THURSDAY, JANUARY 11, 1906.

THE EQUATIONS OF THE WAVE THEORY.

The Analytical Theory of Light. By J. Walker. Pp. xv+416. (Cambridge: The University Press, 1904.) Price 15*s.* net.

MR. WALKER has written a valuable book, but one difficult to review. As he says in his first sentence:—

"The Science of Physical Optics may be regarded as comprising two fields of enquiry; the one includes the study of the physical properties of a stream of light, the other comprehends the investigation of the Mechanism by means of which the stream is propagated. These two divisions may be called respectively the kinematics and the dynamics of the subject."

It is with the first of these that Mr. Walker is concerned; a few experimental facts suffice to show that a stream of light may be represented by a periodically varying vector, transverse to the beam, and on this result, with an appeal where necessary to experimental facts, the treatment of the subject is based.

The appeal to experiment is made as rarely as possible, and as a result we have a book dealing with a physical subject which is almost entirely pure mathematics. Such a book has its value, and in this the value is a high one, for the author has discharged the task he set himself in an admirable manner; but owing to his severe restraint the book lacks interest and its difficulty is increased. It is not a text-book of physical optics, but of the analytical theory of light; the light vector satisfies certain differential equations, and the consequences of this are traced out with a rare degree of completeness. It is a book to which students who desire to know how far the mathematical side of the wave theory has been carried, what are its limitations, and in what directions advances are possible will usefully turn. This knowledge is necessary for the physicist who is more interested in the dynamical theory, for, as Mr. Walker points out, it forms the touchstone on which optical theories are tried, and no one theory of the ether can at present be said to hold the field. No doubt the introduction of even the salient points of the various theories might have had the effect which the author fears of veiling his main purpose; still, the restraint which he has laid on himself has its disadvantages.

Starting with the ordinary geometrical propositions of the wave theory, we come in the second chapter to a discussion of Michelson's experiments and the recent work on the nature of white light; the properties of the polarisation vector are deduced from the non-interference of two beams polarised in planes at right angles. In connecting together the intensity of a beam of light and the amplitude of the polarisation vector, a difficulty is at once met with unless we know the relation between the energy of the stream and the amplitude. For this purpose we require to determine the nature of the vector, and this it is impossible to do without advancing a theory of the mechanism of the transmission, a course which is closed to us. However, the assumption that the square of the polarisation vector measures the intensity is shown to lead to consistent results, and this assumption is made.

The analytical theory really begins in chapter v. with the differential equations of the polarisation vector; the previous discussion has enabled us to express this in the form of a function of $vt-r$, where v is the velocity of propagation, and from these the differential equations are deduced in the usual form, and the important result that when the wave velocity is independent of the period any singularity of phase or amplitude travels with the speed of the wave is shown to follow by a method of proof due to Poincaré; Lord Rayleigh's generalisation in the case when the velocity is a function of the period follows.

Reference had been made in an earlier chapter to Huyghens's principle and its connection with the rectilinear propagation of light; the full proof of the principle depending on the relation at any point within a surface S between a function ϕ_0 satisfying $d^2\phi/dt^2=w^2\nabla^2\phi$ and a certain surface integral taken over the surface of S is then discussed, leading us to Stokes's well known law of the secondary disturbance due to a wave of light, and also to an expression for the disturbance in the neighbourhood of a screen producing diffraction. Fraunhofer's diffraction phenomena are first discussed here; the more complicated cases known as Fresnel's, in which the screen is not at the focus of the light forming the diffraction pattern, follow. The treatment is based on that of Lommel, and deals fully with a rectangular aperture or obstacle, a straight edge, Fresnel's biprism, and a circular aperture and disc. The treatment of the biprism follows Struve and Weber's work.

In chapter ix. an account of some quite recent work by Sommerfeld, Poincaré, and Macdonald dealing with the application of spherical harmonics to diffraction phenomena is given, and after this a short account of Newton's rings and of the laws of reflection and refraction leads to double refraction. For uniaxial crystals the theory is based on Huyghens's assumption, first satisfactorily verified by Stokes, that the wave surface consists of a sphere and a spheroid which touch at the extremities of the axis of the latter, while for biaxial crystals all the laws are deduced from Fresnel's polarisation ellipsoid, a surface which has the property that the velocities of propagation of any wave are equal to the reciprocals of the axes of the section of the ellipsoid by a plane parallel to the wave. Hence the form of the wave surface and the laws of double refraction follow in the usual way.

Chapter xii. contains a number of results on the wave surface which are not easily found elsewhere; in dealing with reflection at a crystal surface, the equations of the polarisation vector in a crystal are first formed, and then the surface conditions are deduced. Free use is made of MacCullagh's ingenious device of uniradial directions. The discussion of the inter-

ference of polarised light follows a normal path, but the part relating to biaxial crystals is unusually full. The later chapters deal with absorbing media, dispersion, structurally active media, and magnetically active media; each of these phenomena is shown to follow from suitable modifications in the expression for the light vector; the interesting question of the constitution of the ether which could give rise to such modifications is, of course, in the author's scheme passed by. But while this is necessarily the case, the analysis given is very full and complete, and Mr. Walker has added to the literature of the subject a book of real value. The book has been printed at the Cambridge Press and published by the Syndics, and their share of the work is admirable.

LIQUID CRYSTALS.

Kristallinische Flussigkeiten und flussige Kristalle. By Rudolf Schenck. Pp. viii+158. (Leipzig: Wilhelm Engelmann, 1905.)

THE announcement of the discovery of liquids that were doubly refracting and dichroic by Prof. Lehmann some fifteen years ago was received with considerable mistrust, for the possession by a liquid of these properties which had hitherto been associated solely with the solid crystalline state seemed at first sight almost inconceivable, and quite inconsistent with the generally accepted ideas as to the molecular tactics of liquids and crystals. The very name of liquid crystal seemed to be self-contradictory. Lehmann's results, however, were soon confirmed by other physicists, one of the most active amongst whom was Dr. Schenck, the writer of the present work on the subject.

Several explanations of Lehmann's observations were offered, based on the assumption that he had worked with liquids containing impurities. Quincke supposed them to consist of solid crystalline particles surrounded by a film of liquid, and Tammann endeavoured to explain their properties by assuming them to be an emulsion of two liquid phases. On the other hand, Lehmann pointed out that it was not justifiable to consider these cases as if they were isolated instances of irregular properties, since the behaviour of these liquids apparently so anomalous may be reconciled with that of other crystalline media if we consider the part played by the rigidity of crystals in maintaining their crystalline form. His investigations have shown that the rigidity of different crystals varies within wide limits. The majority of those we know best offer considerable resistance to deformation, while some, like yellow phosphorus, are quite soft, and others, such as the oleates, have so little rigidity that the force of surface tension is sufficient to deform the crystal from its true geometrical shape; in the limiting case, that of *p*-azoxyanisol and the other liquids investigated by Lehmann, the rigidity has become so small compared with the force due to surface tension that the crystal when placed in a liquid of equal density assumes a spherical form.

Lehmann's work was entirely microscopic, but macroscopic investigations were undertaken by other investigators. A study of the physical properties of the birefringent liquids, particularly of their viscosity and dielectric constants, and an unsuccessful attempt to resolve them by cataphoresis, showed that each of them was without doubt a single substance, and thus the hypotheses put forward by Quincke, Tammann, and other authors were disproved.

Prof. Lehmann's monograph on these bodies, which was reviewed in NATURE recently (vol. lxx., p. 622, 1904), consists mainly of an account of the results of his microscopic investigations and of the theory he has formulated to explain these. A very important part of the work was thus left undescribed, and Dr. Schenck's book covers the ground omitted by Lehmann, and, in addition, gives a short summary of the latter's experiments.

The preparation of the various substances that have been found to yield anisotropic liquids is described in detail, also the determination of their physical constants. The investigation of the surface energy of the liquids indicates that there is no sudden change in their molecular weight at the temperature at which the anisotropic liquid passes into the isotropic condition. The viscosity curves, however, show a large break at this temperature, the isotropic liquids being in some cases the more viscous. The density curves show a similar discontinuity. The two liquids have different specific heats, and there is a small but definite heat of transformation of one form to the other.

Dr. Schenck has given a very complete account of our knowledge of these anomalous liquids, which have great interest both for the chemist and physicist, and his book will be of great service to those who wish for information about them. It is clearly written and arranged, and contains a number of diagrams and plates. Of theories as to their nature he wisely fights very shy, and it seems that considerably more work is needed before we shall be able to form any clear idea as to their molecular structure.

H. B. H.

PLANT-BREEDING IN AMERICA.

New Creations in Plant Life: an Authoritative Account of the Life and Work of Luther Burbank. By W. S. Harwood. Pp. xiv+368; 50 illustrations. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) Price 7*s.* 6*d.* net.

THERE is something to be said in favour of this work; at the same time we imagine no one will have more cause to regret its appearance than Mr. Burbank himself. The reasons for this expression of opinion are easily supplied. It is decidedly desirable that the outside public should be made aware of the enormous practical importance of what is called plant-breeding, and that they should be familiarised with the means and methods adopted by experts for the multiplication and improvement of flowers, fruits, and other vegetable products. A slightly increased percentage of sugar in the sugar-cane or the beet, an apparently trifling improvement in the staple of

cotton, the development of a potato relatively immune to fungous diseases, an increased production of fruit or the introduction of hardier varieties, of some that are earlier, of others that are later, to say nothing of the improvement of flowers in form, colour, and perfume, are all points of great importance and of very great interest from a biological point of view.

In this field of work Mr. Burbank has long been known as an energetic labourer, and it is quite possible that in actual amount his work bulks larger than that of any of his predecessors or his contemporaries. Moreover, as we learn from the book before us, and from other sources, the experimenter is a man of high purpose, modest, and amiable. It is for these personal reasons we imagine that he will have cause to regret the appearance of this volume. We have no desire to belittle Mr. Burbank or to undervalue the importance of what he has accomplished. We believe that he would be the first to acknowledge that there existed strong men previous to the appearance of Agamemnon. But this is a fact that his eulogist does not sufficiently estimate. In perusing the glowing paragraphs of this volume the casual reader might imagine that there were no plant-breeders before Burbank, or that their labours were comparatively insignificant, and yet in our own country alone we seem to have heard of Thomas Andrew Knight, of Dean Herbert, of Trevor Clarke, of Thomas Rivers, of John Laing, of Dominy, of Seden, of Laxton, and of a large number of others whose productions at least vie in importance with those of the American experimenter, whilst a visit to the great establishments of Vilmorin, near Paris, Benary, and others at Erfurt and Quedlinburg, as well as to the trial-grounds of our Veitchs, Suttons, Carters, and many others, would show that the great American hybridist is by no means without a rival in his line of work.

It would hardly be fair to criticise those products of Mr. Burbank's skill and perseverance that have reached us, because it may well be that they are not yet adapted to our climate. At any rate, to name only a few instances, the Burbank plum, the Burbank lily, the Shasta daisy, all so enthusiastically spoken of in the pages of this book and elsewhere, have not, in this country, justified the encomiums passed upon them by the American Press.

When we read of Mr. Burbank's methods of work we do not find anything different from the practices of our "raisers," who are too modest to speak of their efforts as "creations."

Among the "creations" mentioned in this volume is the "thornless edible cactus." Surely we have heard of and seen a spineless Opuntia before attention was called to it in this volume, where it is stated that "nothing more marvellous has ever been done in plant-life"!

Again, "the rare effects developed in the transformation of the columbine" do not differ (so far as we can tell from the illustration facing p. 359) from the stellate columbine known in our gardens for centuries and figured on p. 273 of Parkinson's Paradisus (1629).

A man who has experimented on such a colossal scale for so long a time might be expected to have gathered valuable information on such points as heredity, adaptation, inheritance of acquired characters, as well as formed opinions on Mendelism and mutation. We gather from the book before us that Mr. Burbank's attention has, almost of necessity, been directed to these subjects, and we earnestly hope that now that the Carnegie Institution has granted him a subvention of ten thousand dollars a year for ten years he will find time to record and coordinate his experiments for the benefit of future workers and the increase of biological knowledge.

Incidentally, we glean that Mr. Burbank is not inclined to accept the views of Weismann or of Mendel, but that he looks favourably on the mutation theory of De Vries. Surely no practitioner has had better opportunities of judging of these matters than has Mr. Burbank, and if he will give us his own experiences in his own words, rather than in those of some too partial biographer, the world will be the gainer, and the value of Mr. Burbank's work more accurately gauged than it can be from the perusal of the present volume.

CHEMICAL TECHNOLOGY.

Chemische Technologie. By Dr. Fr. Heusler. Pp. xvi+350. (Leipzig: B. G. Teubner, 1905.) Price 8 marks.

THE author states in the preface that the work is intended for the use of merchants. This at once opens up the question whether a book of this kind, ostensibly written for non-chemists, can fulfil its object. The author is under the impression that a merchant has acquired, in the course of his secondary education, sufficient knowledge to read and interpret chemical equations, and he adopts in his work chemical symbols throughout, in the belief that it would be almost an insult to the German merchant to think him incapable of understanding chemical equations.

The reviewer cannot agree with this opinion in its broad generality. His own experience would lead him to confirm in this respect the truth of the trite old saying, "A little knowledge is a dangerous knowledge." When the commercial director of a chemical works asks his chemist, in times of stress, to use a sulphuric acid of 50° Bé instead of 66° Bé on the score that the former is so much cheaper for the same amount of sulphuric acid, or when the chief clerk struts through the works meddling with the chemistry of the business, then the chemist would certainly prefer the English system of subdividing the work. Of course, there are merchants who are fully able to understand purely chemical questions, but such merchants would certainly have recourse to the extensive manuals on their own specialities rather than study the present work, in which the information on every subject must necessarily be very meagre.

From this point of view the book is not within the horizon of the average chemical merchant. The tendency to explain the subject so far as possible by equations necessarily leads to a twisted and sometimes wrong representation, as these may be read to

mean complete chemical changes, whilst often enough they only express part of the chemical change that is going on. Statistical data, the most useful information to a merchant, are very imperfectly given. Whilst, *e.g.*, the statistics of ammonium sulphate refer to the years 1902 and 1903, other more important branches of chemical technology hark back as far as the 'eighties of last century.

If the question be asked whether this book would prove useful to a chemist, a much more favourable opinion can be pronounced. The work will be found very helpful, as a kind of "Repetitorium," to a chemist who is reading up for examination. Regarded in this light, the book may be said to have been written concisely and to contain an enormous amount of information, put together in a clear and transparent form. Naturally, the attempt of one single author to press the wide range of chemical technology into one small volume carries with it the germ of defect. For in the present state of chemical technology it is clearly impossible for any single person to write on every branch with the necessary authority or even necessary knowledge. The inevitable consequence of such an ambitious endeavour is that books of this kind bear too patently the stamp of writing-desk work. Only in the case of the electrolytical processes dealing with alkali chlorides the author has called in the assistance of an expert. He would have done well to have extended this invitation to other specialists. We therefore find throughout the book many statements which could have been put right by an expert, and we also notice some important omissions. Moreover, some of the weakest chapters, such as those on "leather industry" and "fats and oils," would have been brought into line with the aforementioned chapter on electrolysis. The least satisfactory part of the book are the illustrations. Some of them have done service for half a century, and might have been given their well-earned rest. Others are more in the nature of pictures which convey no information. Others, again, such as the illustration of a native indigo plant, can only provoke a smile. J. L.

OUR BOOK SHELF.

Future Forest Trees. By A. H. Unwin Pp. 108. (London: T. Fisher Unwin, 1905.) Price 7*s.* 6*d.* net.

WITHIN recent years our forestry literature has been rapidly and steadily on the increase, which may be taken as a sign that more attention is now being given to matters sylvicultural than formerly. The above work is one of the most recent additions, and its thoroughly sound, practical, and scientific character should secure it a wide circulation, not only in this country, but also in America, to which it equally refers.

The title chosen by the author, "Future Forest Trees," refers to those exotic, deciduous, and coniferous species of East, West, and North American trees which might with advantage be introduced into our forests. The work embodies the author's own personal experience, as well as the results gained by more than 100 years of extended experiments which have been carried out in Germany.

The selection of exotic species as future forest trees is not by any means so easy a task as one might at first sight suppose. To justify its introduction and cultivation the new species must have some distinct advantageous characteristics which are not possessed by our indigenous trees, such as greater rapidity in growth, greater resistance to adverse climatic conditions (for example, wind, heat, cold, rain, and snow), greater adaptability to the poorer classes of soil, and such like.

It is to Prof. H. Mayr, of Munich, to whom this book is dedicated, that we are indebted for so much valuable information on this very important question, especially as regards the geographical distribution of forest trees.

The first part of the book deals with the imports of American timber to the German market. Importing timber to Germany, the home of forestry, sounds a little like carting coals to Newcastle; nevertheless, there are at least two sufficient reasons, firstly, because some of these timbers are at present not cultivated in that country, and, secondly, it is a well-known fact that the world's supply of timber is not inexhaustible, and is, in fact, rapidly on the decrease. Hence, while Germany can obtain timber at a reasonable price from abroad, she is conserving her own forest reserves with the full knowledge that at no very remote date the price of timber will have risen to a figure which will amply justify this policy of conservation. Part ii. gives the general results of planting experiments with American trees in Germany, Austria, Great Britain, and Switzerland; and part iii. deals with the sylvicultural characteristics and treatment of the various American species of trees.

