts of the Maritime Alps; in more than one place it was about 1650 m., which would signify a sea-level temperature nearly 17° F. lower than that of Ajaccio at the present day. In the valleys, terminal moraines occur, these, of course, being at various levels; for example, in one case at 1350 m., in another as low as 750 m.

As the deepening of the valleys, according to Dr. Lucerna, was a feature hardly less notable than in the Alps—in one valley it amounted, during the Mindel and Riss episodes only, to as much as 85 m.—the advances of the ice gave rise to great masses of gravel, forming terraces in the lower districts, each of which the author assigns to its proper date. Nothing could be more complete. But perhaps some sceptics will suggest that though a cliff terrace on a valley flank indicates, not only a deepening, but also some change in the conditions of erosion, it does not prove a glacier to have been the agent, and that in Corsica, as in the Alps, very much that is set down to the work of ice may quite as well have been pre-glacial.

The second part of Dr. Lucerna's memoir discusses the sea-level in Corsica. During the Glacial epoch the island was gradually rising, and a raised beach or terrace corresponds with each of its episodes. The Günz terrace, near Ajaccio, is about 70 m. above sea-level, the Mindel nearly 40 m., the Riss about 27 m., and the Würm perhaps 13 m. Even the Bühl level can be detected still nearer the sea. The coincidences are curious, but space does not permit an enumeration of the facts from which the conclusions are drawn. If they do not always convince the reader, they will, at any rate, prove that Dr. Lucerna's memoir is a most laborious study of Corsican physiography.

[1] Dr. Roman Lucerna: "Die Eiszeit auf Korsika und das Verhalten der exogenen Naturkräfte seit dem Ende der Diluvialzeit" (Abhandlungen der k.k. Geographischen Gesellschaft in Wien. ix. Band, 1910, No. 1). Pp. vi+144+xiii plates. (Wien: R. Lechner, 1910).

THE PROGRESSIVE DISCLOSURE OF THE ENTIRE ATMOSPHERE OF THE SUN.[1]

Révélations de la couche supérieure de l'hydrogène.

L'ANNÉE suivante, en 1909, nous avons, d'Azambuja et moi, étudié avec les mêmes appareils les raies de l'hydrogène et surtout la raie rouge H_α. Ces raies ont été isolées déjà avec le spectrohéliographe par Hale et Ellermann, qui ont obtenu des résultats fort curieux. En 1903 ils ont reconnu que, avec H_β, H_γ, H_δ, les plages faculaires ne sont plus brillantes par rapport au fond, comme avec le calcium, mais sont souvent noires au contraire. Avec H_α, isolé en 1908, on a en plus tout autour des taches des séries de petites lignes, qui donnent parfois l'impression nette d'un tourbillon, et que Hale a décrites ici même dans une conférence spéciale. De plus ces images de H_α sont magnifiques et très riches en fins détails.

Cependant ces images américaines de H_α sont obtenues par l'isolement de la raie entière, et j'ai annoncé en 1908 qu'elles devaient être un mélange de deux ou trois images et couches distinctes. En effet, d'après Rowland, la raie H_α est doublement renversée, comme la raie K du calcium, mais plus faiblement. Sa largeur avec les parties dégradées est $1^A\,24$, et $0^A\,90$ sans ces mêmes parties. Il faut donc s'attendre à des images quelque peu différentes, lorsqu'on isole les différentes parties de la raie.

Or nous avons vérifié nettement ce fait, et même, contrairement à notre attente, les différences entre les images de l'hydrogène sont relativement plus grandes qu'avec le calcium.

Les résultats exacts sont les suivants :—

Si on isole avec H_α la partie dégradée près des bords, qui correspond à K_1 du calcium à une distance du centre comprise entre $\frac{3.7}{10.0}$ et $\frac{6.9}{10.0}$ d'Angström, on a le résultat de 1903, c'est-à-dire les plages faculaires noires par rapport au fond.

Avec le milieu de chaque moitié, entre les distances $\frac{1.0}{10.0}$ et $\frac{4.2}{10.0}$ d'Angström, l'image est toute différente ; elle offre les principaux caractères des images américaines de 1908, et en particulier les groupements de petites lignes qui constituent ce que Hale a appelé les *Solar Vortices*.

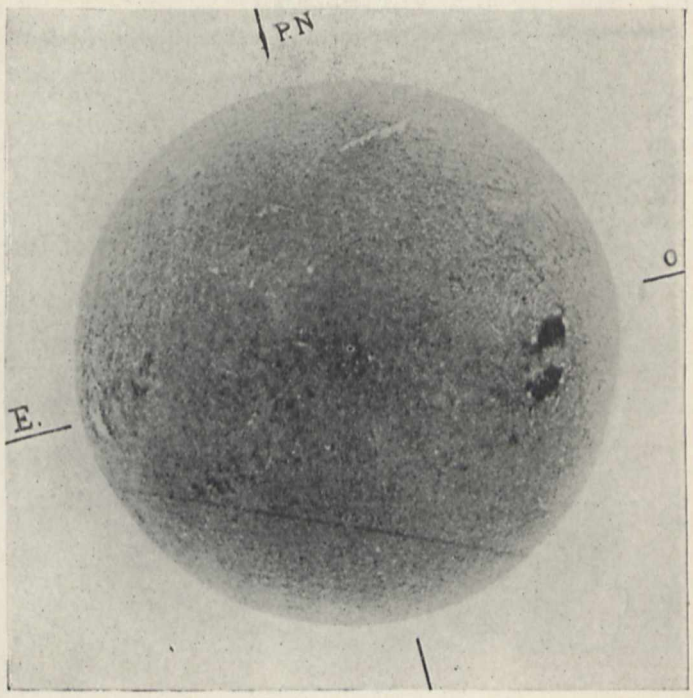
Enfin, avec le centre de la raie, on a une troisième image différente des deux autres, beaucoup plus pâle et simple, qui correspond à la couche supérieure de l'hydrogène.

Or, et *ce point est important*, cette *nouvelle* image offre les mêmes filaments noirs que la couche K_3 du calcium. Quant aux plages faculaires, sur cette image, elles ne sont jamais noires mais brillantes ; elles sont moins étendues qu'avec K_3, et correspondent aux maxima de lumière de ces mêmes plages dans la couche K_3, maxima qui diffèrent de ceux des couches K_2 et K_1. Les parties les plus noires et les parties les plus brillantes sont les mêmes. (Voir les images conjuguées de K_3 et de H_α, obtenues le 11 septembre 1909, les 21 mars et 11 avril 1910.)