We heartily commend this book to all those who are interested in or connected with forestry, as it forms an excellent guide to the cultivation of species which are likely in the course of time fully to justify their introduction.

Elements of Quantitative Analysis. By Dr. G. H. Bailey. Pp. x+246. (London: Macmillan and Co., Ltd., 1905.) Price 4*s.* 6*d.*

AFTER the consideration of some preliminary matters, the author, within the compass of less than two hundred small pages, treats of almost every branch of quantitative chemical analysis, including minerals of many sorts, water, fuel, the products of alkali factories, manures, organic substances, soap, oils and fats, and gases. It follows that the space devoted to each section is very small, and in many cases it would be more correct to say that the methods are indicated rather than described. This economy of words and space sometimes leads to instructions that might cause accidents, as in the description of Kjeldahl's method of estimating nitrogen, where the student is instructed to boil the substance with fuming sulphuric acid, &c., then to "allow to cool and add a tolerable excess, about 50 grams will suffice, of caustic soda. . . . Distill off the ammonia," &c. In other cases the desire to be brief leaves the student without instructions, as in the analysis of water, in which he is told to determine the free and albumenoid ammonia, and referred for the method to a simple description of the estimation of ammonia by Nessler's solution. On the other hand, it is a pleasure to notice that some methods are given that are not generally known, such as the colorimetric estimation of titanium by means of hydrogen peroxide.

The educational value of the work suggested (to which the author refers in his preface) would have been enhanced if the chemistry of the operations and the specific aims of the advisable manipulative pre-

cautions had been given more fully in a few preliminary cases, so that the student might have been helped to understand thoroughly his early exercises. As he gets more advanced he ought to refer to standard works and original treatises. Then this present volume will furnish an excellent series of suggestions as to work that may be done in many directions in order to gain experience and increase his knowledge. C. J.

Elementary Dynamics. By W. M. Baker. Second edition, revised. Pp. x+318. (London: George Bell and Sons, 1905.) Price 4*s.* 6*d.*

THIS text-book follows ordinary lines. The author does well to direct the attention of the beginner at the outset to the fact that *weight* and *mass* are by no means the same thing. Newton's laws are given almost unchanged in words, the second being altered to "rate of change of momentum is proportional to the impressed force, &c." The word *rate* is, in strictness, ambiguous, since it does not necessarily imply time-rate; and the explanation (p. 33) that "rate of change of momentum" means the change of momentum *in* the unit of time is not quite accurate, since the unit of time may be an hour or a week. The poundal figures a great deal; but, happily, as a rule, the values of forces are given in gravitation measure in the answers. The antiquated and inaccurate terms *power* and *weight* are used in the discussion of machines, although *power* has been very properly defined as time-rate of doing work. The old method of defining the instantaneous value of a variable angular velocity as "the number of unit angles which would be described in the unit of time, if during that unit the angular velocity remained the same as at the instant under consideration" is adhered to; but this definition defines nothing. The author is commendably clear in his warning to the student that "centrifugal force" is not a force acting on a revolving body. In the discussion of projectiles, the eye is not pleased by the sight of "$u \sin at - \frac{1}{2}gt^2$" for $ut \sin \alpha - \frac{1}{2}gt^2$; and it is just possible that a beginner may (by the inscrutable ingenuity for error which students sometimes exhibit) misunderstand the expression altogether.

The book contains a very large collection of examples, and has, as a slight departure from the plan of ordinary text-books, a short chapter at the end showing how initial tensions are calculated when cords are cut or broken.

A Historical Geography of the British Colonies. By C. P. Lucas, C.B. Vol. ii. The West Indies. Second edition, revised by C. Atchley. Pp. 348; diagram and maps. (Oxford: The Clarendon Press.) Price 7*s.* 6*d.*

THIS valuable work has been published at an opportune moment, for the decisions of the Imperial Government in such matters as the withdrawal of the white troops and the non-renewal of the mail contract have led to a widespread idea that our West Indian possessions are about reaching the most momentous stage in their long history, namely, their transfer to the United States—an extreme step which is hardly likely to be taken in our time. The volume deals not only with the West Indian islands proper, from Jamaica round to Trinidad, but also with the Bermudas, the Bahamas, the mainland colonies of Guiana and Honduras, and even the far distant possessions in the Cape Horn region—the Falkland Islands and South Georgia. The total area aggregates 127,345 square miles, Guiana alone being 100,000, and Honduras 7562 square miles. The remainder is cut up into a multitude of small islands, ranging down to the Bermudas group, of 19 square miles. Yet each island, however small, has its own separate history. Originally the Spaniards had Papal authority for taking possession of the New World, but they were not a colonising people, and as "conquerors and crusaders they looked for a large area of territory; consequently, while they discovered the whole ring of islands, they settled on the larger ones only, and on those only which lay nearer to the continent. With the smaller islands they had little dealings beyond carrying off their inhabitants for slaves." There was thus no effective occupation of the large majority of the islands, and English, French, and Dutch buccaneers appearing on the scene, in the course of time they divided the islands between them, the lion's share eventually, as the result of treaties or wars, falling to the English. The earliest of the British possessions was Barbados (1605), the latest, by conquest, St. Lucia and Tobago (1803). Obviously, within the compass of a single volume, only a general historical account of each colony could be given, and Mr. Lucas has accomplished his task most successfully. But in addition to the purely historical portion he supplies much information relating to the geography, the geology, and the climate of the islands—as varied as their history. The economic conditions are also fully set forth, the particular industries of the several islands, their exports and imports, and so on, while the form of government of each colony is described. There is a very complete index, and at the end of each chapter there is a list of books and publications which will afford the reader fuller details, many other authorities being referred to in footnotes.

Vorlesungen über mathematische Näherungsmethoden. By Dr. Otto Biermann. Pp. ix+226. (Brunswick: Vieweg und Sohn, 1905.) Price 8 marks.

THE aim of the author of this book is to give a connected and fairly comprehensive account of the most important mathematical methods of approximate calculations. Strictly speaking, all scientific calculations are approximate; but by suitable processes the approximation may be carried to a degree of accuracy sufficient to satisfy the most exacting requirements. How best to effect the approximation in any given case must ever be a most important problem. The necessity for it begins with ordinary arithmetical operations, to which, accordingly, Dr. Biermann devotes a large part of the first chapter. A good deal of detail might have been spared here if only to make room for a complete account of Horner's method of solving numerical equations and extracting roots. The algebraical theory only of Horner's method is given in a later chapter, but not the expeditious arithmetical process. To give an idea of the scope of the book, we find systematic discussions of the calculations of logarithms, graphical solution of equations, methods of interpolation and differences, determination of Fourier coefficients, methods of quadrature and cubature, and a chapter containing, among other things, a description of the sliding scale and Amsler's planimeter. There are some interesting novelties in the sections on graphical solution of equations which might well find a place in our English text-books of algebra, such, for example, as Mehmke's method. The book does not cover all the ground indicated by the term *Näherungsmethoden*, but it certainly covers more ground than any other book. Indeed, it fills what has been until now a distinct blank in mathematical literature; and the author is to be congratulated on the production of a work which cannot fail to be of service to the student of mathematical methods.

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.]*

Insectivorous Water-plant from Trinidad.

SPECIMENS of the carnivorous water-plant from the Trinidad Pitch Lake, referred to in the note on p. 230, have been received at Kew from Mr. Hart. It is not, however, as supposed, "a species of Nitella," which is an aquatic cryptogam, but a flowering plant, and a species of Utricularia.

The habits of these plants are fully discussed in Mr. Darwin's "Insectivorous Plants."

W. T. THISELTON-DYER.

Kew, January 5.

The Maximum Number of Double Points on a Surface.

IT is obvious that a surface, like a curve, must have a maximum number of double points; and it is also obvious that all of them may be *conic nodes*, but only a limited number of them can be *binodes*; but so far as I have been able to discover, no formula has been obtained for determining the maximum number. In Hudson's book on "Kummer's Surface," a proof is given that a quartic surface can have as many as sixteen conic nodes, but no general theorem is alluded to. I shall therefore state a formula by means of which the maximum number can be calculated.

Let a surface of degree n and class m have C isolated conic nodes. Let $\bar{\iota}$ and ι be the number of double and stationary tangents possessed by any plane section of a tangent cone the vertex of which is an arbitrary point. Then it is not difficult to show that

$$m = n(n-1)^2 - 2C \quad (1)$$

$$\iota = 4n(n-1)(n-2) - 6C \quad (2)$$

$$2\bar{\iota} = \{2C - n(n-1)^2 + 5\}^2 - \{n(n-1)(3n-14) + 25\} \quad (3)$$

Now ι and $\bar{\iota}$ must be zero or positive integers; also m must be a positive integer which does not fall below a certain limit, and these conditions will in general be satisfied by taking

$$2C - n(n-1)^2 + 5 = \pm k,$$

where k is the least odd integer the square of which is not less than $n(n-1)(3n-14)+25$. The sign of k must be determined from the above mentioned conditions, and should the least value of k fail to satisfy them a greater one must be taken.

A. B. BASSET.

January 2.

Sounding Stones.

MANY hard and compact varieties of rock are sonorous when struck. Flint nodules often possess this property. The purity of the tone appears dependent upon the length, calibre, and homogeneity of the nodule, the best results being obtained from the long and slender forms. At Studland Bay I have collected many of these "musical" flints, and obtained one from a chalk pit near Faversham which can be used as a gong when suspended. This particular specimen is nearly 2 feet in length (it was once longer), and is scarcely as thick as a rolling-pin!

Many years ago I saw a "rock harmonicon" in the museum at Keswick. It was formed of strips of rock (known as "clinkstones") arranged on the principle of the dulcimer, upon which various tunes could be played.

The phonolite of the Wolf Rock, nine miles south of the Land's End, possesses sonorous properties, and Sir Wyville Thomson has described St. Michael's Mount, an island near Fernando Noronha, as being entirely formed of phonolite which "literally rings like a bell" on being struck.

In quarrying the rock from the Whit Bed, at Portland, the workmen profess to be able to judge of the quality of the limestone by the clearness of the metallic ring emitted from the blocks on being struck.

January 5. CECIL CARUS-WILSON.

Heat a Mode of Motion.

THROUGHOUT Swedenborg's "Principia," published in 1733, both heat and light are constantly regarded as ethereal undulations. The definitions of heat as a rotary movement of minute ether particles will be found in part iii., chapter v., No. 21; chapter vii., No. 10; chapter viii., Nos. 8, 9, 10, 16.

The following is from the "Principia," part iii., chapter vii. :—

"Whatever the ether presents to our organs by means of colours, the air presents to us by means of modulations and sounds. Thus Nature is always the same, always similar to herself, both in light, and in sound, in the eye and in the ear; the only difference is that in one she is quicker and more subtle, in the other slower and crasser."

Although this is not an example from the seventeenth century, it anticipates the theories of Rumford and Young as to light and heat by some sixty years.

CHARLES E. BENHAM.

Colchester, December 23, 1905.

The Naming of Colours.

PERHAPS some of your readers would be interested in, and could suggest some explanation of, the following rather fanciful colour term. A light purple, almost a mauve, is called by the Chinese 雪 (süt$_6$) 青 (Ts'eng), 色 (shik,) "snow green colour." I have asked many educated Chinese for some explanation of the name, but the best I can get is the Chinese are very "fanciful" in the use of colour terms. I may say that the term I have translated "green" is sometimes applied by the Chinese to the colour of the sky.

ALFRED H. CROOK.

Queen's College, Hong Kong, December 2, 1905.

Aurora of November 15.

THE aurora of November 15, 1905, was seen at Szczawnica, in Galicia (Karpathian Mountains), by the meteorological observer Mr. Wojakowski at 9h. p.m. M.E.T.

The day of November 15 and the subsequent night were in Galicia cloudy and rainy. Probably the sky was clear for a while at Szczawnica. The altitude of Szczawnica is 484 metres; longitude, 20° 30′ E. of Greenwich; latitude, 49° 26′ N.

M. P. RUDZKI.

K.K. Sternwarte, Krakau, January 1.

Ascent of Sap in Trees.

WITH reference to an article on the above subject which appeared in your issue of October 26, 1905, the following extract from a paper—which your contributor has doubtless not seen, published nearly ten years ago—will probably interest some of your readers.

FRANK HARRIS.

Maryland, Saundersfoot, December 25, 1905.

EXTRACT FROM *Indian Engineering*, FEBRUARY 8, 1896.

Ascent of Sap in Trees.

Among the various theories which have been advanced to explain the circulation of sap in plants, those dependent on purely mechanical principles are, as has been pointed out, entirely untenable. That hypothesis which relies solely on the osmotic action of the root hairs, though adequate in itself to account for the rise of water to almost any extent, is not compatible with the so-called "negative" pressure observed to exist in the vessels of living timber. The last mentioned among the explanations to which allusion has been made—that which invokes the aid of what may be loosely described as the vital principle—though unobjectionable in itself, unnecessarily complicates

the question; and while some of the difficulties which present themselves upon detailed examination may be overcome, others are less easily surmounted. In the trunk of a tree it is only the cambium itself which can properly be regarded as consisting of living cells—if we use the expression in its usual sense. Besides protoplasm the cambium cell contains a nucleus, and splitting up to form the growing wood is evidently and unquestionably a living cell. The sap cannot, however, be considered as entirely rising through the cambium alone; while the medullary rays and wood-parenchyma, although they both contain protoplasm or such like organic substances, are in no other respects like living tissue. They may be regarded simply as store houses containing nutritive matter, or as actively engaged in the plant's circulation, or as acting in both capacities; but scarcely can they be described as centres of vitality.

The theory which most readily commends itself to our ideas of probability is that which regards osmosis as the primary and all potent cause of the sap's ascent in plants; not taking place in the root alone, as was supposed by those who advocated the earlier theory, but active throughout the whole height of every tree. Concerning osmosis itself it is well to remember that the phenomenon contains nothing transcendental or beyond the reach of ordinary molecular physics for its complete explanation. We know that the particles of a liquid, though far from possessing that mobility which in a gas is due to the great extent of free path enjoyed by its molecules, are constantly in a state of translational motion with regard to each other. The phenomenon of diffusion in inorganic solutions obviously suggests the conclusion that this capacity depends largely upon the relative simplicity which characterises the molecule's construction. Especially is this idea forced upon us when considering the relative diffusibility of various solutions. Here we find the rate of diffusion bearing a definite relation to the solution density; the square of the time of equal diffusion being in the case of such solutions equal to their solution density. It would appear, apart from all questions of chemical combination, that each molecule—or perhaps group of molecules—of the solvent becomes attached to a certain number of molecules of the dissolved substance; this complex group holding together so far as diffusion and osmosis are concerned. Under such circumstances it is only to be expected that the rate of diffusion, which means the passage through intermolecular fluid spaces, or of osmosis, which consists in the passage through interstitial spaces in a porous solid, should vary quite as much as is observed to be the case.

It is true the relatively small differences in the rate of passage through porous bodies observable when inorganic solutions are compared with each other, seem to depend principally upon chemical action between the solutions and the substance; but in the much more marked difference observed when we compare the dialysis of crystalloid and colloid bodies, this does not depend on any such action.

Now in a plant we have a system in which the process of nutrition is going on at both ends, the roots and the leaves of a tree; it is, however, the organic colloid substances which are manufactured in the leaves, while in most part inorganic or crystalloid compounds are absorbed by the roots. Both forms of nutriment are required at every point of the tree. The colloids have to descend, the crystalloids and water have to be raised. Constant evaporation from the leaves by maintaining "negative" pressure in the vessels greatly facilitates the rise of water from below; but the motive power is osmotic action taking place between any or every pair of cells in the chain. The "air bubbles" which form a *chapelet de Jamin* in the vessels and prevent the fall of any water previously raised by osmosis, at times when demand falls or moist air saturating the leaves supplies all water necessary from above, very possibly convert the fluid column itself into the equivalent of a porous body suitable for the action of osmosis to make itself felt between each pair of drops as they hang suspended in the vessels. The film of liquid surrounding each bubble is as a narrow space in a porous body through which the simpler and smaller groups of atoms can more readily pass than can that cumbrous collection which constitutes the physical molecule of any colloid solution. This action adapts itself exactly to the plant's requirements. Should any sap fall short at any point of water or crystalloid solution, osmotic action immediately supplies what is required from below; while the enormous pressures which dialysis can bring into play leave gravity *une quantité negligeable*. The details characterising this action as observable in conifers, as distinguished from dicotyledonous trees, will doubtless vary. The former suggest to most unbotanical minds the idea of an earlier and less highly developed type. The tracheides of a conifer act simultaneously as conducting vessels and as hollow cells in the structural framework of the trunk considered as a beam; while these purposes are more or less differentiated in the case of dicotyledonous plants. In this latter case the wood-parenchyma cells surrounding the "vessels"—filled as they are with colloid matter—appear to supplement the action of the medullary rays, not here in such close connection with conducting tracheides as they are in the case of conifers. The presence of all this colloid matter, scattered throughout the conducting mass and closely connected with the tracheides or with the fitted vessels, probably act as a reservoir and enlarge the sphere of the osmotic action, thus avoiding violent changes and preventing any very noticeable difference in sap density occurring throughout the tree's height. A gradient, however, marking difference in proportion between colloids and crystalloids must necessarily exist whenever water is rising, and this would naturally be expected to follow the introduction of these different forms of nutritive matter at opposite ends of a chain.

ELEMENTARY GEOLOGY.[1]

IF a new elementary text-book of geology is really in request, no better author could be found than the president of the Geological Society of London for 1905. We venture to prefer this work to his somewhat similar "Agricultural Geology," and hope that candidates for a diploma in agriculture will now make use of both. The author, while engaged upon his task, appears to be absolutely devoid of the emotion which "nature-study" provokes in other men in various measure, and his introduction, if a little cold, should lead to accurate observation and understanding. The photographic illustrations are refreshingly large, and include successfully the forms of familiar fossils and even of flint implements. Four pins fixed in a dull white wall would, however, have served as a more satisfactory support for a helpless belemnite than the operating table and other apparatus displayed in Fig. 29. The striking relic of a Triassic land-surface, photographed by Prof. H. E. Armstrong (Fig. 27), is here reproduced, as an example of the admirable landscapes in this volume.

Our only question about the book is as to the class for whom it is intended. In the frequent absence of systematic scientific training in English schools—things are fortunately different now in Ireland—scholars may come up to our universities completely ignorant of chemistry and physics. They may also be ignorant of the animal and vegetable forms around them, and they are certain to believe that coral is a substance laboriously manufactured by an insect. We take it that, on contact with Dr. Marr and the well-known Woodwardian collections, such scholars may become attracted towards geology. Hence, in the present work, this complex subject, relying for its evidence on almost every other science, is treated as one to be laid before babes, who have never handled a blowpipe, or stroked the back of a cat to see that it possessed a spinal column. From these pages the reader may "proceed to the perusal of more advanced treatises." But what

[1] "An Introduction to Geology." By J. E. Marr, Sc.D., F.R.S. Pp. viii+230. (Cambridge: University Press, 1905.) Price 3s. net.

is to be his course of study in between? Before the advanced treatise, or, at any rate, such a one as Dr. Marr would approve, can be really entered on and appreciated, the student must surely have some practical acquaintance with carbon dioxide and silica as chemical substances, with "boneless animals" and "those possessing bones," and with other matters that are here mentioned as if they were absolutely new to his intelligence. On pp. 224 and 225 the beginner is sent out into the open country as his "true museum." This is excellent advice for the true beginner in geology, but not for those beginners in science whom Dr. Marr, from his experience of English public schools, finds himself compelled to contemplate.

Among the excellent points in the present treatise we notice the early introduction of conceptions of crust-movement, which render descriptions of other phenomena far more easy of comprehension; the reference to what is often known as "plucking" in the action of glaciers (p. 57); and the concise account of plains of denudation (peneplains) on p. 99. Among the very few slips, we may note that Kimeridge (p. 179) is in Dorset, not in Wiltshire; that the insoluble part of felspar (p. 79) does not by itself form china-clay; and that the phrase "evaporation of water by the sun" (p. 67) is scarcely a happy one. The fan-structure on p. 93 is, we think, not that usually thought of in connection with the term.

On p. 65 we must invoke subsidence of the crust to enable the sea to perform all the work there claimed for it; and we should like more sympathy on p. 89 with the view that the earth is continually losing moisture from its interior. Lastly, the author (p. 181) should not, even by an accident of phraseology, encourage a belief in the existence of "fossil thunderbolts." But these small asperities only give an edge to our appreciation. GRENVILLE A. J. COLE.

FIG. 1.—Wind-worn surface of older rocks (on right), revealed by removal of New Red Sandstone, Charnwood Forest. Landscape of Triassic times. (From Marr's "Introduction to Geology.")

TIDAL RESEARCHES.[1]

ONE of the crowning features of the enunciation by Newton of the law of universal gravitation consisted in the fact that herein the phenomena of the tides and their relationship with the moon could for the first time be coordinated with other well-known phenomena of the solar system. Though the principal phenomena of rise and fall and ebb and flood of the sea must have been recognised by coast dwellers and navigators from the earliest times, the theory of the tides as it exists to-day may fairly be said to have originated with Newton, and its purpose has largely been to examine to what extent these phenomena are attributable solely to a gravitational cause or how far it may be necessary to invoke some other exciting or controlling influence.

It was early recognised that a theory which failed to take due account of the inertia of the water, of the earth's rotation, and of the curvature of its surface could but inadequately represent the phenomena actually existent in nature, and the reduction of the tidal problem to a mathematical form in which all these features were duly taken into account was first accomplished by Laplace; since his time the equations furnished by him have formed the basis of almost all attempts to further the study of the tides from its purely theoretical aspect. The theory of tides in narrow canals developed *in extenso* by Airy, though not directly based on Laplace's equations, consists largely in the discussion of a special type of solvable cases of the more general mathematical problem propounded by Laplace. In the memoirs under review the author emphasises the hopelessness of such attempts to realise their main purpose of providing a theory sufficiently exact and yet sufficiently general in character to allow of direct comparison with observations, as is the practice in the study of other gravitational phenomena such as the planetary motions, and proposes a new method of attacking the problem. An essential difference between this method and that of Laplace consists in the fact that in the former the influence of the earth's rotation is regarded as of secondary importance. Such solutions of Laplace's equations as have been obtained, which allow of an exact estimate of the

[1] "A Manual of Tides." Part iv. A, Outlines of Tidal Theory. Part iv. B, Cotidal Lines of the World. By Rollin A. Harris. Appendices to Reports of U.S. Coast and Geodetic Survey.

influence of the rotation in the restricted problems dealt with, by no means appear to justify this course.

If, however, a complete tidal theory which should adequately account for all the phenomena of observation has hitherto been found wanting, at least considerable advance in the coordination of observed phenomena has been obtained by the introduction of the harmonic analysis for the discussion of tidal observations, while tidal records suitable for such analysis have accumulated. These, so far as they are accessible at all, are scattered through various scientific publications, and the author has rendered a valuable service to all interested in tidal phenomena in collecting them in tabular form in a single memoir. The tables given on pp. 664–677, part iv. A, and pp. 342–351, part iv. B, contain the results of the harmonic analysis of tidal observations taken at more than four hundred stations distributed throughout the world, and probably contain almost all information of a precise character in relation to the tides at present available. These tables give the amplitudes and phases of the principal types of oscillation as derived from observation alone, and only involve theory in so far as it enables us to assign the periods in advance by means of exact astronomical data. It is to be regretted that in no case is any indication given of the degree of precision with which the analysed results reproduce the actual observations from which they are derived, or of the extent to which they confirm the theory on which they depend.

A considerable portion of the memoirs is further devoted to an attempt to coordinate the results derived from different stations so as to form a comprehensive picture of the general progress of the tide-wave over the surface of the ocean, and the results are exhibited in a series of charts indicating the position of the wave crest at each successive cotidal hour.

The construction of these charts is, unfortunately, but vaguely indicated. As already stated, no ready means is provided of estimating the value of the material used for the purpose, or of the methods used for its combination.

In so far as these charts are based on the results of observation alone we are prepared to believe that they give a fairly accurate representation of the actual tides in the regions where observations are sufficiently numerous to supply the necessary information, but, as is well indicated in the cotidal chart due to Berghaus and reproduced by the author, there will remain very considerable tracts of the ocean surface about which no observational information is available, and which are left blank on the charts prepared by Berghaus. In fact, as tidal observation is almost of necessity confined to the neighbourhood of the coast lines, the only method of filling in such blanks is to have recourse to theory, and the correctness or otherwise of the charts prepared by the author must therefore depend to a very considerable extent on the correctness of the theory which he has put forward, which forms the principal subject of Part iv. A.

This theory has already been the subject of adverse criticism in NATURE (September 4, 1902, p. 444), and we cannot but regret that we have to adhere to the objections to it previously raised.

Without reverting to these objections it is rather our purpose here to examine the particular applications of it now dealt with in part iv. B, which constitute the chief purpose for which it was designed. The object of the author, as he himself expresses it, is "to obtain through theoretical considerations . . . a first approximation to the times of the principal ocean tides," *i.e.* the phases of the oscillations in relation to those of the disturbing forces which produce them. The times in question are deduced from a theorem based on the analogue of the compound pendulum which asserts that in maintained simple harmonic motion under the action of friction "the virtual work of the external periodic forces is zero at the instant of elongation." If we rightly understand the significance of this theorem, it would appear to imply that, at the instant of elongation, the disturbing forces which give rise to the type of motion under consideration form an equilibrium system. We conclude either that they are in equilibrium throughout the motion or that they are in equilibrium at this instant in virtue of the fact that their resultant, which is *ex hypothesi* of a simple harmonic character, is passing through its zero phase. The former hypothesis may be dismissed as giving rise to no permanent oscillation; the latter indicates a phase difference of a quarter of a period between the phase of the oscillation and that of the resultant disturbing force.

The application of the theorem in question to the tidal problem is somewhat obscure, but the illustration of the simple pendulum presented by the author enables us at once to recognise an essential condition under which it is applicable. The phase difference in this case is correctly expressed by equation (297), which indicates in general a phase difference of zero or half a period when friction is slight. When, however, friction is sufficiently great the phase difference may amount approximately to a quarter of a period, and the same will be true even with small friction when there is an exact coincidence between the period of the disturbing force and the "natural" period of vibration of the pendulum.

Thus the fundamental theorem on which the determination of the phase depends only holds good if we regard friction as sufficiently large to control the phase, and unless the relative influence of friction in comparison with other causes which influence the phase is in some way known, the phase will remain quite indeterminate. Of course it may be contended that in the case of the tides the conditions necessary to render friction the controlling factor exist, but this contention is nowhere put forward explicitly by the author, and we are of opinion that it could not be substantiated. We are further of opinion that the effects of friction on phase will be everywhere comparatively insignificant, so that we should expect to find the phases of the oscillations, so far as they can be resolved into separate simple harmonic types, approximately in agreement with (or differing by half a period from) those of the disturbing causes instead of, as the author's theory requires, differing from them by a quarter of a period. We conclude that the author's theory ceases to be available even to lead to a "first approximation" in the determination of the phases.

We can thus only regard the charts produced, except in so far as they are controlled by direct observations, as a speculation on the part of the author unsupported by scientific evidence, and regret that an otherwise painstaking and far-reaching research on our existing knowledge of the tides has been marred by the intervention of an unsatisfactory theory which we feel bound to regard as not merely inadequate, but for the purposes to which it is applied actually misleading.

S. S. H.

AGRICULTURAL EDUCATION AND COLONIAL DEVELOPMENT.

IN a paper on "The Teaching of Agriculture" read by Mr. F. B. Smith, director of agriculture in the Transvaal, before the British Association, there occurs a statement which is of special interest to educationists and to the public of this country. The paper was read with the object of directing attention to the keen desire for agricultural education that now exists in South Africa, and to the improvements in the condition of the colonies which might be looked for if a satisfactory system of education and research were established. But though colonial Governments are willing, and the enlightened members of the agricultural community are anxious to get on, progress is slow, and chiefly because suitable teachers for agricultural colleges and other officers for colonial departments of agriculture are hard to find. The words used by Mr. Smith are:—"The difficulty of obtaining men qualified to fill such positions is great, and frequently one of two things happens: either an *unsuitable man from the Homeland* (the italics are ours) is appointed, with the result that a department is seriously hampered or discredited, or a selection has to be made from abroad. I am not speaking without experience, for I could give many examples in support of my argument that a great deal of harm has been caused to agricultural administration and education in the colonies by the sending out of inexperienced and unsuitable men from Great Britain." Again, after stating that the demand will continue, and is likely to increase, Mr. Smith asks, "Cannot some steps be taken to improve matters, and to supply the want?"

Unfortunately it is not only in South Africa that the Mother Country's insufficiency is being felt, for within the past few years there has been quite an extraordinary awakening to the value of agricultural education in the British possessions, and the Homeland has not been able to afford the guidance and assistance which her colonies expect. That there is an awakening we have ample evidence; thus a recent number of the *West India Bulletin* informs us that the president of the West Indian Agricultural Conference of 1905 remarked:—"Agricultural education is at the root of the successful development of these colonies," and another speaker referred with surprise to the rapid rise in importance of this subject. Again, from the Indian Financial Statement for 1905 we learn that the Government of India, which in 1902–3 spent about 60,000*l.* on improving agriculture, has now sanctioned an expenditure of 250,000*l.* for the provision of agricultural institutions, experimental farms, &c. But although this forward policy has the approval of all sections of the Indian public, it must wait, for in India, as in South Africa, the problem is to find men competent to give effect to the policy.

The director of agriculture for the Transvaal is perhaps too severe on the "unsuitable man from the Homeland." The good work accomplished by this same "unsuitable man" in the past ten years has been one of the chief causes of the rise in popularity of agricultural education. But it must be admitted not only that men are hard to find, but that when found they seldom have the training which is desirable. The fact is that Britain still looks upon agricultural education purely from the national standpoint, and gives no thought to her colonies. Through the Board of Agriculture, agricultural institutions in England and Wales receive about 10,000*l.* per annum; but these grants are made to provide for the education of the English farmer, and without reference to our foreign possessions.

A few weeks ago a deputation waited upon the Board of Agriculture to ask that increased grants might be given for teaching and research in connection with English agriculture, and it was admitted by the Board that further aid in this direction was desirable. If the present grants are insufficient for the special needs of this country, it is clear that they are quite inadequate for the requirements of Greater Britain. It may be argued that India and the colonies should provide for themselves; but we hope that Mr. Smith's question may not receive this answer. Greater Britain makes the reasonable request, "If you send us men, send us trained men," and if we neglect this request our colonies must find men elsewhere. They cannot mark time indefinitely, nor can they risk their prosperity by engaging the services of incompetent men.

England is herself content with her small outlay on agricultural education and research, but we must not conclude that what is good enough for the Mother Country is good enough for her colonies. English agriculture is highly developed, is conservative in its methods, and there is no agricultural party to be reckoned with by the English statesman. We do not ask for, and we do not get, the assistance claimed by the farmers of countries like Denmark and the United States. In India and the colonies it is different; agriculture is undeveloped, applied science may do much for the farmer, and the prosperity and contentment of the agriculturist are of great political importance. Though, therefore, the English agriculturist does not complain of the meagre endowments of agricultural science, we must not assume that those responsible for the development of Greater Britain will remain satisfied with what this country is now doing. The colonies have hitherto taken our men, because men trained in British schools and universities have been their traditional leaders; but it is clear that if we wish them to continue to do so we must make greater efforts to meet the new demand.

Nothing could possibly be more damaging to the reputation, not only of English teachers of agriculture, but of England, than such an experience as the director of agriculture for the Transvaal recorded before the British Association. If our men are incompetent, if they are unfit to lead, the sooner, not only our teachers, but our statesmen, take the matter up the better. The colonies must know, and without delay, that the universities and colleges of this country can supply trained agriculturists. We are indebted to the director of agriculture for his plain if unpalatable warning. There appears to be a danger that while the means of securing a preference for our merchandise are being discussed, we may lose the preference now accorded to our men.

MAGNETIC WORK IN INDIA.[1]

THIS relates to the temperature coefficients of horizontal force magnetographs of the Watson pattern belonging to the Indian Survey. The magnet system consists of magnetised iron wires, fixed parallel to one another, in a framework which is attached to a quartz fibre. The upper end of the fibre is attached to a torsion head, by turning which the magnet system is brought nearly perpendicular to the magnetic meridian. With increase of H (horizontal force) the magnet turns until the increased torsion balances the increased magnetic couple, and the position of the magnet is recorded

1 Survey of India. Professional Papers, 1905. Serial No. 8. Experiments made to determine the Temperature Coefficients of Watson's Magnetographs. By Captain H. A. Denholm Fraser, R.E. Pp. 45; with 6 plates and 5 sheets of curves. (Calcutta: Office of the Superintendent of Government Printing, India, 1905.)

photographically by means of a beam of light reflected from a mirror attached to the magnet. With rise of temperature the magnetic moment diminishes slightly, whilst the rigidity of the quartz increases, both causes tending to diminish the angle of torsion and so simulating a fall in H. Measurements made on one of the magnetographs prior to its despatch from England showed a temperature coefficient of approximately 67 for 1° C. ($17 \equiv 1 \times 10^{-5}$ C.G.S.); but the values obtained in India with different magnet systems and suspensions are mostly about 12·57 for 1° C. There is, however (see footnote p. 13), no necessary contradiction between these results. The untwisting caused by a given rise of temperature varies as the total angle of torsion, and this varies as the local value of H. But H in India is nearly twice as large as in England. Thus the movement of the magnet due to the change of rigidity in the fibre caused by a rise of 1° is nearly twice as big in India as in England. The memoir discusses the temperature experiments made in India, and the difficulties arising from imperfect temperature control, defects in quartz fibres or in the method of fixing them, and from other causes. The observational data are recorded, and exhibited in the curves, with a detail which is unusual in a printed volume. The values found for the temperature coefficients *in India* are five times larger than those applicable *in England* to some magnetographs of older types with metal suspensions. Even in magnetic chambers under refined temperature control, a small temperature coefficient has advantages which can be fully appreciated only by those experienced in the reduction of magnetic data. Thus the results of the present memoir, though of limited general interest, deserve the attention of instrument makers.