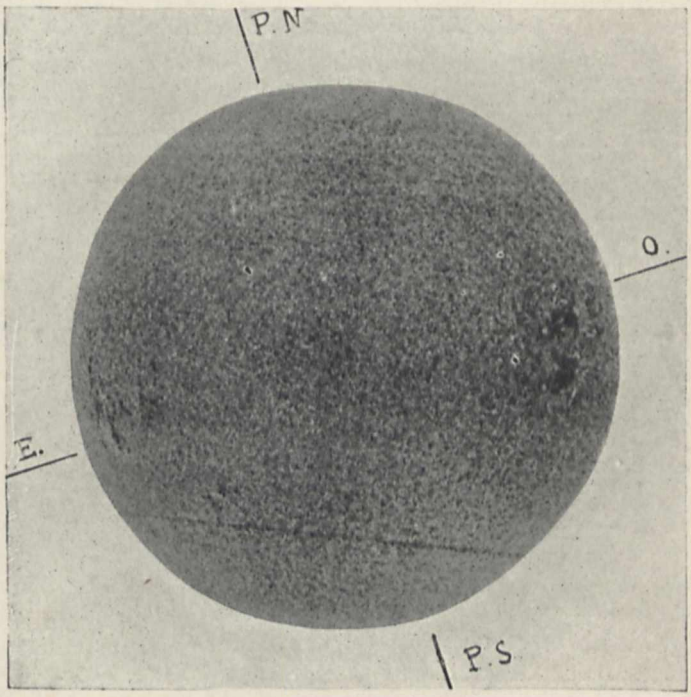
De plus nous avons isolé aussi les différentes parties de la raie bleue H_α de l'hydrogène, moins élevée dans l'atmosphère que la raie H_α et nous avons obtenu des images qui montrent presque exclusivement les plages faculaires en noir, comme la partie dégradée de la raie rouge H_α, et qui correspondent donc à une couche basse.

Finalement, on est conduit à conclure que l'hydrogène offre, comme le calcium, au moins trois couches distinctes superposées, qui sont pour la première fois clairement séparées.

Cependant, dans ce qui précède, j'ai expliqué les différentes parties d'une même raie, et les différentes images par le jeu ordinaire de l'émission et de l'absorption dans les gaz, en admettant, comme il est naturel, que la densité du gaz et la largeur de la raie diminuent lorsqu'on s'élève dans l'atmosphère. Mais on a objecté que la dispersion anomale pouvait jouer aussi un rôle et expliquer au moins en partie les particularités des images. Or, à mon avis, la dispersion anomale, certes, doit intervenir, mais faiblement, et est négligéable dans une première étude. Les raisons sérieuses à l'appui de cette assertion, seraient ici trop longues à développer. D'ailleurs si on a reconnu dans le laboratoire la dispersion anomale avec la raie H_α de l'hydrogène, on ne l'a pas constatée avec les raies du calcium. De plus, comme le centre de la raie ne subit pas la dispersion anomale, l'objection ne s'applique pas aux images de la couche supérieure, qui nous occupent surtout ici.



Couche supérieure de l'hydrogène.

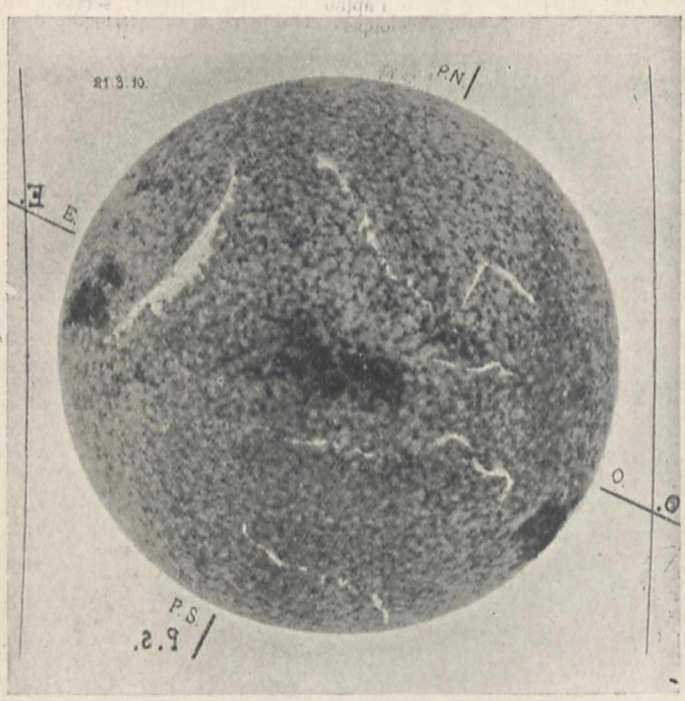


Couche moyenne de l'hydrogène.

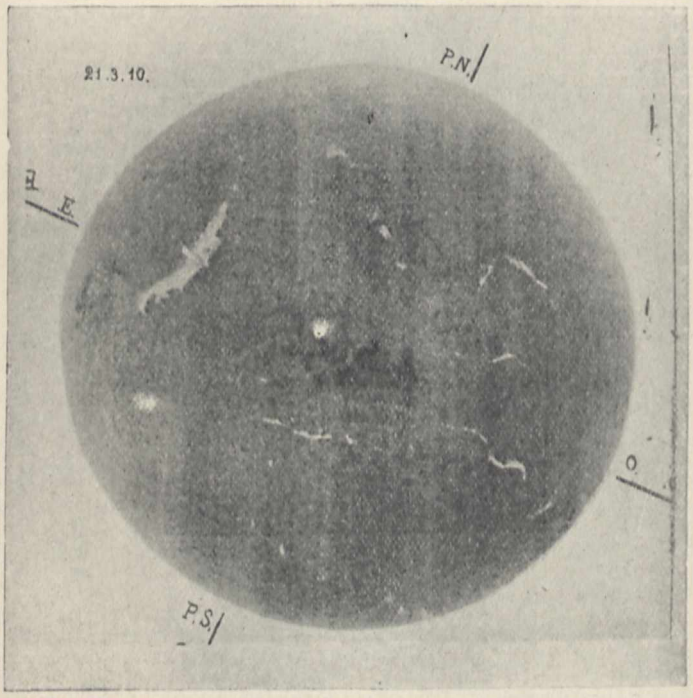
PLATE II.—Images du 22 septembre, 1909.

[1] Discourse delivered at the Royal Institution of Great Britain, on Friday, June 12, 1910, by Dr. H. Deslandres, Membre de l'Institut. Continued from p. 426.

Les filaments noirs qui se retrouvent les mêmes avec le calcium et l'hydrogène, sont bien un élément caractéristique des couches supérieures. Quelques uns avaient été déjà entrevus ou signalés par Hale dans les premières images



Couche supérieure du calcium.



Couche supérieure de l'hydrogène mélangée à une petite portion de la couche moyenne.
PLATE III.—Images du 21 mars, 1910.

complexes de K et de H_α sous le nom de longs flocculi noirs, et présentés comme dûs très probablement aux couches élevées. On a en effet dans ces conditions les filaments les plus importants dont la raie noire est très large. En fait la reconnaissance complète des filaments et de leurs propriétés ne peut être abordée qu'avec les images mêmes des couches supérieures.

Un autre élément important de ces dernières couches est la plage faculaire brillante qui se retrouve au même point que sur la surface, mais avec des formes différentes.

En résumé, si on considère les quatre couches formées par la surface et l'atmosphère, les parties les plus brillantes restent au-dessus des facules. Mais les parties les plus noires ont des positions très différentes sur la surface et dans la couche supérieure. En bas ce sont les taches et en haut ce sont les filaments, qui ont une surface noire totale supérieure à celle des taches. Il convient de mesurer l'aire des filaments aussi exactement que celle des taches.

Recherches sur les mouvements de l'atmosphère. Spectro-enregistreurs des vitesses.

Le filament noir attire surtout l'attention, et a bien, comme il a été dit plus haut, une importance au moins égale à celle des taches. Quelle est donc l'origine, quelle est donc la nature de ces longues lignes noires? Une réponse précise est bien difficile, et il suffit de rappeler notre incertitude à l'égard des taches qui sont étudiées depuis 300 ans. Cependant avec le filament, la recherche peut être plus facile. La surface, qui porte la tache, est comprise entre l'intérieur du soleil, qui nous échappe et les couches basses complexes de l'atmosphère; mais la couche supérieure, à laquelle est lié le filament, est plus libre, plus dégagée, et peut avoir une structure et des mouvements plus simples.

Et en effet, nous avons obtenu récemment à Meudon sur le filament quelques résultats dignes d'intérêt et grâce à l'emploi d'un appareil spécial, organisé jusqu'ici à Meudon seulement et appelé *Spectro-enregistreur des vitesses*. Cet appareil que j'emploie depuis 1892, a été en 1907 largement amélioré. Il décèle, comme son nom l'indique, les mouvements radiaux des vapeurs solaires, en juxtaposant les petits spectres de sections successives équidistantes sur le disque solaire, avec une seconde fente large et des mouvements discontinus automatiques. Cet enregistreur est un complément obligé du spectrohéliographe et est au moins aussi utile. Il décèle, outre les vitesses radiales, les formes générales de la vapeur, les détails de la raie entière et en particulier la largeur de la raie isolée, largeur très variable d'un point à l'autre de l'astre. Il révèle les points où le spectrohéliographe est en défaut; car ce dernier ne peut, avec une fente de largeur constante, isoler exactement une raie de largeur variable; en un mot il enregistre tous les éléments qui échappent au spectrohéliographe et permet d'interpréter sûrement ses résultats.

Sur les épreuves obtenues avec la raie K, l'examen à l'œil nu montre aussitôt que les mouvements radiaux sont en général plus notables sur le filament que sur les points voisins; parfois même toutes les raies K_3 du filament sont inclinées dans le même sens; ce qui annonce un tourbillon à axe horizontal, qui peut être opposé au tourbillon à axe vertical admis dans les taches. Mais, à cette agitation succède, comme avec la tache, un calme relatif. Si alors, on mesure avec soin les déplacements et la vitesse radiale de K_3 lorsque la vapeur est au centre du soleil, on trouve que la vapeur est ascendante et avec une vitesse souvent supérieure à la vitesse équatoriale de rotation (soit 2 km. par seconde). Le fait a été vérifié sur plusieurs filaments. Les taches et les filaments mis à part, les vitesses verticales dans la couche supérieure sont notables et souvent du même ordre que la vitesse équatoriale de rotation. La grandeur de ce mouvement vertical étonne moins si on remarque que la masse de gaz qui est l'atmosphère repose sur un foyer intense de chaleur.

Des mesures analogues ont été faites avec soin au centre

du soleil sur les facules et les flocculi, et le résultat a été inverse. La vapeur, au contraire, a un mouvement descendant et les parties relativement noires autour sont ascendantes. D'une manière générale aux points brillants de l'image K_3 de la couche supérieure, la vapeur descend ; elle monte là où l'image est relativement sombre ; ce qui est assez logique, car la vapeur qui descend se comprime et s'échauffe ; celle qui monte se détend et se refroidit.

Cette propriété reconnue déjà sur un grand nombre d'épreuves est importante ; car elle explique la structure spéciale de ces couches atmosphériques, qui s'annoncent comme divisées en courants de convection juxtaposés, exactement comme les liquides de nos laboratoires chauffés uniformément par le bas.

Les flocculi brillants forment souvent sur une étendue notable et avec netteté des polygones juxtaposés par leurs sommets, et tout semblables aux polygones qui constituent les cellules tourbillons des liquides, si bien étudiées en France par Besnard.[1] Comme la vapeur descend sur les flocculi brillants et s'élève dans des intervalles, chaque polygone solaire est aussi une cellule tourbillon. Quant aux autres flocculi du même soleil ils offrent des polygones moins nets ou incomplets, ou encore, mais plus rarement, ont des formes tout à fait irrégulières.

D'autre part, les filaments et alignements sont probablement la limite de tourbillons cellulaires plus grands, superposés aux précédents dans la couche supérieure, et dont les taches occuperaient le centre. Cette disposition est en accord avec les mouvements de cette couche près des taches reconnus par l'astronome anglais Evershed. On s'explique alors aisément pourquoi les taches sont des points et les filaments des lignes parfois très longues. La question, par ces recherches, est donc déjà un peu éclaircie ; elle sera, semble-t-il, élucidée complètement par des mesures continues de vitesses radiales, mesures étendues au disque entier de l'astre, et malheureusement très longues.

Reconnaissance des filaments polaires.

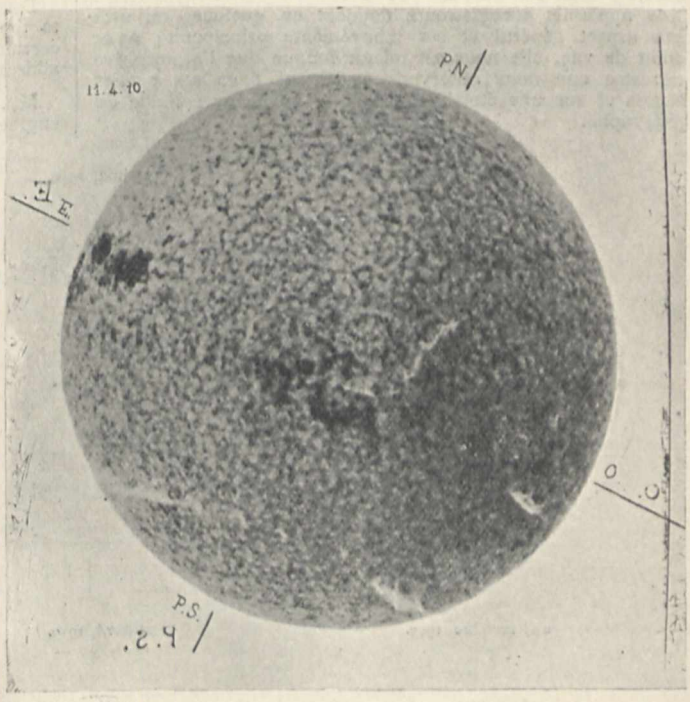
Je terminerai par une nouvelle propriété des filaments récemment reconnue à Meudon et publiée. L'observatoire a déjà les images de la couche supérieure pour plus de 20 rotations entières de l'astre, et il est possible d'étudier la distribution des filaments. Ils apparaissent à toutes les latitudes ; mais, aux pôles, en général, ils sont groupés sur une courbe plus ou moins circulaire, souvent non confondue avec un parallèle, et qui entoure le pôle. Cette courbe polaire de filaments est parfois nettement dessinée au deux pôles ; mais en général elle est nette seulement à un seul, et se déplace d'un pôle à l'autre. Cette courbe polaire était particulièrement nette et forte en avril dernier au pôle sud. (Voir les deux images du 11 avril et la Fig. 4, qui représente les filaments de quatre jours différents.)

Ces filaments polaires sont accompagnés de proéminences, et sont en accord avec les maxima secondaires de proéminences qui ont déjà été signalées aux pôles. Ils peuvent aussi être en relations avec la forme particulière de la couronne solaire au moment du minimum et avec l'inclinaison souvent constatée de l'axe coronal par rapport à l'axe ordinaire de rotation.