NOTES.

We regret to see the announcement that Prof. C. J. Joly, F.R.S., Royal Astronomer of Ireland, died on January 4 after a long illness. He was only forty-one years of age.

A Bill which provides for the adoption of the weights and measures of the metric system in all departments of the Government of the United States on July 1, 1908, has been introduced into Congress.

A Central News message from New York states that by the will of the late Mr. Yerkes the Yerkes Observatory, Chicago, is given the sum of 20,000*l*.

Arrangements are being made for the celebration of the twenty-first anniversary of the foundation of the Royal Geographical Society of Australia, Queensland. It is proposed at the end of the current session, in the last week of June, to carry out some appropriate form of commemorative ceremonial to mark the close of the first twenty-one years of activity of the society.

On Tuesday next, January 16, Prof. E. H. Parker will deliver the first of a course of three lectures at the Royal Institution on impressions of travel in China and the Far East. The Friday evening discourse on January 19 will be delivered by Prof. J. J. Thomson, the subject being some applications of the theory of electric discharge to spectroscopy. On February 2 the discourse will be delivered by Prof. S. P. Thompson on the electric production of nitrates from the atmosphere.

As the signature "H. Weir" occurs so frequently to the illustrations of "Wood's Natural History," which was the popular zoological work of a generation ago, a reference to the death of Mr. Harrison Weir, the well known animal artist, claims a place in our columns. Mr. Weir, who was born at Lewes in 1824, died at his residence at Appledore, Kent, on January 3, at the close of a long period of retirement. Although his portraits of wild animals can scarcely be compared with those of Wolf, they are in most cases—except when drawn from menagerie specimens in poor condition—true to nature and display considerable spirit. Mr. Weir's special *forte* was, however, the portraiture of domesticated poultry, and his work "Our Poultry" has a permanent value as an authentic record of the characteristics of the different breeds at the time it was written. As a judge of poultry and pigeons the deceased artist had a high reputation.

The first expedition sent out to West Africa by the Liverpool Institute of Commercial Research in the Tropics left England on January 6. The members, who are conducted by Lord Mountmorres, director of the institute, are:—Mr. Kenneth Fisher, chemist; Mr. L. Farmer, botanist; Dr. Slater Jackson, entomologist; and Mr. Coates, commercial adviser. The expedition is proceeding to Dakar, Bathurst, Konakri, and, if possible, to the Cameroons. Being only an experimental expedition, the stay on the west coast will not be of very long duration; in fact, Lord Mountmorres is to return in time to visit the exhibition of rubber at Ceylon in April. But should the results prove satisfactory there is every probability that the institute will dispatch a second expedition to spend a long period in Africa. One of the chief objects of the expedition will be an inquiry into the cultivation of rubber—how to improve the quality of West African rubber in order to bring it up to the same standard as the similar rubber from other colonies, and how to protect and increase the present supply. An effort will also be made to discover new sources of oils, and to find means of increasing the supply by making use of present waste. As regards the study of the prospects of West Africa becoming a fibre-producing country, this branch of the work will include investigation regarding the establishment of hemp, cotton, jute, and ramie growing, and also of new fibres.

We have received a copy of the report of the Albany Museum for 1904, in which substantial progress is recorded on all sides. It is satisfactory to learn that the proposed cooperation between the museum and the Rhodes University College promises to be of advantage to both institutions. Dr. Schönland, the director of the museum, has already been appointed professor of botany in the college.

Much interest attaches to a paper by Mr. Pilgrim in part iii. of the *Records of the Geological Survey of India* for 1905, in which the author describes an elephant skull from the alluvium of the Godaveri valley. This skull belongs to *Elephas namadicus*, of Falconer and Cautley, but the author brings forward evidence which in his opinion proves the identity of that form with the European *E. antiquus*.

Our knowledge of the land and fresh-water molluscs of Formosa and Japan has been greatly extended by the work of Japanese collectors, the results of which are described by Messrs. Pilsbry and Hirase in the October, 1905, issue of the *Proceedings of the Philadelphia Academy of Sciences*. The collections from Formosa were made in Taiwan, and chiefly consist of land-shells; but although no labour or expense were spared, the number of specimens procured was not so large as anticipated. Nevertheless, out of a total of seventy-one species, twenty-

seven, together with thirteen new subspecies, are described as new. The Japanese collection was chiefly made in the Kyushu and Ryuku chains of islands, and is most satisfactory, as we have now a fair knowledge of the snails of all the larger and of many of the smaller islands.

THE muscles of the jaws and pharynx in dog-fishes and skates form the subject of an illustrated article by Mr. G. E. Marion in the December, 1905, number of the *American Naturalist*. Considering the marked difference in the shape of the two species, the similarity in their muscular system is noteworthy; but, as might have been expected, the skate possesses a few muscles not found in the dog-fish. The deep muscles of the trunk of the former are described for the first time. In another paper Dr. E. N. Transeau discusses the forest-centres of eastern North America, and arrives at the conclusion that there are four such developmental areas, namely, the great conifer forest of the north-east, the deciduous forest of the Ohio basin, the south-eastern coniferous tract, and the insular tropical forest of southern Florida, the centre of which is in the West Indies. The forest-centres correspond with centres of high temperature and humidity.

SOME practical results may perhaps follow a paper contributed by Mr. E. Iwanoff to *Biologisches Centralblatt* of December 15, 1905, on the cause of sterility in zebra-pony hybrids. Sterility appears to attach to the male and not to the female hybrids, although the latter really produce this sterility. For it appears, according to the author's researches, that the spermatozoa are destroyed by leucocytes while within the body-cavity of the female. The female-blood is, in fact, found to contain a substance known as spermatoxin, which acts fatally on the spermatozoa. A similar substance also exists in the blood of female hybrid trout, but as impregnation of the ova takes place outside the body-cavity, no ill results follow to the spermatozoa. It is suggested that in the case of female zebra-hybrids the effects of the spermatoxin should be neutralised by the injection of an anti-spermatoxin serum.

IN the *Biologisches Centralblatt* (December 15, 1905) Prof. Gorjanović-Kramberger discusses the relationships of the race of men whose remains have recently been discovered at Krapina, south of the Styrian frontier. From the examination of these remains it appears that the Krapina race is identical with the one from Neanderthal, Spy, La Naulette, Schipka, &c., for which the name *Homo primigenius* has been proposed. From this primitive type there seems to be a complete transition in cranial characters, through the upper diluvial *H. sapiens fossilis*, to modern man, who occasionally exhibits some of the peculiarities of the ancestral form, such as the absence of the chin prominence and the presence of wrinkles in the enamel of the molars. The pre-diluvial race of Galley (? Gallows) Hill, England, presents a difficulty, since, although this is the oldest, it is at the same time the most modern type. This is explained by the theory of the existence at this early date of two distinct types of mankind, namely, *Homo sapiens fossilis* at Galley (?) Hill, which had attained a relatively high development, and *H. primigenius* at Krapina, Neanderthal, &c., the advance of which may have been prevented by unfavourable conditions of existence.

THE contents of No. 195 of the *Quarterly Journal of Microscopical Science* relate to the anatomy, histology, development, &c., of various groups of invertebrates, and are all of a highly technical nature. Prof. Haswell contributes the first part of a series of papers on the turbellarian worms, dealing in this instance with Heterochærus; while Prof. Carpenter discusses the segmentation and phylogeny of arthropods, and Mr. Hill records his observations on the maturation of the ovum of Alcyonium. Mr. F. C. Sinclair, in the fourth article, alludes to certain points in the anatomy of the myriopods of the family Platydesmidæ; and in the fifth and last Prof. Minchin describes a new sporozoon infesting the mucous membrane of the human nasal septum. At the end of his paper Prof. Carpenter observes that "the more probable conclusion seems to be not that arthropods and polychæte annelids stand to each other in the relation of descendants to ancestors, but that the two groups represent specialised collateral branches from a common stock. My own view is that their common ancestors were microscopic animals, unsegmented, or with comparatively few segments between a broad head-lobe and a narrow tail-somite. The occurrence of the nauplius larva in some members of all the great crustacean groups justifies the phylogenetic importance attached to that form by Müller."

THE position and relations of the abdominal and thoracic viscera of an adult male negro are described and very fully illustrated in a monograph entitled "Topography of the Thorax and Abdomen," by Prof. Potter, just published by the University of Missouri (University of Missouri Studies, Science Series, vol. i., No. 1). The monograph represents a contribution to "descriptive anatomy"—the raw material out of which, when enough has been accumulated, we may hope to build a "scientific anatomy." For several reasons this contribution, though small, is valuable, first, because of the accuracy of the workmanship; secondly, because it deals with a well developed adult man, accidentally suffocated; and thirdly, because it deals with the Negro race, the anatomy of which at the present moment is of the greatest interest. This interest centres round, not what may be called the normal anatomy of that race, but its variations and abnormalities, and to obtain a knowledge of these, records of hundreds of subjects are required. In the subject described by Prof. Potter the cæcum occupies an abnormally high position, a position recalling that seen in the young European child and in the Anthropoid; this, apparently, is a characteristic of the Negro race, for in four subjects recently dissected by the writer of this note a similar condition was observed. Prof. Potter built up the reconstructions and projections shown in the plates of his monograph from a series of twenty-five sections, into which the trunk was divided after being hardened by the injection of a 50 per cent. solution of formaldehyde—a solution employed first by Prof. Jackson. Prof. Potter is to be congratulated on the manner in which he has carried out a laborious task.

SOME figures quoted by the Governor of the Bahamas in his report on the Blue-book of the Bahamas, according to a writer in the *Journal of the Society of Arts*, give an idea of the extent of the sponge fishery business carried on in those waters. There are schooners and sloops with an aggregate tonnage of 5952 engaged in this industry. Attached to the vessels are 2517 open boats, and 5517 men and boys are employed on them. There are also 291 open boats engaged, manned by the owners living on the coasts of several of the out-islands to the number of 445. Disquieting reports as to the exhaustion of the sponge beds and the increasing quantities of small sponges brought to market, which should have been left in the beds to grow to a proper marketable size, recently led to the enactment of a law under which a sponge fisheries board is established with certain powers for the regulation

of the fisheries, and provided with a small annual grant for expenses. Recently the Bight of Abaco was examined, and the result fully confirms the suspicions previously entertained. It is reported that the beds are thickly sown with small sponges which are constantly being gathered by the itinerant fishermen who are continually working over these fields pulling all the sponge they can find without regard to size or quality, in consequence of which there are very few large sponges to be found anywhere. The spongers living in the settlements all round the coast are in sympathy with the movement for protecting the industry against the wasteful methods complained of, and will welcome any reasonable laws for the protection of the young sponge.

THE manurial experiments with cotton in the Leeward Islands detailed by Dr. F. Watts in the *West Indian Bulletin*, vol. vi., No. 3, may be expected to furnish useful information after a trial of some years, when a succession of crops will have emphasised the necessary requirements, and irregularities of climate can be eliminated by averaging results. Dr. Watts recommends the return of the seed to the land, preferably after crushing to express the oil, or as the manure from animals fed on the seed. From the notes by Sir Daniel Morris on grape fruits and shaddocks it is gathered that the larger fruits, referred to *Citrus decumana*, are generally known as pumelows or shaddocks; the smaller fruits assigned to the variety or species *paradisi* may be distinguished as forbidden fruit when round, or as grape fruit having a pyriform shape.

IN *Science*, June 23, 1905, Prof. B. M. Duggar reviews the present-day problems of plant physiology. On the subject of turgor regulation, allusion is made to the investigations of Mayerburg, which tend to show that increased turgor in fungi is caused by the production of osmotic substances within the cell. The writer refers to Moore's work on the organisms found in leguminous tubercles showing that they can assimilate free nitrogen apart from the leguminous plant, to Laurent's experiments on the effects of feeding dicœcious plants with different fertilisers, with the results that nitrogen or calcium appeared to increase the number of staminate flowers, and potassium or phosphorus the number of pistillate flowers, and to Blakeslee's identification of homothallic and heterothallic forms of the Mucorineæ.

THE avenues and fruit gardens of Quetta afford a striking testimony to the beneficent results of the British occupation. Writing in the *Indian Forester* (October, 1905), Mr. E. P. Stebbing traces their origin to the foresight of the early administrators, notably General Sir Stanley Edwardes, Sir Hugh Barnes, and Colonel Gaisford. Cuttings of chinar, *Platanus orientalis*, poplars, and willows were brought from Kandahar in 1882. The avenues consist of a mixture of two or more species from the white and black poplars, the reamer, *Populus sp.*, and Euphrates poplars, the Kandahar, *Salix alba*, Kabul, *Salix acmophylla*, and weeping willows, the plane, and a species of American ash. In the gardens some fine old mulberries point to the existence of these trees previous to the occupation by the British; a few specimens of *Populus Euphratica* are found, and walnuts have been planted with satisfactory results.

WE have received a copy of a paper by Dr. Hans Reusch, of Christiania, on the geographical relations of Norway and Sweden. Dr. Reusch deals with the origin and geographical nature of the present frontier between the two countries, and with the density and distribution of population. The paper is reprinted from the *Geographische Zeitschrift*.

PROF. DR. A. OPPEL contributes to the *Deutsche geographische Blätter* a long paper on the forest regions of the middle and upper Mississippi, the prairie lands of Canada, and the New Ontario. The paper is a continuation of Prof. Oppel's previous studies in North America, and is an account of a lengthened journey undertaken during 1904; it contains an immense amount of valuable and interesting information.

THE *Mitteilungen* of the Vienna Geographical Society contain an interesting preliminary report on observations of the altitude of the forest-line in the Austrian Alps, by Prof. R. Marek. The most important general result is that the forest-line sinks continuously from west to east, the rate of fall increasing towards the east, and a difference of 556 metres being recorded within the area investigated—extending through about five degrees of longitude. The average height of the forest-line is about 750 metres below that of the snow-line.

THE third number of the *Abhandlungen* of the Vienna Geographical Society is devoted to a suggestive paper by Dr. Fritz von Kerner. The author discusses the annual march of temperature in the north temperate zone by considering the ratio between the difference between mean monthly values for April and October and the difference between the mean of the hottest and coldest months of the year. Plotting the values of this ratio on a chart, he gets lines to which the name "Thermoisodromes" is given. The distributions revealed in this way, and by further developments of the method, give results of considerable interest in tracing the relations of the "oceanic" and "continental" elements in the climate of the regions covered.

IN a neat art-green canvas cover, Messrs. Burroughs, Wellcome and Co. have issued their well known photographic exposure record and diary for 1906, and the moderate price of 1*s.* renders it within reach of every photographer. The important features of this pocket-book have been maintained, and the information brought up to date; the light tables, as was the case last year, are printed on perforated leaves, so that each month may be torn out, disclosing the table for the current month opposite the mechanical calculator fixed to the inside of the back cover. The excellent get-up, finish, useful contents, and general handiness of this exposure record and diary have made it a necessary part of a photographic outfit, and this year the photographer who possesses a copy can compete for prizes offered for pictures produced with "tabloid" photographic chemicals.

WITH the December (1905) issue the *Journal of the Franklin Institute* of Philadelphia concludes its 160th volume, and the varied contents show that the high standard that has characterised this journal for eighty years is well maintained. The more important papers in this number are of metallurgical interest. Prof. A. E. Outerbridge gives an able summary of recent scientific progress in metallurgy. Mr. E. Stütz gives a detailed account of the progress made within the past eighteen months in the introduction in the United States of the alumino-thermic process as applied in engineering practice. The progress has been rapid, and the process has proved quite as successful in America as elsewhere for welding and for the repair of castings. Lastly, Mr. Laurance

Addicks discusses the subject of the electrolytic refining of copper, especially from the point of view of the multiple system. The main differences between this system and the series system are in power cost, compactness, and cost of preparing anodes. The fact that large refineries on both systems are being satisfactorily worked bears witness to the close balancing of the advantages and disadvantages in each case, although much more material is refined by the multiple than by the series process.

DURING the night of January 5–6 the central and southern parts of England experienced a very severe gale; the 6h. p.m. observations received at the Meteorological Office on January 5 gave but little indication of the approach of such a severe disturbance, but were sufficient to justify the hoisting of storm signals on all our west coasts. The weather chart for 8h. a.m. on Saturday, January 6, showed that the centre of the storm, which had travelled very rapidly, lay over Lincolnshire, and that strong gales were prevailing in the English Channel and over the southern and eastern counties. In the London district the gusts were very heavy, but it did not experience the full fury which was met with on the coast, although some injury was caused by falling slates and chimneys, and some trees were uprooted. Several wrecks have been reported from the English Channel, and much damage was done to shipping in the Bristol Channel and elsewhere. On Tuesday afternoon (January 9) London and other parts were visited by sharp thunderstorms, accompanied by heavy rain and hail.