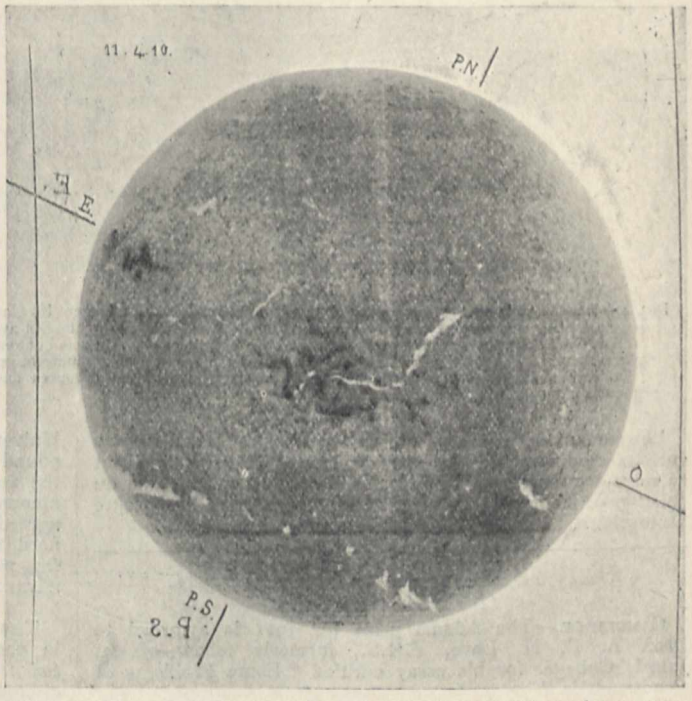
Parfois, la courbe polaire est accompagnée du côté de l'équateur d'une ligne de filaments parallèles, qui est réunie à la courbe par des filaments ou alignements inclinés ; et on a ainsi une disposition analogue à celle des bandes de la planète Jupiter.

Enfin la zone polaire de filaments, où la vapeur, comme on l'a vu plus haut, est ascendante, peut être rapprochée de la zone des taches et facules voisine de l'équateur, et où la vapeur est au contraire descendante. On est conduit à supposer dans la couche supérieure une grande circulation méridienne, un grand courant général de convection, analogue à celui qui existe sur la terre dans chaque hémisphère entre la latitude de 35° et le pôle.

Le temps manque malheureusement pour développer toutes les conséquences de ces premières observations.



Couche supérieure du calcium.



Couche supérieure de l'hydrogène mélangée à une petite partie de la couche moyenne.

PLATE IV.—Images du 11 avril, 1910.

[1] Cette disposition par polygones juxtaposés est parfois très nette sur le Soleil presque entier. L'épreuve K_3 du 18 Septembre, 1908, présente dans l'hémisphère sud, près du centre, quelques-uns de ces polygones, réunis par leurs côtés et leurs sommets ; mais, une image plus nette et plus grande est nécessaire pour les bien voir.

Mais les faits présentés suffisent à montrer le grand intérêt des études sur l'atmosphère solaire supérieure et la nécessité de les continuer.

L'atmosphère solaire est la seule que nous puissions observer dans son ensemble et dans ses couches successives. Nos appareils enregistreurs donnent en quelques minutes son aspect général et ses mouvements principaux; à ce point de vue, elle nous est mieux connue que l'atmosphère terrestre que nous observons seulement dans ses parties basses et sur une étendue restreinte, même avec l'aide du télégraphe.

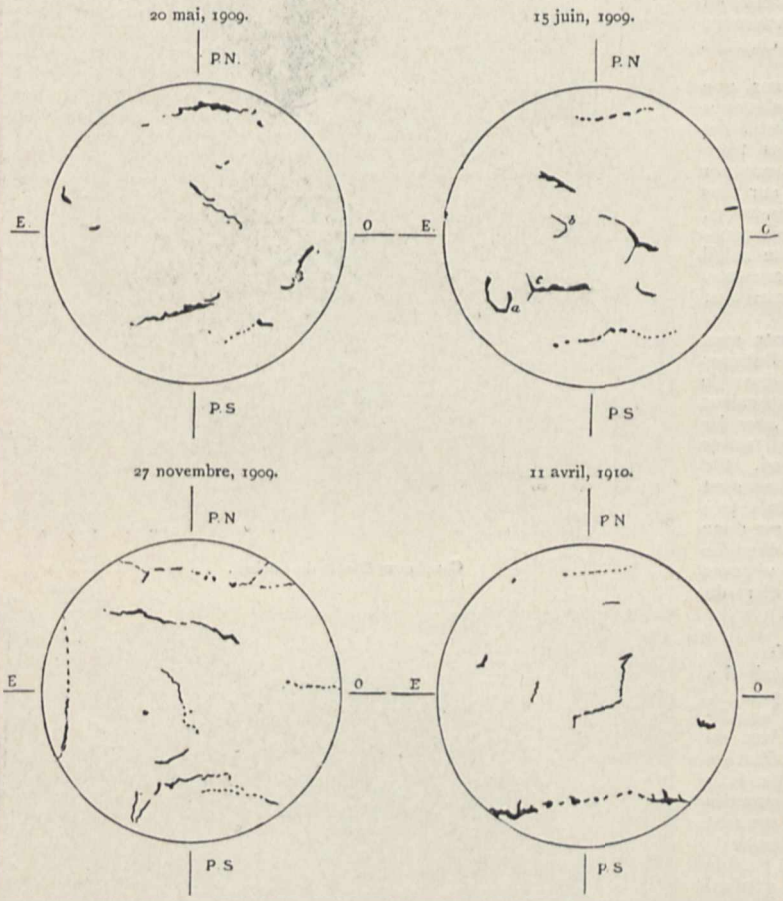


FIG. 4.—Images de la couche supérieure de l'atmosphère solaire qui montrent les filaments noirs caractéristiques et en particulier les filaments polaires. Ces images, obtenues avec l'aide de d'Azambuja, ont été relevées sur les épreuves monochromatiques du soleil obtenues avec la partie centrale des raies H_a de l'hydrogène ou K du calcium. Elles montrent seulement les filaments noirs sans les alignements. Les plages brillantes des épreuves au-dessus des facules n'ont pas été représentées.

Le réseau de courants de convection et les filaments curieux reconnus dans les couches hautes du soleil, peuvent se retrouver aussi sur la terre, et c'est ainsi que l'étude du soleil peut nous apprendre à mieux connaître notre propre atmosphère.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Adams prize for 1911 is awarded to Prof. A. E. H. Love, F.R.S., formerly fellow of St. John's College, for his essay entitled "Some Problems of Geodynamics."

The adjudicators of the Hopkins prize awarded by the Philosophical Society for the period 1900–3 have awarded the prize to Prof. J. H. Poynting, F.R.S., for his researches on the transmission of energy in the electric field and on the pressure exerted by radiation.

MR. FRANK HOWSON has resigned the lectureship in physiology in the College of Medicine of the University of Durham to accept a similar appointment at Sydney, New South Wales.

DR. T. J. MACNAMARA, M.P., Parliamentary Secretary to the Admiralty, will distribute the awards of prizes and certificates at the Battersea Polytechnic, and deliver an address, on Tuesday evening, February 28.

MR. JAMES LEES, assistant lecturer in the faculty of engineering at the University of Bristol, has been appointed to the post of lecturer in engineering in the South African College, Cape Town.

THE annual distribution of prizes to students of the City and Guilds of London Institute will be held on February 17 at the Mansion House, the Lord Mayor presiding. Dr. R. T. Glazebrook, F.R.S., of the National Physical Laboratory, will deliver an address.