A SIXTH edition of the "Hints to Meteorological Observers," prepared under the direction of the council of the Royal Meteorological Society by Mr. W. Marriott, has just been published. The work has been revised and enlarged, and although only consisting of sixty-seven pages, including text, tables, and many illustrations, contains all that is necessary for ordinary normal climatological stations; its conciseness renders it, in our opinion, all the more valuable, and at the present time—the excellent instructions prepared by Mr. Scott for the Meteorological Office being out of print—it is the most useful book of instructions now available for English observers. Among the additions may be mentioned references to the Richard recording instruments (a want to which we recently referred), fuller instructions in connection with phenological observations, and tables for the conversion of anemometrical values from English to French measures, and *vice versâ*. The work would be a desirable acquisition for all meteorological observers, especially those not conversant with the more comprehensive instructions lately published in the French and German languages.

THE Meteorological Committee has issued a useful little pamphlet (12 octavo pages, with charts) on the relation between pressure, temperature, and air circulation over the South Atlantic Ocean. The introductory remarks state that the preparation of monthly wind and other charts occupied the marine department of the Meteorological Office from 1898 to 1904, and were based on no less than 946,000 observations. The charts were published by the hydrographic department of the Admiralty, and at the request of the Meteorological Council Captain Hepworth, the marine superintendent, undertook the preparation of notes which, with a number of small diagrams, are deductions from an examination of the elaborate charts above referred to. They show the variations, the position and intensity of the areas of high pressure, and their relation to the equatorial doldrums, the distribution of gales, fog, &c. The gales appear to reach the South Atlantic in two ways:—(1) they cross South America between 25° S. and Cape Horn, or (2) they avoid the land, and round Cape Horn to the eastward, following the general drift of air and sea surface. Fog is rarely met with north of the thirtieth parallel, except near the land on either side of the ocean. More southward fog may be expected, and is increasingly frequent the higher the latitude reached. This is attributed to the increase of gale frequency with latitude, the cyclonic systems causing rapid fluctuations in air temperature.

THE value for the latent heat of water is the subject of a note by Prof. A. Leduc in the current number of the *Comptes rendus* (January 2). He points out that, in spite of the fundamental importance of this constant, there is a difference of 1 per cent. between the 79·25 of Laprostaye and Deasins, confirmed by Regnault, and the 80·03 of Bunsen. He discusses the possible effect on these figures of the recent work on the variation of the specific heat of water, and shows that even after this is taken into account the difference is still of the same order. Substituting, however, 0·9176 for the density of ice at 0° C. for the 0·91674 found by Bunsen, the 80·03 of the latter investigator becomes 79·15. The larger number for the density of ice is that found by M. Leduc from his own researches, who thus arrives at 79·2 calories at 15° C. as the most probable value for the latent heat of water.

THE third part of "The Primary Arithmetic," edited by Dr. Wm. Briggs, has been published by Mr. W. B. Clive at 6*d*.

A COMPREHENSIVE catalogue of microscopes and accessories has just been issued by Messrs. W. Watson and Sons, High Holborn, W.C. Several of the instruments described and illustrated embody valuable modifications in constructional detail; and the requirements of all classes of workers are met by the two series of objectives—holoscopic and parachromatic—computed by Mr. A. E. Conrady, under whose supervision the whole of Messrs. Watson's optical work is now produced.

TWO more subject-lists of works in the library of the Patent Office have been published. The first comprises books on heat and heat-engines (excluding marine engineering), and the second deals with works on aërial navigation and meteorology. Each list consists of two parts, a general alphabet of subject-headings, with entries in chronological order of the works arranged under these headings, and a key, or a summary of these headings shown in class order. These lists may be obtained at the Patent Office, Chancery Lane, W.C., at 6*d*. each.

THE *Bulletin of the Johns Hopkins Hospital* for December, 1905 (xvi., No. 177), contains the second of the Herter lectures by Prof. Hans Meyer on the contributions of pharmacology to physiology, several medical and surgical papers and reports of societies, and some interesting extracts from medical reports by Dr. Wiesenthal, a physician who lived in Baltimore in the latter part of the eighteenth century. The *Bulletin* is an admirable publication, and should be in the hands of all medical practitioners.

THE Science Press of New York has published an account of a research of Prof. E. L. Thorndike on the measurement of twins as the first number of a series of monographs to be known as "Archives of Philosophy, Psychology, and Scientific Methods," which are to be edited by Profs. J. McKeen Cattell and F. J. E. Woodbridge. This monograph presents the results of precise

measurements of fifty pairs of twins from nine to fifteen years old in six mental traits, and their bearing upon the comparative importance of heredity and environment as causes of human differences in intellectual achievement.

FIVE new volumes—Nos. 146 to 150 inclusive—of Ostwald's "Klassiker der exakten Wissenschaften" have been received from the publisher—Mr. W. Engelmann, Leipzig. No. 146 is a paper by Lagrange (1768), translated from the French and edited by Herr E. Netto, the title being "Über die Lösung der unbestimmten Probleme zweiten Grades." J. B. Listing's "Beitrag zur physiologischen Optik," edited by Prof. O. Schwarz, forms No. 147 of the series; and a lecture delivered at Vienna by E. Hering in 1870, "Über das Gedächtnis als eine allgemeine Funktion der organisierten Materie," constitutes No. 148. Under the title "Tastsinn und Gemeingefühl," an article contributed by Dr. E. H. Weber in 1846 to R. Wagner's "Handwörterbuch der Physiologie" is reprinted with notes by Herr E. Hering. Of particular interest is the reprint (No. 150), edited by Herr A. von Oettingen, of Fraunhofer's paper entitled "Bestimmung des Brechungs- und Farbenzerstreuungs-Vermögens verschiedener Glasarten, in bezug auf die Vervollkommnung achromatischer Fernröhre." This volume contains a plate showing Fraunhofer lines in the solar spectrum, and a picture of the statue of Fraunhofer at Munich.

OUR ASTRONOMICAL COLUMN.

COMET 1905*c* (GIACOBINI).—Observing at Sunderland on December 22, 1905, Mr. Backhouse estimated that the magnitude of comet 1905*c* was approximately 8·3, at 18h. 40m. G.M.T., the observation being made in faint twilight; its diameter he found to be $5\frac{1}{2}'$.

As this comet now rises but about an hour before sunrise, and the apparent distance from the sun is decreasing, it will be scarcely possible for further observations to be made before February, when the comet should again become visible, possibly to the naked eye, in the evening sky.

EPHEMERIS FOR HOLMES'S COMET (1892 III., 1899 II.).—The following search-ephemeris for Holmes's comet is published by Herr H. J. Zwiers in No. 4063 of the *Astronomische Nachrichten*:—

1906		0h. G.M.T. α (app.) h m s	δ (app.) ° ′ ″
January	11	21 5 39	−18 59 53
,,	13	21 9 45	−18 30 19
,,	15	21 13 51	−18 0 25
,,	17	21 17 57	−17 30 13
,,	21	21 26 7	−16 28 55
,,	25	21 34 15	−15 26 26
,,	29	21 42 21	−14 22 49

In referring to the ephemeris for comet 1892 V. in these columns last week, that object was designated, by mistake, Holmes's comet. Both bodies were discovered at about the same time, and their periods are very similar, but comet 1892 V. is the faint one discovered by Prof. Barnard, by photography, on October 12, 1892, and was not seen on its return in 1899. A report that it has been detected at the La Plata Observatory is as yet not confirmed.

On the other hand, Holmes's comet was bright enough in 1892 to be observed with the naked eye, and, owing to its eccentric fluctuations in brightness, was described by Prof. Barnard as certainly the most remarkable comet he had ever seen, taking everything into consideration. During an interval of fourteen minutes its diameter, as observed with the 36-inch refractor, increased from 43″·4 to 47″·9, and the comet became perceptibly brighter whilst under observation. This comet was first seen on its return in 1899 by Prof. Perrine on June 10 of that year. According to the above ephemeris, the comet should set about ninety minutes after sunset on January 11, but probably its low declination will make it a difficult object to find.

PHOTOGRAPHS OF THE SOLAR GRANULATIONS.—Using the astrographic telescope of the Pulkowa Observatory, Prof. Hansky has obtained some exceedingly interesting photographs of the solar granulations and spots on a large scale. The solar image at the focus of the instrument has a diameter of 3 cm., and by the use of an achromatic double concave lens was enlarged up to 54 cm. (about 21 inches).

The negatives thus obtained were photographically intensified by repeated copying, and details of the granulations became visible. Portions of the strengthened images were then enlarged to such a scale that the solar diameter would be equal to 6 metres (*i.e.* nearly 20 feet).

Copies of the sections thus enlarged are reproduced in the bulletin issued by Prof. Hansky, and on comparing two which were taken with an interval of twenty-five seconds it is seen that the granulations have undergone but little change, although relative movement and changes in brightness are discernible. Photographs taken with an interval of one minute show great changes, and after three minutes only one or two of the granules are recognisable.

The dimensions of the granules vary considerably; the smallest measured had a diameter of about 670 km., the largest about 2000 km.

Prof. Hansky intends to prosecute this research further, and hopes thereby to solve several questions regarding the periodic appearance of granules, the effects of their movements on spots and faculæ, &c.

THE ORBIT OF ξ URSÆ MAJORIS.—On many grounds the determination of the correct orbit of the double star ξ Ursæ Majoris is of great interest and importance, and for this reason M. N. E. Nörlund, of Copenhagen, has made a very careful re-investigation of the available data and measurements. About eighteen orbits have been computed previously.

The results of this investigation are given in No. 4064 of the *Astronomische Nachrichten*, and the places computed from the elements obtained are compared with those obtained by many different observers.

For the period M. Nörlund obtains 59·8096 ± 0·06 years, for the time of periastron 1815·057, for the distance $a = 2''{\cdot}5128$, and for the eccentricity of the orbit $e = 0{\cdot}4108$.

THE INTERNATIONAL FISHERY INVESTIGATIONS.[1]

THE first of the reports referred to below is the first report of the British North Sea Investigations Committee on the International Fisheries Investigations. From time to time during the last three years in which the investigations have been in progress, the International Council has issued the "Bulletin des Resultats," in which are contained the results of the hydrographical and plankton investigations carried out on the periodic cruises; and also the series of "Publications de Circonstance," containing the results of incidental investigations carried out by the various naturalists on the staffs of the different committees. Quite recently, too, the council has issued the third volume of "Rapports et Procès-Verbaux," containing a *résumé* of the results obtained up to the present time. The present volume is, however, the first report which deals exclusively with the results obtained by the British vessels. It is a report to the Fishery Board for Scotland on part of the investigations made by the Scottish staff.

The first three papers in the report, written by Messrs. Helland-Hansen and Robertson, deal with the hydrography of the Færöe-Shetland channel and the adjacent sea regions—the area investigated by the Scottish vessels, H.M.S. *Jackal* and the *Goldseeker*. The principal Scottish line of hydrographical stations extends from the Shetlands to the Færöe Islands, and it is along this line that the changes taking place in the constitution of the sea-water can most easily be observed. It has long been known that the water in this region may be derived from various

[1] "Report on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1902–3." Edited by D'Arcy W. Thompson. Pp. vii+618. [Cd. 2612.] (London: H.M. Stationery Office, 1905.) Price 8*s.* 9*d.* net.

"Report on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1902–3." Report No. 2 (Southern Area). Edited by Dr. E. J. Allen. Pp. ix+377. [Cd. 2670.] (London: H.M. Stationery Office, 1905.) Price 8*s.* 9*d.* net.

sources. We have to deal first of all with the "Gulf Stream," or, as it is now termed, the "Norwegian branch of the European stream," which, originating in the Atlantic Ocean, flows north and east through the Scotland-Shetland and the Færöe-Shetland channels, sometimes reaching as far north as the Murman coast. A second component is water of Arctic origin which enters the Shetland-Færöe channel as an offshoot from the east Icelandic polar stream. Further, the hydrography of these regions is complicated by the occasional presence of water from the Norwegian Sea, from the coasts of Britain, or from the North Sea itself. These various components are traced by observations of their salinity, temperature, and plankton contents. The Norwegian branch of the European stream is shown to exhibit a well marked periodicity. In 1903 the inflow of Atlantic water through the Shetland-Færöe channel decreased from May on, and practically ceased in November, resuming in February of 1904. The southerly polar stream attained its greatest volume in spring; it is apparently able to make its way southwards at all seasons of the year, either as an undercurrent or at the surface. When it is strong it may obstruct the Norwegian stream in the Færöe-Iceland channel, and cause the latter to pass to a greater extent between Scotland and Shetland. These are the principal results attained so far, and they do not add much to our knowledge of the hydrography of these regions; but it must be remembered that they are founded on the results of one year's complete investigations only, and are best to be appreciated at the end of the five years' investigations and when they are considered along with the results attained by the other investigations now in progress.

A most important part of the original scheme of investigations was the discussion of the statistics obtained by the participating States. These matters receive proper attention in the present volume, and Prof. Thompson discusses in a very attractive manner an interesting series of statistics furnished by the Granton Steam Fishing Company, and a similar series of statistics given by the steam trawlers owned by Messrs. Johnston, of Montrose. In each case the average catch per vessel has been calculated, and tables and curves are given showing, in an interesting fashion, the seasonal fluctuations of the fishes under review, which are haddock, whiting, cod, plaice, turbot, and lemon sole. In the case of each fish there are generally two maxima of abundance, one of which is always well marked and the other not so well shown. In the case of the haddock there is, however, a very close correspondence between the catch of this fish and the surface temperature of the sea, a correspondence which Prof. Thompson points out is most probably due to the fact that the great summer fishery for herring takes place at the time when the surface waters of the sea have their greatest temperature, and when the haddock is shoaling to feed on the herring spawn. It is notable that in neither of these cases is there any certain indication of a progressive decrease or increase in the volume of the catches of any of the fishes in question.

Perhaps the most valuable paper in the volume is that contributed by Dr. Fulton in which he elaborates the method of studying the distribution and seasonal fluctuations of fishes first suggested by him in the reports of the Fishery Board for Scotland some years ago. This consists in obtaining accurate records of the catches made by a large number of trawlers, and also information of the places where these catches were made. This plan of obtaining commercial fishery statistics (apart, of course, from the ordinary official figures) was first practised by the Fishery Board, and a considerable number of Aberdeen steam trawlers now regularly provide these figures. The first results of these investigations were published in the annual reports of the Fishery Board, but they are now utilised in connection with the other investigations of the international organisation. The figures are collected by the statistical staff of the Fishery Board at the market in Aberdeen, and are expressed as the quantities of fish caught per vessel per 100 hours' fishing. The North Sea is divided into a number of squares, each of which is bounded by one degree of latitude and two degrees of longitude. All the catches of fish made on each of these squares during each month of the year are then brought together and expressed as the cwts. of fish caught per 100 hours' fishing on each area, and curves are constructed which are superposed, and so show in a very instructive manner the variation in the abundance of each kind of fish from month to month during the year. It is thus shown that there are two maxima of abundance for each fish during the year, one of which corresponds with the spawning time of the species. It is further shown that there is a "complementary or compensating fluctuation" among different species on the same ground, one species becoming abundant as another becomes scarce, so that the sum total of the species on the same ground remains nearly constant during the year.

Other reports in the same volume are those by Dr. T. Scott on the crustacea collected during the seasonal cruises of the *Goldseeker*, and similar papers by Mr. Clark on the other plankton collections. Prof. Thompson also contributes a translation of a paper by Sandstrom and Helland-Hansen on the mathematical investigation of ocean currents. It is regrettable that the fishery experiments of the *Goldseeker* have not been described and summarised in this volume, but these will no doubt be the subject of a future report. One must not omit to mention the beautifully engraved charts of the North Sea which illustrate the paper on the trawling statistics of Aberdeen.

The second of the reports under notice deals with the part of the international investigations which was entrusted to the Marine Biological Association, and gives an account of the researches carried out in the southern part of the North Sea and in the English Channel. In some respects this report is complementary to that issued by the Scottish Fishery Board; in the latter special attention is directed to the results of the hydrographical work and to statistical studies, while fishery investigations are not reported upon. In the English Blue-book, on the other hand, the bulk of the space is devoted to an account of the fishery investigations. The hydrographical researches, which are reported only by Mr. D. Matthews, were carried out in a somewhat limited area, but are of very great interest. It is shown that the water in the English Channel is derived from two main sources:—(1) high salinity water (35·6 parts per thousand and upwards), which enters the Channel as a current flowing in a northerly direction from the Bay of Biscay; and (2) low salinity water, entering the Channel as a southerly current from the Irish Sea and the Bristol Channel. The limits of these contributing currents are well shown on the hydrographical charts, where the lighter water is seen to be present mainly to the west of a line running roughly south from the Scilly Isles; while the denser water forms a tongue of variable magnitude, according to the season, entering the Channel in a north-easterly direction near Ushant. Within the Channel itself the hydrographical conditions are very complex; a general drift of surface water from west to east has been observed, but the distribution of the high and low salinity waters in the Channel is far from simple. Generally speaking, the main source of the water entering the Channel during the summer and early autumn is the Irish Sea, while during the rest of the year the denser water of the Bay predominates. The observations have been made for a year only, so that the very important question whether or not these changes in the origin of the contributing waters are periodic remains still to be investigated.

Perhaps the most interesting part of the report is that by Mr. Garstang dealing with the results of experiments on the marking and liberation of living plaice and other fishes. These experiments have now been carried out by most of the national research staffs, and are yielding results which are very instructive from the point of view of the growth and migrations of the plaice especially. The mark used is a brass label bearing a number, and fastened to the body of the fish by means of a silver wire passing through the body and attached to the other side by a bone button. This mark can be attached to the fish without permanent injury to the latter, and apparently without any retardation of growth or other disturbance of the normal habits of the fish. The results are recorded in Mr. Garstang's report, and are illustrated by means of synoptical charts which show the principal migrations made by the fishes which have been recovered. Up to the end

of 1903, 1463 plaice were marked in this way, and of these 287, or 19 per cent., have been returned to the association. The general facts regarding migrations brought out by these experiments are these:—the smaller fishes do not appear to migrate to any considerable extent, and the larger the fish is the more extensive are its migrations. In some cases the distance travelled has been very considerable; thus one plaice is shown to have travelled a distance of 175 miles in about six weeks, and another travelled a distance of 210 sea-miles in eight months. The general trend of the migrations has been in a southerly direction during the winter and in a northerly one during the summer. As a rule, the smaller fishes travel from the shallow water "nurseries" to the deeper waters during the earlier period of their life.

A most attractive part of these migration experiments is the question of the transplantation, on a commercial scale, of fishes from overcrowded grounds to those grounds where the conditions for favourable growth are present, but where there is not already an abundant population of the kind of fish in question. An interesting account of such an experiment is given by Mr. Garstang. Although the conditions of nutrition on the well known Dogger Bank are apparently very favourable for plaice, yet, on account of its comparatively isolated situation, this area contains a population of plaice which is probably far below that which it is able to support. Accordingly, more than 1000 small plaice were transplanted from certain in-shore grounds to the Dogger Bank, and in the course of a year more than 40 per cent. of these fishes were re-captured from the Bank itself and the slopes around it. It is shown that the growth-rate of these fishes was far in excess of that of those living on the ordinary in-shore fishing grounds, and the question of the practicability of the wholesale transplantation of small plaice from the shallow-water fishing grounds to such grounds as the Dogger Bank is carefully discussed. It is very questionable, however, whether transplantation operations on such a scale could be arranged at all so as to be successful.

The remainder of the report deals with the records of the fishing experiments and with various other matters. Dr. Wallace presents a report on the growth-rate of the plaice based on the examination of the annual growth-rings in the otoliths. Mr. Todd contributes a lengthy account of his examination of the contents of the stomachs of a very great number of fishes caught in the course of the trawling operations, and draws some interesting conclusions on the food of the various species dealt with. Lastly, Mr. Gough reports on the occurrence and distribution of the plankton of the English Channel during 1903.

The records of the trawling experiments contain a large mass of observations which are capable of much further analysis than has been attempted in the present report. 84,000 measurements of individual fishes have been made in the North Sea and in in-shore waters, and when these are considered along with the records of the hauls made by the Scottish Fishery Board's exploring steamer abundant material should be forthcoming for a discussion of the distribution of fishes in the North Sea according to their age and size. Altogether the North Sea Fisheries Investigation Committee is to be congratulated on the publication of these reports.

J. JOHNSTONE.

INSECT PESTS OF THE COTTON PLANT.[1]

THESE two reports may be taken as object-lessons of the way in which such economic investigations should be carried out by the agricultural departments of progressive countries.

The wide area over which cotton cultivation is spreading makes the investigation of its enemies in those regions where it has long been cultivated of great value. Such researches guide us in investigating new enemies, and they prepare us to guard against the introduction of pests with foreign seed.

The authors of the report on the bollworm have produced a work of great value to all cotton planters. The pest is recorded from North and South America, the West Indies, Europe, many parts of India, China, and Japan, the East Indies, Australia and New Zealand, and even in the Gilbert and Navigator Islands. Of particular interest is the record from the Sudan and British East Africa, but it is not recorded as attacking cotton there. Besides infesting cotton, it is equally destructive to corn, and the authors tabulate seventy other food plants, distributed over twenty-one natural orders.

There are excellent plates showing ova, larvæ damaging the buds, tassels and ears of sweet-corn as well as cotton.

The injuries are explained, and it is clearly pointed out how the cotton becomes infested by the third and fourth

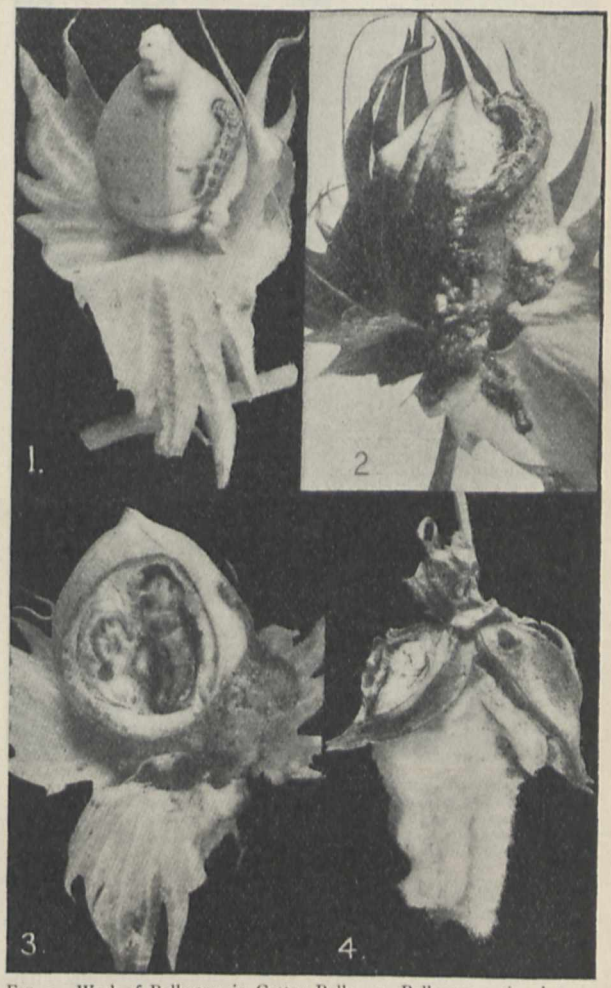


FIG. 1.—Work of Bollworm in Cotton Bolls. 1, Bollworm eating into a half-grown cotton boll; 2, bollworm boring into a full-sized cotton boll; 3, full-grown bollworm and its work in large cotton boll; 4, cotton boll only partially destroyed by bollworm, two "locks" open, the others destroyed (original).

generations of larvæ, the previous ones feeding upon the corn.

The summary given of the life-history shows that the moth may lay from 500 to 3000 eggs, especially upon the "silks" of corn and the "squares" of cotton. During warm weather they hatch in two or three days. In spring the young larvæ eat the buds, later the silks and tassels of the corn; in August and September they attack the cotton. They bore directly into the "squares" and "bolls," and destroy the latter. Maturity is reached in two weeks; they then enter the soil to pupate. Detailed descriptions are given of all the stages, the effects of climate, and variations in colour. Nothing definite is shown to account for the great variation seen in the larvæ.

[1] "The Cotton Bollworm." By A. L. Quaintance and C. T. Brues. U.S. Department of Agriculture, Bureau of Entomology, *Bull.* 50. Pp. 155+plates xxv+figs. 27. (1905.)
"The Mexican Cotton Boll Weevil." By W. D. Hunter and W. E. Hinds. *Idem*, *Bull.* 51. Pp. 181+plates xxiii+figs. 8. (1905.)

Amongst predaceous enemies is mentioned a Chrysopa which feeds upon eggs and young larvæ. Wasps appear to do most good. Numerous parasites are also described; one, *Trichogramma pretiosa*, a small hymenopteron, attacks the eggs, others the larvæ; but from what we gather from the report man cannot expect much help from these "natural checks." Remedial and preventive cultural measures are thus fully explained.

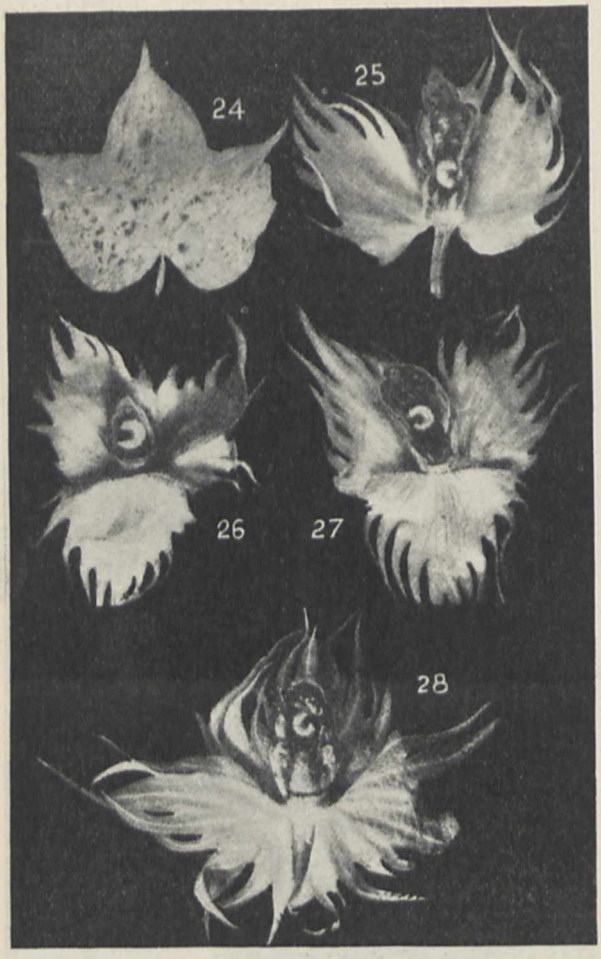


FIG. 2.—Various Results of Larval Work. 24, Leaf fed on extensively by weevils in confinement; 25, full-grown larva in square ready to bloom; 26, full-grown larva in square of usual size; 27, larva full-grown, ovary in square entirely destroyed: 28, larva full grown, ovary untouched—all reduced (original).

The Mexican cotton boll weevil is luckily confined to the United States, Mexico, Cuba, and Guatemala. The authors have been unable to verify the reports that it has been found in Africa or Brazil. If a cotton weevil occurs in the former country it is probably another species, as we see is the case in the Philippine Islands.

The Mexican weevil has the unique record of developing in less than twenty years from an obscure species into a great pest. The authors ably describe its life-history and destructive habits in Texas and elsewhere. In the summary of the life-history it is stated that the egg is deposited by the female in a cavity formed by eating into a square or boll. The egg hatches in a few days, and the footless grub begins to feed, making a larger chamber for itself as it grows. The pupa also occurs in the boll. It is important to note that no other food than cotton has been found.

Some interesting experiments are recorded which tend to show that the weevils are not able to locate their food by smell.

Another series of experiments showed that the weevils prefer Egyptian cotton (Mit Afifi) to the American upland cotton.

Their capacity for reproduction seems appalling, judging from the table given showing the annual progeny of one pair of hibernating weevils, which amounts to 12,755,100!

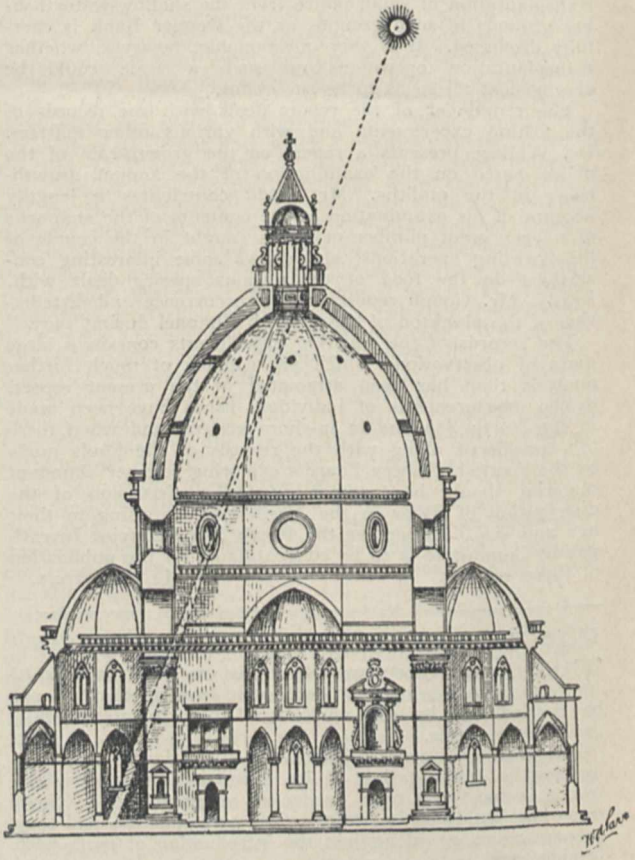
The beetles hibernate in many places, as in infected bolls and stalks, and it is shown that the early destruction of the stalks in the fall is the most effective way to reduce the pest.

Dissemination takes place in cotton in bales and that sent for "ginning." Shipments of seeds are said to be almost certain to carry weevils if coming from infested areas. The report also shows another important point, namely, that the pilosity of the plant affects the progress of the weevil. Parasites do not seem to be of much use. Doubt is cast by the authors upon the benefit of *Pediculoides ventricosus*. Mention is also made of the possible use of the Mexican ants (*Ectotomma tuberculata*), &c. Of great importance to those who import seed is the result showing that bisulphide of carbon is the best substance to clean the seed.

FRED. V. THEOBALD.

THE GREAT GNOMON OF FLORENCE CATHEDRAL.

ALTHOUGH numerous Christian churches are either oriented or adorned with reference to some astronomical phenomenon, there are few of such direct interest to the astronomer as the magnificent cathedral of Florence, which contains a gigantic contrivance for determining the advent of the summer solstice. We refer to the famous gnomon, placed in the dome of that cathedral by Paolo Toscanelli about the middle of the fifteenth century, and



described and illustrated by Mr. W. A. Parr in the December number of *Knowledge and Scientific News*.

Lalande in 1765 referred to this instrument as "la méridienne que l'on voit dans la Cathédrale de Florence est le plus grand monument d'Astronomie qu'il y ait au

monde," but at that time the astronomical significance of the Egyptian temples, or even of our own less pretentious Stonehenge, had not been demonstrated.

Sir Norman Lockyer has shown in "The Dawn of Astronomy" that the enormous edifice at Karnak, the temple of Amen-Ra, was oriented for a similar purpose, so that at the setting of the sun on the day of the solstice, and at that time only, the solar beam flashed along the darkened axis of the temple, some 500 yards long, and illuminated the "holy of holies" wherein the priest was ready to fulfil the rites of "the Manifestation of Ra." He has also shown that Stonehenge was erected for a similar purpose about the year 1680 B.C., but in this case the limb of the actual (rising) sun was observed, the avenue simply forming the sight-line to the point on the horizon where the sun-god would make his first appearance on the day of the solstice.

But although since Lalande made the statement quoted above it has been shown that the gnomon at Florence is not the *largest* monument to astronomy the world has ever seen, it is still one of the most interesting. As may be gathered from the accompanying illustration, the sunlight, passing through the southern window of the lantern, falls on to the gnomon, which is built into the marble sill of the window, and thence, through a circular orifice, on to a "solstitial" marble slab let into the cathedral floor some 300 feet below, where its correct position at the solstice is marked, or was intended to be marked.

This immense meridian instrument was probably designed by Toscanelli in order to provide exact observations for the correction of the Alphonsine tables which were then in use, but which represented very inadequately the solar motion, more especially as regards the true length of the tropical year. Whether he also intended to observe the variation of the obliquity of the ecliptic is a much discussed question, but it does not seem improbable. In either case his gnomon, probably built only in 1468 A.D., could not answer this purpose anything like so surely as do the Amen-Ra and Stonehenge structures, built many centuries earlier. Apart from this reason, the facts that the gnomon itself has been removed from its original position, and that the solstitial circle on the cathedral floor has been found to be erroneously placed, have destroyed for ever the instrument's utility in this direction. It has been used, however, in order to detect any possible movement in the fabric of the cathedral, but, to the credit of Brunelleschi, who built the structure, no such movement has ever been demonstrated.

In the light of the recent articles in NATURE (p. 153) concerning the fires, &c., by which the ancient British festivals were celebrated, it is interesting to note that Mr. Parr considers that the great display of fireworks, which to the modern Florentine forms the chief attraction of the Midsummer Day festival, is simply the analogue of the "St. John's Fires" kindled in former times to celebrate the advent of the summer solstice. On that day huge crowds of Florentines flock to the cathedral in order to celebrate the festival of their patron saint, St. Giovanni, and at night the great dome itself is illuminated.

W. E. R.

THE TRAINING OF THE BODY AND MIND.