IT is announced in *Science* that the fund of 150,000*l.* for the Johns Hopkins University is now complete. This insures the payment to the fund of a further 50,000*l.* offered conditionally in February of last year by the General Education Board, as was explained in our note last week on the report of the president of the Johns Hopkins University for the year ended August 31, 1910.

DR. HERMON C. BUMPUS has resigned the post of director of the American Museum of Natural History, New York, which he has held since 1902, and has accepted an appointment as "business manager" of the University of Wisconsin. The post is a new one, the University having recently decided to divide the administrative work between the president and an officer of this name. The office will be entirely separate from academic or teaching functions.

THE Drapers' Company has made a grant of 15,000*l.* for the erection of a new wing for the department of applied science of the University of Sheffield. The new buildings will be used to house the mining section and the research department for the silver and allied trades. The council of the University on January 27 passed a resolution thanking the Drapers' Company, and expressed a desire to associate the name of the Drapers' Company with the extensions as a record of the company's generosity.

THE Birmingham Education Committee has decided to recommend the City Council to increase the grant to the University of Birmingham from one halfpenny in the pound to an amount equal to one penny in the pound on the assessable value of the city, which it is expected will amount to about 12,000*l.* The Education Committee has agreed also to suggest to the University authorities the need for increasing the number of scholarships available for persons who would not otherwise be able to take advantage of the University teaching.

THE following gifts and bequests for higher education in the United States have been announced recently in *Science*. An old student, who does not wish his name disclosed, has given 20,000*l.* to the University of Pennsylvania for the endowment of a chair of physiological chemistry. It will be known as the "Benjamin Rush chair of physiological chemistry." Dr. Alonzo E. Taylor, formerly of the University of California, will be the first occupant of the chair. The University of Vermont has received 13,593*l.* from the Rockefeller Foundation, repre-

senting the first instalment of a gift of 20,000*l.* made to the University on condition that an additional 80,000*l.* was raised. The 80,000*l.* has now been subscribed, and the amount 54,200*l.* has been collected. The total amount is to be added to the endowment fund for the general uses of the University. Mr. William Blodgett has given to Columbia University two farms near Fishkill, N.Y., to be used in connection with the work in agriculture. By the will of Mrs. Martin Kellogg, Yale University receives a bequest of 10,000*l.* from the estate of the late Mr. Martin Kellogg, who was formerly president of the University of California.

LORD CURZON OF KEDLESTON was on January 25 installed as Lord Rector of Glasgow University. The subject of his address was "East and West: a Retrospect and a Forecast." After a brilliant review of the ethnographic and historic *differentiae* of Asia and Europe, he proceeded to estimate the probabilities as to their future relations. Some had argued that we in Europe "have given to Asia little that she values, or, if left to herself, would not cast away. Our education, it is said, she has only borrowed to turn against us; our religion she rejects; our civilisation she despises; she is indifferent to our science; she will manufacture our implements for her own protection; she will dispute our hegemony, defy our authority, dispense with our agents, undersell our produce, and end by annexing our trade." Lord Curzon gave in detail his reasons for disbelieving this prediction. Among others, he recalled the fact that "the inventions of science, which we are told that the East is to retain for its own selfish use, are not confined to producing the comforts, or conveniences, or even the destructive implements that are employed by man. They have, on the whole, a unifying and softening influence. The electric telegraph, the railway, the steamship, the Press, the post, travel to and fro—all these are agencies which tend to bring men together rather than keep them apart. Medical science has shown itself to be so valuable an instrument of social influence and fusion, that it has been permanently grafted on to missionary enterprise. The common share in this heritage of science would render it very difficult for the East to shut itself successfully off again from the West, or to pursue a policy of selfish exclusion. Even were the dependent portions of the East to recover complete political autonomy, the Western would be always "within its gates." "Some of those whom I have the honour of addressing here may be called on to play a part in the future evolution of the great drama which I have endeavoured to describe. If so, I would ask them to bear in mind three things—never to look down on the East or the Eastern; to remember that the progressive elevation of the East is still the noblest work with which the West is charged; and to realise that each individual European in Asia is not merely a soldier, but a standard-bearer of his race. In a Chinese temple at Canton there stands a venerated gilt statue of a man with a benevolent expression on his features and a black hat on his head. He is supposed to be the Venetian Marco Polo, and to be thus honoured by the Chinese because he taught the West to understand and to respect the East. Be it yours, if you have the opportunity, to earn a similar reputation."

A CONFERENCE of about forty delegates of the provincial joint committees of European schools in India was held early in January at Calcutta, under the presidency of Sir Robert Laidlaw. In addition to delegates from every province in India, including Burma, we learn from the *Pioneer Mail* that several prominent education officials were present and took part in the discussions. Several speakers pointed out the inadequacy of the educational facilities offered for the children of Europeans in India, and eventually some fifteen resolutions were adopted. One resolution urged that in view of the great and increasing difficulty of finding suitable occupations for the children of the domiciled community, as well as for other and higher reasons, this conference regards it as urgently necessary that European schools should be enabled to provide a more efficient and complete training, physical and intellectual, than they have hitherto given, and that to such improved general education should be added instruction especially devised to prepare scholars for their chosen professions in life. Another recorded that the conference regards a more efficient staff, especially in the lower classes of schools, as an indispensable condition of improvement in education. Whilst considering it necessary that for the present qualified teachers should, as hitherto, be brought from abroad, the conference regards it as equally necessary that such efficient training should be provided in India as should make it possible for locally recruited candidates to equip themselves fully for the teaching profession, and, further, the conference considers "that every qualified teacher should enjoy a reasonable salary increasing with long service, some provision for retiring allowance, and fair security of tenure." A third resolution pointed out that the conference regards the adequate and complete education of the domiciled community as one of the primary responsibilities of the Government of India, and considers that in view of the necessary larger cost of that education the imperial revenue must bear a larger share than heretofore. At the same time, it acknowledges the duty both of the Christian churches and the domiciled community to assist the Government financially and otherwise to a much greater extent than in the past. Regarding the curricula of Indian universities as unsuited to European students, the conference strongly urged the establishment of a Central European College affiliated to the University of London, and staffed, for the present, by fully equipped teachers from abroad. To this college, it was decided, may suitably be added classes for the training of secondary teachers.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 26.—Sir Archibald Geikie, K.C.B., president, in the chair.—Major P. A. **MacMahon**: Memoir on the theory of the partitions of numbers. Part v.: Partitions in two-dimensional space.—Arthur **Schuster**: The origin of magnetic storms. The paper contains a critical examination of the theory that magnetic storms are caused by streams of electrified corpuscles ejected from the sun. If the electro-kinetic energy of such storms be calculated, it is found that, when the magnetic field produced is comparable with that observed in magnetic storms, the energy is enormously great compared with that obtained by mere addition of the energies of the separate corpuscles. Even if during violent storms, when the magnetic force may be of the order 0·004 C.G.S., the corpuscles had an initial velocity nearly equal to that of light, the energy required to establish the magnetic field would be sufficient to reduce the speed to less than 4 kilometres a second before the swarm reaches the earth, the passage between the sun and the earth taking about a year. In this calculation the cross-section of the swarm is assumed to be determined by the effective duration of the magnetic disturbances which it is supposed to produce. If the swarm be reduced in cross-section the energy belonging to it would be diminished, but for a given magnetic force the density of the corpuscles in the swarm must then be correspondingly greater. This leads to the consideration of the effects of electrostatic repulsion between the particles. It appears that if H be the magnetic effect, the electrostatic acceleration at the edge of a swarm of electrons must be greater than 5×10^{17} H. This acceleration would be sufficient to drive a corpuscle in the first second through a distance equal to more than the diameter of the earth. It follows that, even taking account of electromagnetic attractions between the corpuscles, a swarm of corpuscles, when sent out from the sun in a definite direction, would soon be dissipated to such an extent that no sensible magnetic disturbance could be produced. Finally, the electrostatic effects, which would be observed on the surface of the earth in each magnetic storm, are discussed, and here the calculation also leads to the conclusion that the theory criticised is untenable. If magnetic disturbances are produced by rays emanating from the sun, it can therefore only be in an indirect manner. We may imagine that the injection of corpuscles ionises the upper portions of the earth's atmosphere, and consequently renders the already existing electromotive forces more effective, or we may imagine that the approach towards the earth's magnetic field of highly conducting