FOR years the London County Council has arranged a conference of teachers during January, and this time it was held on January 4–6 at the Medical Examination Hall on the Victoria Embankment. In the old days, when the County Council was only interested in technical instruction, the meetings were devoted to the interests of science teachers more particularly, but now that general education has been added to the responsibilities of the body that governs London, matters appertaining to all kinds of teaching are considered at the conferences.

The first day's work was, however, devoted to a subject that affects all education, namely, that training of the body which is correlated with the proper development of the mind. Mr. A. J. Shepheard (vice-chairman of the education committee of the London County Council), who opened the conference, urged the importance of a complete education, and Colonel Malcolm Fox (inspector of physical training to the Board of Education) read the first paper, which dealt more particularly with physical training in elementary schools. He began with a brief sketch of the history of gymnastics and physical culture in general, though going no further back than the days of ancient Greece, which, in its beautifully symmetrical statues, has left us undoubted evidence that it had little to learn in the science of training the body.

Colonel Fox went on to say that the Greeks practised little of what we understand as gymnastics, and attained their object by such exercises as riding, dancing, leaping, or running, and he pointed out that the trend of gymnastic opinion is again turning strongly in the same direction. As the power of Greece declined, her universal physical culture ceased to be national, and passed to the individual whose business it was to afford entertainment by exhibiting his prowess in the arena. When the remnants of greatness passed to Rome, no physical training became general, as the many contented themselves with the excitement afforded by the efforts of the trained few. It is true that the "sporting nobles" of the famous Tenth Legion used from time to time to descend into the arena, competing with some favourite team in the chariot races, or matching their skill with sword and shield against the net and trident. This action was, however, exceptional, and the period bears the picture of a vast concourse hanging with fevered excitement on every stroke of sword or cast of net—spectators at a game that they themselves had little ability or desire to play. To find a modern parallel to such a scene we have unfortunately not far to seek.

After touching on the absence of any definite system of gymnastics also in the middle ages, and the recommendation of exercises as a cure for certain complaints as early as the sixteenth century, the reader of the paper traced the use of systems in France, in Germany, where gymnastics were first used in an educational sense, in Switzerland, where Pestalozzi adopted them, and in Sweden, where between 1776 and 1839 Ling was the pioneer in classifying gymnastics into groups and arranging them scientifically in accordance with the needs of the human body.

Colonel Fox described how, after an interregnum, revivals of physical training took place, and stated that under the tests of modern physiological knowledge the Swedish system of Ling stands out preeminently above all others. He further dwelt on the mild and gradual work in its early stages, on its effects upon the body and success in other countries, as well as its educational results. These admit of no immediately apparent proof, but they do exist, as a few weeks' trial of them will most assuredly show. Psychology, Colonel Fox said, with our limited knowledge, allows of deductions only from experience, and the latter is unanimous that the educational results claimed by Ling are gained, and that the qualities of courage, obedience, decision, alertness, concentration of thought, and self-confidence are not confined to the hour or two of the gymnastic lesson, but become part and parcel of the child's nature.

After speaking of methods, duration of lessons, the dearth of male teachers, and matters of interest to elementary and other teachers, Colonel Fox concluded by quoting figures from the report of a Royal Commission on Physical Education in Scotland. Of 600 children examined in Aberdeen, only 326 were found to be in good health, while of the same number in Edinburgh but 171 were found to be sound.

The next paper was by Mr. W. Langbridge (headmaster of Wolverley Street School, Bethnal Green), and dealt with exercises which can with advantage be performed in classrooms and afford a relief to ordinary lessons during which activities are constrained.

In the afternoon Sir Lauder Brunton took the chair, and discussed education in connection with the threefold character of man. At first, he said, moral training was provided, and churches and cathedrals were built long before the people could read or write; then mental culture was considered, and became very general; and, lastly, it was being recognised that the condition of the body had considerable effect upon the morals and the mind, so that a physical training was also considered necessary. He gave some interesting instances to show how character

and habits had been entirely altered by accidents to the brain, and said that while Newton was physically weak, Young, who was his superior even in mental capacity, was a circus rider, and could perform almost any bodily feat.

Sir Lauder Brunton spoke of the need to train the higher inhibitory nerve centres, and of the possibility of keeping in order involuntary movements. He said that children could not do physical exercises unless they were properly fed, and urged that no damage must be done by over-exertion. Medical inspection was desirable, but teachers, he thought, could easily learn to recognise the signs of danger.

Dr. Kerr (medical adviser to the London County Council Education Committee) took as his subject the position of physical exercises in the infant department of the elementary school. He pointed out that while certain of the nerve cells in the infant were quickly matured, and this was especially so with those dealing with behaviour that has been hereditary for long periods, other nerve cells were still capable of being acted upon for a considerable time. In this state they were very susceptible to fatigue, and frequent periods of rest were needed in which the waste products from action could be removed. He advised the use of physical exercises for infants, and maintained that no great perfection of detail ought to be looked for.

Of a different character was Mrs. Kimmins's paper on the educational value of organised play, for it was a graphic account of the way in which most of the benefits claimed as coming from physical training could be gained out of school, and in the particular case described, away from it.

All the speakers upon physical exercises agreed that these were only complementary to games; and in the last paper of the day Miss Kingston (organising instructor of physical exercises of the London County Council) discussed the interrelation of drill and organised play.

It should be pointed out that all concerned were most anxious that the word drill should not be used, as it called up in the mind military drill, something quite different from the exercises and unfitted for children. There was also considerable unanimity as regards the need for the pupils to do the work for its own sake and as a pleasure, and not as a task. Sir Lauder Brunton was most emphatic on this point, as was also Dr. Kerr. The Rev. Stuart Headlam, a member of the old School Board, in the discussion objected to things being made too pleasant, but it had been pointed out that even games pall if they are too much organised, and their interest and freshness thus lost.

There is no doubt but that as true nature-study should properly put the child so far as possible into the same mental relation with its surroundings that primitive man enjoyed, so physical exercises adopted in a pleasurable way should counteract the baneful effects of civilisation, as Dr. Kerr pointed out on Thursday, and, one may add, give our young people the bodily advantages of their remote ancestors.

As on previous occasions, Mr. C. A. Buckmaster and Dr. Kimmins (chief inspectors, respectively, to the Board of Education and the London County Council, education committee) organised the conference in a remarkably successful manner. WILFRED MARK WEBB.

COLOUR VISION IN THE PERIPHERAL RETINA.[1]

THE results of a research into the nature of colour vision in the peripheral portions of the retina, carried on by Mr. Baird during the years 1903 and 1904 in the psychological laboratory of Cornell University, have lately been published in a pamphlet. The work so carefully done by Hess and the numerous papers by him on this subject have received fairly general acceptance, and in the present work Mr. Baird confirms most of Hess's conclusions. The reason he gives for the publication of a pamphlet which contains little new work of any great value is that Hellpach, in his research on the nature of colour sensation in the peripheral retina, had arrived at conclusions which controverted many of the statements of earlier observers, and it was deemed advisable to repeat Hellpach's work in order to see whether there might not be some fallacy in the method. Mr. Baird's work practically in every respect confirms that of Hess, and we think there is little doubt that his explanation of the confusing results obtained by Hellpach is correct, that Hellpach did not allow sufficient time to elapse between successive stimulations, and consequently the colour sensation due to the immediate stimulation was partly modified by a latent after image of the preceding stimulus.

In standardising his colours, Mr. Baird arrived at practically the same results as Hess. The red used transmitted no part of the visible spectrum, and Hess, in order to get a stable red, had to mix it with a certain amount of blue. The yellow, green, and blue used corresponded fairly exactly with Hess's stable colours.

It is when we come to the problem of equating the white values of the different colours that the greatest difficulty is met with. We must confess to a strong suspicion of the value of Mr. Baird's method. He is engaged on a research on the nature of colour vision in the peripheral retina, and in the determination of his standards he utilises the very portion of the retina which he is subsequently going to investigate. We quite allow that there is no satisfactory method of equating white values at present known, but we certainly think that Mr. Baird has chosen the least satisfactory of all. Probably the best method of photometry available at present depends on the flicker phenomenon, and for Mr. Baird's purpose we feel sure it would have been much more suitable and much more scientific than the method he did adopt.

In other respects the work has evidently been carefully done, and though, as we have said, it adds little that is new to our stock of knowledge, it is of value in that it confirms much of the work of previous observers.

[1] "The Colour Sensitivity of the Peripheral Retina." By John Wallace Baird. Pp. 80. (Published by the Carnegie Institution of Washington, 1905.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. R. A. LEHFELDT, professor of physics at the East London College, has been appointed to the chair of physics in the Transvaal Technical Institute, Johannesburg.

THE Corporation of Glasgow has resolved to make a grant of 10,000*l.* to the building fund of the Glasgow and West of Scotland Technical College, from the common good of the city.

IT is satisfactory to find a committee of the Classical Association reporting that "in view of the legitimate claims of other subjects the amount of time devoted to the classics on the classical side of boys' public schools is as great as can reasonably be expected." From the report which was presented at a meeting of the association on Saturday last, it appears that in the highest form on the classical side in the larger public schools a considerable amount of specialisation is allowed to many boys. In the other forms the time devoted to Greek and Latin together generally amounts to about one-half of the whole number of school hours. In the smaller public schools there is less specialisation in the highest form. The proportion of time given in school to classics increases from somewhat less than one-third in the lowest form in which both Greek and Latin are studied to slightly less than two-thirds in the highest form. The committee suggested that time and effort might be saved and better results obtained by certain changes in the method of teaching Greek; and in the discussion upon the resolutions put forward with this end in view, we are glad to see that Canon Lyttelton, headmaster of Eton, pointed out that the time gained by the adoption of the plan proposed "might well be given to instruction in some of the elements of scientific knowledge rather than to history and archæology. Let them hold out a helping hand to their scientific colleagues and meet them half-way. There had been too little conciliation between the two sections of teachers. Then we might hope to correlate these great subjects, which were too important to abandon, but which we had not yet enabled to live in amity together."

THE organisers of the North of England Education Conference, held this year at Newcastle-upon-Tyne on January 5 and 6, had to struggle with the fact that almost all persons and bodies who were desirous of conferring together had their hands full with the difficulties of primary education and its immediate continuations. The conference was well attended by between two and three hundred members drawn chiefly from the education committees of the county councils, the permanent officials of such committees, and schoolmasters and mistresses, and their interest was almost entirely directed to the problems called into existence by the duties now thrown upon the education committees. Not a word was said as to higher education, very little as to secondary education in any form, and, it may be added, scarcely a word as to the religious difficulty. The tone of the conference was distinctly optimistic, and it was the general opinion that if the councils were less encumbered by intervention of the Board of Education, and deputed more of their own work to persons in each locality, the difficulties that have declared themselves would work themselves out. It was encouraging to see so much determination to cope with the questions, in spite of the heavy tax of time thrown upon the education committees, and it is very clear from the local patriotism exhibited that the councils will not ultimately rest content with perfecting a primary system. It is, however, a question of pounds, shillings, and pence, and so long as the councils are left without other resources than the rates it is clear that improvements must wait a long time.

THE December, 1905, issue of the *Bulletin of the Massachusetts Institute of Technology* comprises, as usual, a list of the staff and students of the institute, with a statement of the requirements for admission, a full description of the courses of instruction, and an account of the Lowell School for Industrial Foremen. It is interesting to note that the institute offers summer instruction during the months of June and July, supplementing the work of the regular school year. Summer courses are undertaken primarily for the benefit, first, of those who wish to distribute their work over a larger portion of the year, or to gain more time for advanced work; and, secondly, of those who, through illness or other causes, have deficiencies to make up. Moreover, to bring students into closer relations with the practical side of their professions, professional summer schools are held in the departments of civil engineering, mining engineering and metallurgy, architecture, chemistry, and geology. The students, accompanied by instructors, give their time to field-work, or visit and report on mines and industrial establishments. The Lowell School for Industrial Foremen is a free evening school which includes, at present, mechanical and electrical courses extending over two years. These courses are intended to bring the systematic study of applied science within the reach of young men who are following industrial pursuits and desire to fit themselves for higher positions, but are unable to attend courses during the day. This number of the Bulletin, with its 408 pages, provides abundant evidence of the excellent work being accomplished by this widely known institute.

THE annual meeting of the Geographical Association was held on January 5, when the report for 1905 was adopted. The report shows that the total membership of the association is 503, including teachers of every grade, school inspectors, and others interested in geographical education. An important advance was made during the year by the formation of local branches. This is a valuable expansion of the work of the association, enabling members to meet at more frequent intervals, to discuss the advantages presented by their own district for teaching geography, permitting combination in excursions and cooperation in the accumulation of lantern-slides and other materials necessary for good teaching. The geographical exhibits collected by the association in 1904 were on view during the year at Liverpool, Huddersfield, Bedford, and Oxford. Part of the exhibits were lent to Felsted School for a local exhibition. The exhibition is now being broken up, and exhibits lent to the association returned. Dr. G. R. Parkin, secretary of the Rhodes Scholarship Trust, who was in the chair, dealt in his address with the general question of geography. In war, he said, geography is of the greatest importance. If our commanders at the battle of Colenso had possessed an elementary knowledge of the geography of the country thousands of precious lives might have been saved. In a nation like ours, which may any day find it necessary to send an expedition to a frontier place in India or to some corner of Africa, the intimate study of geography is an essential condition of national safety and honour. In commerce, too, geography is everything. Only last year the great cotton districts of Lancashire began to realise that the supplies of cotton were not sufficient for the demand, and Sir Alfred Jones organised a company to discover what places under the British flag are suitable for raising cotton. This is largely a geographical work which a great commercial country like ours should be carrying on as a Government measure. As the great workshop of the world, which almost requires the world from which to draw raw material and food, no nation ought to know so much about geography as ourselves, and yet up to the last eight or ten years hardly a subject has been shown so little consideration.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, December 12, 1905.—Mr. Howard Saunders, vice-president, in the chair.—*Exhibitions.*—Twelve enlarged photographs of whales taken at the fin-whaling factories in east Finmarken in 1883–89: A. H. **Cocks.** The species represented were *Megaptera longimana, Balaenoptera sibbaldii, B. musculus,* and *B. borealis.*—The tail-vertebræ of a dormouse of the genus Eliomys, which showed the phenomenon, hitherto unrecorded among Mammalia, of the regeneration of a bony structure in case of accident: Oldfield **Thomas.** The caudal vertebra, in this case the twelfth, which had been originally broken across, had grown out into a slender styliform appendix 15 mm. in length and rather less than 1 mm. in diameter, the normal vertebræ of this part of the tail measuring about 6×2 mm. On further search two other specimens exhibiting the same structure had been found, and it appeared, therefore, that dormice, like lizards, were able partly to regenerate their tails, when these important balancing-organs got accidentally broken.—Microscopic sections of the skeletal tube found in the restored tail of one of the dormice (Graphiurus) exhibited by Mr. Thomas: Dr. W. G. **Ridewood.** The wall was made up of close-set lamellæ, producing in a transverse section a fine concentric striation. Lacunæ with numerous branching canaliculi were disposed regularly in relation with the concentric striations, and the general effect was that presented by a transverse section of the humerus or femur of a frog. Internally to the bony layers, and contiguous with the central jelly, was a moderately thick layer, which was clear, homogeneous, and highly refractive. Dr. Ridewood also exhibited, by way of contrast, slides of the skeleton of the restored tail of an iguana lizard, the skeletal tube in this case being composed of calcified fibro-cartilage and not of bone.—*Papers.*—Observations and experiments on the habits and reactions of crabs bearing sea-anemones in their claws: Prof. J. E. **Duerden.**—Notes on a large collection of snakes made by Mr. Alan Owston in Japan and the Loo Choo Islands: Captain F. **Wall.**—A collection of South Australian spiders of the family Lycosidæ contained in the museum at Adelaide: H. R. **Hogg.** Thirteen species were remarked upon, ten of which were described as new.—A collection of mammals obtained by Colonel A. C. Bailward during a shooting trip through Persia and Armenia during the past summer, and presented to the National Museum: Oldfield **Thomas.** Thirty-one species were enumerated, and special attention was directed to the discovery of Calomyscus, a primitive murine, the only ally of which, amongst recent forms, was the North American Peromyscus.—The colour-variation of the beetle *Gonioctena variabilis*: L. **Doncaster.** The material on which the paper was based was collected almost entirely at Granada, and the author found that, although the insect was extraordinarily variable, when a large collection was examined the beetles could be classified into two chief

groups with but few intermediate forms.—Two new species of worms, one a Pontodrilus from the shores of the Red Sea, and the other an Enchytræid of the genus Henlea from India, which was destructive to the eggs of the locust: F. E. **Beddard.**—Two species of decapod Crustacea, a crab and a prawn, collected by Dr. R. Hanitsch, of Singapore, from a small artificial fresh-water pool on Christmas Island: Dr. J. G. **de Man.** The interest of their occurrence lies in the fact that previous to the construction of the reservoir, a few years ago, there seems to have been no possible habitat for these animals on the island, and they must have been introduced since that time, perhaps by migration from the sea. The crab was referred to *Ptychognathus pusillus*, a species described by Heller from the Nicobar Islands forty years ago, and not since found. The prawn was made the type of a new variety of *Palaemon lar*, both the variety and the typical form having a wide distribution in countries bordering the Indian Ocean.—Results of experiments made in connection with the heredity of webbed feet in pigeons: R. **Staples-Browne.**—New and rare British Oribatidæ: C. **Warburton** and N. D. F. **Pearce.** Eleven species were remarked upon, of which seven were described as new to science, and two were recorded for the first time as being British. The nymph of *Serrarius microcephalus* was described for the first time, and it was pointed out that *Gustavia sol* of Kramer was a nymph of an unknown species of Serrarius.