material containing ions of both kinds acts by induction. The effect of such induction would primarily be an increase in the horizontal and a diminution of the vertical forces, while the currents induced in the earth, tending to diminish the horizontal forces, would, owing to their inertia, die out more slowly, so that a semi-permanent effect would be left after the storm. This agrees with observation, but there are at present not enough data available to test the sufficiency of the explanation.—Arthur **Schuster**: The periodicity of sun-spots. In this communication, the sun-spot records of the last ten years are discussed in so far as they have a bearing on the results previously submitted to the society. It appears that the period of 4·79 years discovered by the author is confirmed, but that the evidence does not support the periodicity of 4·38 years, which had been previously described as doubtful, nor that of 8·36 years, which during the first half of last century seemed active. Attention is directed to the independent discovery of the period of 4·79 years in the declination range of the magnetic needle at Munich by Mr. Oppenheim.—Dr. G. C. **Simpson** and C. S. **Wright**: Atmospheric electricity over the ocean. This paper contains the results of observations made on the voyage from England to New Zealand on Captain Scott's Antarctic ship the *Terra Nova*. The investigation is divided into four parts. The first part deals with the electrical potential-gradient over the ocean. It is found that the gradient has its chief maximum in the evening and its chief minimum soon after midday. The afternoon minimum is remarkable because, though observed at many stations on land, it has often been ascribed to the disturbing effect of dust. In view of the present results, this explanation does not seem correct. The minimum, which is observed at 4 a.m., and which has been considered the principal one in observations taken on land, is only feebly developed at sea. The numerical value of the potential-gradient was found, on the average, to be about 80 volts per metre, and is therefore approximately the same as that observed on land. The second part of the investigation deals with the quantity of radio-active products which are found in the air. The observations show that these products are decidedly fewer at sea than on land, and a specially low value, both north and south of the equator, is found in latitudes from 30° to 40°. This is ascribed to the fact that the air in these latitudes is supplied by pure air descending from the upper parts of the atmosphere, while it is mainly the air which has passed over land which carries radio-active products with it. In the third part of the investigation, the number of free ions in the air are measured, and here again it is found that the ionisation over the sea is smaller than that over land. In the concluding part of the paper the spontaneous ionisation in a closed vessel is measured. Though part of the effect is ascribed to a real effect of air becoming conducting by itself, some of the results obtained indicate clearly that when the ship near land was exposed to radio-active emanation, the observed ionisation showed an increase for several hours afterwards.—Dr. W. H. **Young**: The Fourier constants of a function. In this paper the possibility of treating the Fourier series of a function $f(x)$ in various circumstances, as if it were convergent and integrable term by term, when multiplied by another function, is illustrated by the application of this fact to the determination of expressions for $\Sigma a_n n^{-q}$ and $\Sigma b_n n^{-q}$, a_n and b_n denoting the Fourier coefficients of $f(x)$, and q having a non-negative value. The formulæ are shown to be valid for any function that has bounded variation in an interval containing the origin, and is elsewhere summable, provided only that q is greater than zero.—J. A. **Crowther**: The energy and distribution of scattered Röntgen radiation. Experiments have been made to determine what fraction of the incident radiant energy is scattered per unit mass of a radiator when primary Röntgen rays fall upon it. From the numbers obtained a value has been deduced for the number of electrons per atom of the radiating substance. The value obtained agrees closely with that previously deduced from experiments on the scattering of homogeneous β rays, being very nearly three times the atomic weight of the substance. The distribution of the scattered radiation has been measured. It reaches a maximum forwards and backwards along the line of the primary beam, and falls to a minimum at right angles to this direction. At any given angle with the primary beam there is always a preponderance of scattered radiation in the forward direction. This preponderance increases the more nearly we approach the line of the primary beam.—Mrs. Hertha **Ayrton**: Some new facts connected with the motion of oscillating water. The author's explanation of the origin of ripple-forming vortices having been contested, she has made further experiments to prove the two propositions on which it rests, viz. that when water oscillates over a submerged obstacle:—(1) during the whole of any single swing a diminution of pressure is established close to the upper part of the lee side of the barrier; (2) while the water is falling below the mean level, in the half of the trough where the obstacle is, there is a back pressure against the flow on its lee side below the area of diminished pressure. Experimental proof of these pressure conditions is given by means of an obstacle in the form of a hollow water-tight box, of which the top and one side are covered with thin guttapercha tissue diaphragms, the air being expelled and the box partly filled with water. These pressure conditions cause a jet to flow down close to the lee side of an obstacle during the first part of a swing, and a vortex to form during the second by upsetting the equilibrium of water, in the lee of the obstacle, that would otherwise remain at rest. The back pressure extends only to the limits of this slack water, *i.e.* to the line where the lowest water flowing over the obstacle strikes the bottom. A trough with an artificial end fitted with diaphragms is used to show that such pressure conditions are not confined to submerged obstacles, but come into existence close to any solid where water, in oscillating, is moving away from it, and wherever two masses of water are flowing away from one another, as at the node of a stationary wave. These variations of pressure give rise to jets and vortices near the surface of oscillating water wherever it meets the end of a vessel, and at every node; it is these jets and vortices, and the streams that feed them, that cause the residual whirls previously found by the author in oscillating water. The most important proof of this is that when the trough is rocked, so that there is much bottom motion but very little rise and fall, and, consequently, only feeble jets and vortices, the author's residual whirls are insignificant, while Lord Rayleigh's, beneath, develop to their full length and height even in deep water.

Geological Society, January 11.—Prof. W. W. Watts, F.R.S., president, in the chair.—Miss G. R. **Watney** and Miss E. G. **Welch**: The zonal classification of the Salopian rocks of Cautley and Ravenstonedale. The district described lies north-east of Sedbergh and west of the Dent fault. Below are Valentian rocks (A and B divisions of the Stockdale shales). The Wenlock beds are most fully developed in some streams entering the river Rawthey from the south. The detailed succession of these is given, and confirmatory sections are described in other parts of the district. The Ludlow beds are found mainly in the northern part of the area, where the geology is simpler. A comparison is instituted between these beds and those in the Welsh borderland, and those of Wenlock age in southern Sweden. A description of a Cyrtograptus intermediate in character between *C. rigidus* and *C. symmetricus*, and of a new Monograptus from the Nilssoni beds of Wandale Hill, is given in a palæontological section.—Herbert **Bolton**: A collection of insect remains from the South Wales Coalfield. Nine examples of insect remains, all, with one exception, blattoid in character. Seven are described as new species. The insect remains are referable to three horizons, one at the base of the upper series of the Coal Measures, and two in the upper part of the Pennant series. The suggestion is put forward that possibly Carboniferous cockroaches were not only phytophagous in habit, but frequented decaying Cordaites leaves in order to feed upon the Spirorbis. The presence of archimylacrid and orthomylacrid forms is considered indicative of an advance in insect development in the British Carboniferous beyond the palæodictyopteran types, while their abundance in the Pennant and upper series of the South Wales Coalfield may justify the hope of finding more primitive forms at a lower horizon in the same coalfield.

Royal Microscopical Society, January 18.—Prof. J. Arthur Thomson, president, in the chair.—Prof. J. Arthur **Thomson**: Presidential address: the determination of sex. The president discussed, historically and critically, five theories or sets of suggestions. (1) It has been suggested that environmental condition, operating on the sexually-undetermined, developing offspring-organism, may, at least, share in determining the sex. The evidence in support of this has in great part crumbled before criticism and before the counter-evidence of cytologists and Mendelians. (2) It has been suggested that the sex is quite unpredestined in the germ-cells before fertilisation, and that it is then settled by the relative condition of the gametes (as affected by age, vigour, &c.), or by a balancing of the inherited tendencies which these gametes bear, neither ovum nor spermatozoon being necessarily decisive. The evidence in support of this is very far from satisfactory. Yet in view of some sets of experiments, of R. Hertwig in particular, it seems rash to foreclose the question. (3) It has been suggested that the sex is predestined at a very early stage by the constitution of the germ-cells as such, there being female-producing and male-producing germ-cells, predetermined from the beginning, and arising independently of environmental influence. The evidence in support of this is very strong, both on experimental and on cytological grounds. (4) It has been suggested that maleness and femaleness are Mendelian characters, and one form of this very attractive theory is that femaleness is dominant over maleness, and that females are heterozygous as regards sex and males homozygous as regards sex. But there are grave difficulties as well as very striking corroborations. (5) It has been suggested that environmental and functional influences, operating through the parent (or, in short, the parent's acquired peculiarities), may alter the proportion of effective female-producing and male-producing germ-cells, as, for instance, in Russo's experiments on rabbits. This possibility remains tenable. Prof. Thomson argued in support of the thesis that there is no sex-determinant at all in the usual sense, but that what determines the sex of the offspring is a metabolism-rhythm, a relation between anabolism and katabolism, or a relation between the nucleoplasm and the cytoplasm. Many sets of facts converge in the inference that each sex-cell or gamete has a complete equipment of both masculine and feminine characters, of which there are doubtless chromosomic determinants. It may be that the liberating stimulus which calls the masculine or the feminine set into expression or development is afforded by the metabolism-rhythm set up in the cytoplasmic field of operations. It may be that this metabolism-relation—between nucleoplasm and cytoplasm doubtless, and likewise between anabolism and katabolism—leads, first and necessarily, to the establishment of ovaries or of spermaries, and secondly, either directly or through the gonads with their internal secretions, to the expression of the contrasted masculine or feminine characters.

PARIS.

Academy of Sciences, January 23.—M. Armand Gautier in the chair.—L. E. **Bertin**: Additional remarks on the general laws of retarded or accelerated motion in ships.—A. **Müntz** and E. **Lainé**: The nitrates in the atmosphere of the Antarctic regions. A series of determinations of the nitrates in snow and rain in southern latitudes have been carried out by R. E. Godfroy, accompanying Dr. Charcot's Antarctic expedition. Expressed in milligrams of nitric anhydride per litre, the amounts found varied between 0·1 and 0·4, with an average of 0·23. These results are compared with the data of Boussingault in Alsace, Lawes and Gilbert at Rothampstead, and Müntz and Marcano at Caracas, in the tropics. It was especially desired to obtain figures for the proportion of nitrate in rain and snow during the occurrence of the aurora borealis, but owing to the absence of this phenomenon at the stations occupied by the expedition, these data were not obtained.—M. Branly was elected a member in the section of physics in the place of the late M. Gernez.—Ernest **Esclangon**: A system of fixed or differential synchronisation. An improvement in the system of governing recording chronographs. The synchronising wheel, making approximately one revolution per second, carries two poles of soft iron, and these pass at each revolution in front of two electromagnets, the latter being actuated by the controlling clock. If the wheel carrying the electromagnets is slowly rotated, a differential movement is obtained. If driven so as to make one revolution in twenty-four hours, for which purpose an ordinary clock movement is sufficiently accurate, the synchronising wheel can be controlled to give one revolution per sidereal second. The system can also be applied with advantage to the control of an equatorial.—P. **Idrac**: First observations on the new star in Lacerta. The spectrum of this star, discovered December 30, 1910, has been studied and photographed at the Observatory of Meudon with the arrangement already used for the study of the Halley and Innes comets. Five hydrogen lines are brilliant, and also a strong band about $\lambda=464$. As regards the classification of this star, it might be either a variable star of long period or a new star; the great brilliance of the hydrogen lines appears to rather favour the second hypothesis.—C. **Russyan**: The system of generalised canonical ordinary differential equations and the generalised problem of S. Lie.—Paul **Lévy**: Differentials of functions of plane lines.—U. **Cisotti**: The dynamical reaction of a liquid jet. The dynamical reaction of the liquid jet does not depend on the form of the vessel in the neighbourhood of the orifice. In the particular case where the jet is a continuation of the axis of the vessel, the reaction of the liquid jet is entirely supported by the bottom of the vessel.—Jean **Becquerel**: The magnetic modifications of the absorption and phosphorescence bands of rubies, and on a fundamental question of magneto-optics. The nine different principal cases described by H. du Bois and Elias are shown to be reducible to five; the anomalies are shown to depend on a faulty orientation of the crystal with respect to the optic axes.—A. **Senouque**: Experiments in wireless telegraphy from an aëroplane. There is no difficulty in sending wireless messages from an aëroplane provided that the sending instruments are sufficiently strongly built to resist the disturbing influence of the vibrations of the motor, and are sufficiently light in proportion to the supporting power of the aëroplane.—Pierre **Weiss**: The rationality of the ratios of the magnetic moments of the atoms, and a new universal constituent of matter. By the assumption of the existence of a substance *magneton*, possessing a definite magnetic moment, the experimental results of Kamerlingh Onnes and Weiss, Weiss and Foëx, P. Pascal and other workers, are readily explained. Magneton is regarded as a universal constituent of matter.—C. E. **Guillaume**: The anomaly of the expansions of nickel-steels. The effect of chromium and manganese in altering the expansion of nickel-steels is discussed, and the results given in graphical form.—Eugène **Bloch**: The discharge potential in the magnetic field. The modern theory of disruptive discharge, in the few cases to which the calculation can be definitely applied, appears to be in complete accord with the observed facts. The rule of interkathodic action given by M. Gouy appears to fail in certain cases.—Jean **Meunier**: A new property of copper, and on the active flameless combustion of gases or convergent combustion.—J. **Bougault**: The transformation of phenyl-$\alpha\beta$-pentenic acid into its $\gamma\delta$-isomer. The action of solution of caustic soda on the $\alpha\beta$-acid did not give the expected $\beta\gamma$-isomer, but the $\gamma\delta$-isomer. The identity of the latter acid was established by its iodolactone and by the conversion of the lactone into the corresponding phenyl-$\gamma\delta$-pentenic acid. This is the first example of such a transformation.—Georges **Dupont**: Acetylene pinacone. This substance was prepared by the action of acetone on the magnesium compound of dibromoacetylene, and a description is given of its behaviour towards dehydrating agents and towards the halogen acids.—Pierre **Breteau**: A method for the complete destruction of organic matter in the detection and estimation of mineral poisons. The material is heated with strong sulphuric acid, as in a nitrogen determination, in a current of nitrous fumes. The oxides of nitrogen are obtained by the action of sulphur dioxide upon nitric acid. If the sulphur dioxide is taken from a cylinder of the liquid gas, the production of the oxides of nitrogen is under perfect control; 300 grams of organic matter can be completely destroyed in four hours by this method.—O. **Lignier** and A. **Tison**: Are the Gnetales apetalous

Angiosperms? It is concluded that the flowers of Gnetales are clearly Angiosperms, but, contrary to the views usually held, represent organs in course of reduction.—Marcel **Mirande**: The action upon green plants of some substances extracted from coal-tar and employed in agriculture. Various mixtures are sold of substances extracted from coal-tar for use as insecticides or antiseptics. It is shown that discretion must be employed in the use of such substances, as under certain conditions they may be harmful to plants.—René **Maire** and Adrien **Tison**: Some Plasmodiophoraceæ.—Eugène **Pittard**: An analysis and comparison of the dimensions of the skull and face in gipsies of both sexes.—Ch. **Gravier**: Some animals parasitic on the Madrepores of the genus Galaxea.—L. **Bordas**: The morphology and histological structure of the digestive apparatus of the larva of the Lepidoptera.—Paul **Marchal**: The parasites of the olive-fly in Tunis. A description of *Opius concolor*, a parasite of the olive-fly, and the part it may play in destroying this fly, and thus indirectly protecting the olive crop.—R. **Robinson**: The aponeurotic cavities of the intercostal muscles and their signification in physiology and medicine.—Ch. **Vaillant**: A new method of determining by radiography whether an infant, supposed to have been born dead, has really lived or not. After replying to various criticisms, the author adduces additional facts in support of the views put forward by him on this subject in 1908.—Marc **Romieu**: Plasmatic reduction in the spermatogenesis of *Ascaris megalocephala*.—Gabriel **Bertrand** and M. **Javillier**: The influence of manganese on the development of *Aspergillus niger*. Salts of manganese are shown to possess a markedly favourable influence on the development of this mould.—L. **Bounoure**: A comparative study of four digestive diastases found in some species of Coleoptera.—M. **Groth**: The primary of Sierra Morena.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part v. for 1910, contains the following memoirs communicated to the society:—

July 9.—K. Willy **Wagner**: The propagation of currents in cables with an imperfect dielectric.

July 23.—H. **Weyl**: Ordinary linear differential equations with singular regions and their proper functions.—L. **Lichtenstein**: The integration of a definite integral with respect to a parameter.—K. **Lerp**: The sources of error in the Kaufmann-Simon method of determining the specific charge of an electron.—F. **Bernstein**: The last of Fermat's theorems.—O. **Toeplitz**: The theory of quadratic forms with an infinite number of variables.—F. **Bernstein**: The second case of the last of Fermat's theorems.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 2.

ROYAL SOCIETY, at 4.30.—Experiments to investigate the Infectivity of *Glossina palpalis* Fed on Sleeping Sickness Patients under Treatment: Col. Sir D. Bruce, F.R.S., Captains A. E. Hamerton and H. R. Bateman, and Dr. R. van Someren.—Experiments to Ascertain if *Trypanosoma gambiense* during its Development within *Glossina palpalis* is infective: Col. Sir D. Bruce, F.R.S., and Captains A. E. Hamerton, H. R. Bateman, and F. P. Mackie.—Further Experimental Researches on the Etiology of Endemic Goitre: Captain R. McCarrison.—On the Leaves of Calamites (Calamocladus Section): H. Hamshaw Thomas.—Complement Deviation in Mouse Carcinoma: Dr. J. O. Wakelin Barratt.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

LINNEAN SOCIETY, at 8.

RÖNTGEN SOCIETY, at 8.15.—The Work of Action of an Induction Coil: Prof. Salomonson.

FRIDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 9.—Grouse Disease: A. E. Shipley, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—President's Address: Flint and Chart: W. Hill.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Rivers and Estuaries: W. H. Hunter.

MONDAY, FEBRUARY 6.

ROYAL SOCIETY OF ARTS, at 8.—Brewing and Modern Science: Prof. Adrian J. Brown.

ARISTOTELIAN SOCIETY, at 8.—Value and Reality: Miss H. D. Oakeley.

SOCIETY OF CHEMICAL INDUSTRY, at 8 (at King's College).—The Chemistry of the Lead Chamber Process: Dr. F. Raschig.

SOCIETY OF ENGINEERS, at 7.30.—Presidential Address: F. G. Bloyd.

TUESDAY, FEBRUARY 7.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Recent Theories about Palæolithic Man: J. Gray.

ZOOLOGICAL SOCIETY, at 8.30.—On the Structure and Function of the Gas-glands and Retia Mirabilia associated with the Gas-bladder of some Teleostean Fishes, with Notes on the Teleost Pancreas: Dr. W. N. F. Woodland.—Skulls of Oxen from the Roman Military Station at Newstead, Melrose: Prof. J. Cossar Ewart, F.R.S.—Plankton from Christmas Island, Indian Ocean. I. On Copepoda of the Family Corycæidæ: George P. Farran.—On some New Zealand Spiders: H. R. Hogg.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Detroit River Tunnel, between Detroit, Michigan, and Windsor, Canada: W. J. Wilgus.

WEDNESDAY, FEBRUARY 8.

ROYAL SOCIETY OF ARTS, at 8.—Some Nigerian Head-hunters: Captain A. J. N. Tremearne.

GEOLOGICAL SOCIETY, at 8.—Investigations pursued in conjunction with Mr. R. E. Priestley, in the Course of the British Antarctic Expedition of 1907–09, more especially the Investigations connected with Glacial Geology: Prof. T. W. Edgeworth David, C.M.G., F.R.S.

THURSDAY, FEBRUARY 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: (1) Certain Physical and Physiological Properties of Stovaine and its Homologues; (2) The Effect of some Local Anæsthetics on Nerve: Dr. V. H. Veley, F.R.S., and W. L. Symes.—(1) Experimental Researches on Vegetable Assimilation and Respiration. VIII. A New Method for Estimating the Gaseous Exchanges of Submerged Plants; (2) Experimental Researches on Vegetable Assimilation and Respiration. IX. On Assimilation in Submerged Water-plants and its Relation to the Concentration of Carbon Dioxide and other Factors: Dr. F. F. Blackman, F.R.S., and A. M. Smith.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Superstitions: R. A. Leslie Moore.

ROYAL INSTITUTION, at 3.—Problems of Animals in Captivity: P. Chalmers Mitchell, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned discussion*: Long Distance Transmission of Electrical Energy: W. T. Taylor.—Extra High Pressure Transmission Lines: R. Borlase Matthews and C. T. Wilkinson.

MATHEMATICAL SOCIETY, at 5.30.—The Application of the Mathematical Theory of Relativity to the Electron Theory of Matter: E. Cunningham.

FRIDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 9.—Robert Louis Stevenson: Sir Sidney Colvin.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Rivers and Estuaries: W. H. Hunter.

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