Royal Meteorological Society, December 20, 1905.—Mr. R. Bentley, president, in the chair.—Attempt to fly kites for meteorological purposes from the mission ship attached to a deep-sea fishing fleet in the North Sea: G. C. **Simpson.** These observations, which were made in July and August last, were carried out on behalf of the joint kite committee of the Royal Meteorological Society and of the British Association. By the kindness of the Royal National Mission to Deep-sea Fishermen, the kites were flown from the deck of the mission ship *Queen Alexandra* attached to the Red Cross Fleet. Owing to the vessel being almost continuously employed in trawling, the opportunities for flying kites were very limited; nevertheless, Mr. Simpson was able to secure eight ascents during the time he was on board the vessel, and he now gave the results obtained. The greatest height reached was 5800 feet.—Method of flying kites in Barbados in April and May last year: C. J. P. **Cave.** Mr. W. H. Dines, who had examined the records, said that the humidity traces show generally a value of about 60 per cent. at the surface, rising to 80–90 per cent. at heights from 1000 feet to 2000 feet, and then falling off again in some cases to 50 per cent. or less as the height increases. These values are lower than might have been expected over a tropical ocean. The increase is of the ordinary kind, but the maximum value occurs at a far lower elevation than is the case in Europe. It is probable that the relative humidity forms an extremely accurate index to the vertical circulation, a low humidity indicating a descending current of air, and so it may be inferred that there is some settling down of the atmosphere over the region of the smaller west Indian islands in April and May.—Temperature observations during the partial solar eclipse, August 30, 1905: W. H. **Dines.**—Comparison between Glaisher's factors and Ferrel's psychrometric formula: J. R. **Sutton.**—A rapid method of finding the elastic force of aqueous vapour, &c., from dry and wet bulb thermometer readings: J. **Ball.**

Chemical Society, December 21, 1905.—Prof. R. Meldola, F.R.S., president, in the chair.—Azo-derivatives from methyl-α-naphthocoumarin: J. T. **Hewitt** and H. V. **Mitchell.** Several of these derivatives are described; the most interesting is *p-nitrobenzeneazomethylnaphthocoumarin*, which gives an intense blue coloration in alkaline solution.—The preparation and reactions of benzoyl nitrate: F. E. **Francis.** Benzoyl nitrate is formed by the interaction of benzoyl chloride with silver nitrate at low temperatures. It is a light yellow oil which, if carefully warmed, decomposes into benzoic anhydride and oxides of nitrogen, but if heated quickly explodes.—The supposed identity of dihydrolaurolene and of dihydro*iso*laurolene with 1 : 1-dimethylhexahydrobenzene: A. W. **Crossley** and N. **Renouf.** Zelinsky and Lepeschkin supposed that these three substances were identical, but this is not the case.—The diazo-derivatives of 1 : 5- and 1 : 8-benzenesulphonylnaphthalenediamines: G. T. **Morgan** and F. M. G. **Micklethwait.**—Further experiments on a new method of determining molecular weights: P. **Blackman.**—Studies in fermentation. The chemical dynamics of alcoholic fermentation by yeast: A. **Slator.** The results indicate that the reaction, measured by observing the change in pressure due to evolution of carbon dioxide, is the slow decomposition of a compound produced by the interaction of the enzyme and the sugar.—Some new platinocyanides: L. A. **Levy** and H. A. **Sisson.** Hydrazine and hydroxylamine platinocyanides are described.—An intramolecular change leading to the formation of naphthalene derivatives: E. F. J. **Atkinson** and J. F. **Thorpe.** Ethyl sodiocyanoacetate condenses with benzyl cyanide to form ethyl α-cyano-β-imino-γ-phenyl-*n*-butyrate. This, when treated with an equal weight of sulphuric acid, forms an intense green solution, which yields ethyl 1 : 3-diaminonaphthalene-2-carboxylate.—The relation of position isomerism to optical activity, V., The rotation of the menthyl esters of the isomeric dibromobenzoic acids: J. B. **Cohen** and I. H. **Zortman.** An account of certain physical constants, including the molecular rotations of the six isomeric menthyl dibromobenzoates.—Some derivatives of naphthoylbenzoic acid and of naphthacenequinone: J. Q. **Orchardson** and C. **Weizmann.**—Ethyl β-naphthoylacetate: C. **Weizmann** and E. B. **Falkner.**—Contributions to the chemistry of the amidines. 2-Aminothiazoles and 2-imino-2 : 3-dihydrothiazoles. 2-Iminotetrathiazoles and 2-amino-4 : 5-dihydrothiazoles: G. **Young** and S. I. **Crookes.**—The action of water on diazo-salts: J. C. **Cain** and G. M. **Norman.** An extension of a method of investigation, already described, to diazo-salts from 2 : 4-dibromoaniline and dibromo-*p*-toluidine (*cp. Proc. Chem. Soc.*, 1905, xxi., 206).—Note on the atomic weight of nitrogen: A. **Scott.** A reply to Richards (*Proc. Amer. Phil. Soc.*, 1904, xliii., 116) showing *inter alia* that the recent work of Richards and Wells on the atomic weights of chlorine and bromine has cleared up the discrepancy between the numbers obtained by the author for the atomic weight of nitrogen (*cp. Journ. Chem. Soc.*, 1901, lxxix., 154).—The solubility of zinc hydroxide in alkalis: J. **Moir.** When zinc hydroxide dissolves in excess of caustic alkali, the phenomenon is essentially the production of an equilibrium between the alkali and the zincic acid, and no definite chemical compounds such as $ZnO,8KOH$ are formed.—The slow combustion of carbon disulphide: N. **Smith.** The reddish-brown deposit formed when carbon disulphide and oxygen are passed through a heated tube consists chiefly of an acidic compound $C_{16}H_6O_4S_8$. The silver and ammonium salts have been prepared.

PARIS.

Academy of Sciences, December 26, 1905.—M. Troost in the chair.—Researches on the insoluble potassium compounds contained in humic materials: M. **Berthelot.** Powdered wood charcoal, after careful extraction with dilute hydrochloric acid and water, was treated with dilute solutions of potassium acetate and calcium acetate, the constituents of the charcoal ash being determined before and after the treatment. The results are compared with those obtained previously in which the charcoal was washed with water only, and conclusions drawn as to the nature of the potassium salts existing in wood charcoal.—On a standard of light: J. **Violle.** A description of some attempts to establish a standard of light by utilising the constant temperature obtained by boiling silver and copper.—On a new petrographic type of certain leucotephrites from Somma: A. **Lacroix.**—New observations on the formation and the quantitative variations of the hydrocyanic principle of the black elder: L. **Guignard.** The amount of the glucoside falls off very slightly with the increase of age of the leaf. At the end of the vegetative period it does not pass into the stem, but remains in the leaf when it falls off, and hence cannot be regarded as a reserve substance.—The influence of some factors on experimental parthenogenesis: Yves **Delage.** Numerous chemical reagents can bring about experimental parthenogenesis, and the conditions may also be varied, but the

fundamental action or condition still remains to be determined. The variable results obtained with the same reagent under, apparently, the same experimental conditions are pointed out, showing the necessity of averaging a large number of experiments before drawing conclusions. The reagent which has given the best results is made up of sea-water, 3 c.c., solution of NaCl of 2½ molecules per litre, 45 c.c., distilled water, 72 c.c., sulphite of soda, 5 drops.—On the identity of surra and mbori: A. **Laveran.** It has already been shown that morphologically the trypanosomes of surra and mbori were nearly identical, and also that animals which had been rendered immune to surra were practically immune to mbori. In the present paper it is shown that an animal which has acquired immunity for mbori is also immune for surra, and hence the conclusion is drawn that the trypanosomes in these two diseases belong to the same species. The trypanosome of mbori is a less virulent variety of *Trypan. evansi.* —Observations on the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the first quarter of 1905: J. **Guillaume.** The results are summarised in three tables showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—On isothermal surfaces and a class of envelopes of spheres: A. **Demoulin.**—On some generalisations of Picard's theorem: C. **Carathéodory.** —On the non-stationary movement of a fluid ellipsoid of revolution which does not change in figure during the movement: W. **Stekloff.**—On a transformation of certain linear partial differential equations of the second order: J. **Clairin.**—Reclamation of priority regarding an apparatus of M. Nodon for examining the solar protuberances at any time: Antoine **Sauve.**—On the propagation of light in a system in translation and on the aberration of the stars: G. **Sagnac.**—On the mechanism of the production and the nature of kathodic pulverisations: Ch. **Maurain.** The kathodic pulverisations appear to consist of moderately large particles, torn from the kathode by the shock of the α rays, and charged electrically, but with an e/m much smaller than for the projectiles constituting the kathode rays.—On the mobilities of the ions of saline vapours: G. **Moreau.**—On the respective spectra of the different phases of the electric spark: G. A. **Hemsalech.** Using the arrangement of apparatus described in an earlier note, the author finds that the electric discharge gives a line spectrum in non-ionised air and a band spectrum in ionised air. It is shown that a single oscillation is capable of producing and rendering luminous the metallic vapour.—The sulphates of samarium: Camille **Matignon.** The methods of obtaining the acid and basic sulphate from the neutral sulphate are given, together with the properties of these salts.—The action of acetylene on iodine pentoxide: Georges F. **Jaubert.** Acetylene is quantitatively oxidised to carbon dioxide by iodine pentoxide at 80° C. In the estimation of carbon monoxide in the air by the iodine pentoxide method, it is therefore necessary to ensure the absence of acetylene by appropriate reagents.—The action of glucose on selenious acid: MM. Œchsner **de Coninck** and **Chauvenet.** In the reduction of selenious acid by glucose, a red amorphous colloidal variety of selenium is produced, insoluble in carbon bisulphide. At 100° C. it is partially converted into black selenium.—The action of ammonia gas on the tribromide and triiodide of phosphorus: C. **Hugot.** A yellow amide of phosphorus is formed by this reaction at low temperatures; at higher temperatures it is decomposed, phosphorus imide being formed.—On the methods employed by the Arabs to get metallic lustre on enamels: L. **Franchet.**—On a new mode of preparation of barium: M. **Guntz.** The purest metal obtained in previous work contained 98·5 per cent. of barium. If this is converted into the hydride, and the latter heated *in vacuo* at 1200° C., the sublimed metal is crystallised and of 99·5 per cent. purity.—On some new derivatives of pentabasic phosphoric acid, $P(OH)_5$: P. **Lemoult.**—Syntheses of derivatives of 1 : 4 : 7 symmetrical heptanetriol: J. L. **Hamonet.**—Products of the hydrogenation of carvacrol: Léon **Brunel.** An account of the results obtained by the application of the Sabatier and Senderens method to carvacrol.—Some liquefying and hydrolysing actions of starch: P. **Petit.**—On the presence of trachytes and hypersthene andesites in the Carboniferous strata of Corsica: M. **Deprat.**—On *Raphia Ruffia*, a wax-producing palm: Henri **Jumelle.**—On an important variation of the tuber of *Solanum Maglia*: Édouard **Heckel.** Experimental work tending to confirm the view of de Candolle that this is the wild species from which the cultivated potato is derived.—On the use of manganese as a manure: Gabriel **Bertrand.** An account of some experiments, made on the agricultural scale, showing the beneficial effect of the addition of manganese sulphate as a manure.—The assimilation of carbon dioxide by the chrysalids of Lepidoptera: Mlle. Maria **von Linden.**—On the parallelism between phototropism and artificial parthenogenesis: Georges **Bohn.**—On the independence of metamorphosis and the nervous system in batrachians: P. **Wintrebert.**—On the inoculation of cancer: M. **Mayet.** The soluble products obtained from a cancerous tumour in man, free from solid matter by filtration through porcelain, and injected into a dog, gave rise to a cancerous growth. —The pathological nature of the Holmgren canals of nerve cells: R. **Legendre.** The author's views are in direct opposition to those of Holmgren concerning the function of the cavities in nerve cells, and he regards them as pathological in nature.—On the discovery of Amphibia in the Coal-measures of Commentry: Armand **Thevenin.** —Magnetic observations at the Observatory of Ebre on the occasion of the eclipse of the sun of August 30, 1905: P. **Cirera.**

January 2.—M. H. Poincaré in the chair.—On the estimation of carbon monoxide in air by iodic anhydride: Armand **Gautier.** With reference to the note by M. G. Jaubert in the last number of the *Comptes rendus*, the author points out that he published this fact in 1898, and has also shown how to correct for the error introduced into the determination by the presence of acetylene. Acetylene does not occur in the air of towns. —New observations on the Pycnogonides collected in the Antarctic regions in the course of the expedition directed by M. Jean Charcot: E. L. **Bouvier.**—On the deformation of quadrics: C. **Guichard.**—On the mutations of some fossil plants of the Coal-measures: M. **Grand'Eury.** A *résumé* of the results obtained by the author during the last ten years.—Observations of Giacobini's comet (1905*c*) made at the Observatory of Toulouse with the 38 cm. Brunner-Henry equatorial: F. **Rossard.** Observations made on December 18 and 22, 1905, showing the positions of the comparison stars and apparent positions of the comet.—Provisional elements of Giacobini's comet (1905, December 6): E. **Maubant.**—Observation of Giacobini's comet (1905*c*) made with the 16 cm. Brunner equatorial at the Observatory of Lyons: J. **Guillaume.** Observations made on December 12, 1905. The comet appeared as a diffuse luminosity of 30″ to 40″ diameter. —Photographic study of the annular nebula in Cygnus, N.G.C. 6894: Gabriel **Tikhoff.** The details shown by the photograph are in general agreement with those published by Keeler, from the Lick Observatory.—Theorem on entire functions: M. **Auric.**—A contribution to the study of photographic screens: J. **Renaux.** Remarks on the use of colouring matters for photographic screens.—Researches on the terrestrial field, carried out during the total eclipse of August 30, 1905: Charles **Nordmann.**—On the determination of the rare gases in natural gaseous mixtures: Charles **Moureu.** A diagram of the scheme of apparatus used by the author is given, together with exact details of working. Oxygen and nitrogen are removed by hot lime and magnesium mixture, hydrogen and hydrocarbons by heated copper oxide, moisture and carbon dioxide by phosphoric anhydride and soda lime respectively. The last traces of nitrogen are removed by metallic calcium.—On the heat of fusion of ice: A. **Leduc** (see p. 254).—On the synthesis of the amido-acids derived from the albumens: L. **Hugounenq** and A. **Morel.**—The structure of plants developed in the light, without carbon dioxide, and in presence of organic materials: M. **Molliard.** The essential characters of plants cultivated under the above conditions are a structure resembling that of the subterranean organs and the formation of tissue with plurinucleated cells.—Symbiosis of orchids and several endophytic fungi: Noel **Bernard.**—On the copepods collected by the Charcot expedition and communicated by M. E. L. Bouvier: M. **Quidor.**—On a new micro-

sporidium, *Pleistophora macrospora*: Casimir **Cépède.**—On the intimate structure of the protoplasm in the Protozoa: Emmanuel **Fauré-Fremiet.**—A respiratory apparatus for the exploration of places filled with irrespirable gases: M. **Guglielminetti.** The apparatus consists of three parts, the bottle of compressed oxygen, the regenerator and cooler, and the respiratory mask. Illustrations are given showing a diagrammatic arrangement of the whole apparatus, and its position in actual use. Its weight is 13 kilograms.—Observations made on Mt. Blanc on the effect of altitude on the blood: H. **Guillemard** and R. **Moog.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 11.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Charing Cross Company's City of London Works: W. H. Patchell (*Conclusion of Discussion*).

LONDON MATHEMATICAL SOCIETY, at 5.30.—On the Diffraction of Sound by Large Cylinders: J. W. Nicholson.—On the Monogeneity of an Algebraic Function: Dr. H. F. Baker.—On the Expression of the so-called Biquaternions and Triquaternions with the aid of Quaternary Matrices: J. Brill.

FRIDAY, JANUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Annular Nebula in Lyra: E. E. Barnard.—(1) Star Reductions: (2) The Work of a Colonial Observatory: W. E. Cooke.—(1) Elements and Light Curve of RV Lyræ; (2) Elements and Light Curve of VW Cygni: A. Stanley Williams.—The Value of the Constant of Refraction: L. de Ball.—Observations of Comet *b* 1905 from Photographs taken with the 30-inch Reflector of the Thompson Equatorial: Royal Observatory, Greenwich.—On a New Method of Determining the Absolute Dimensions of an Algol Variable: A. W. Roberts.—Report on Observations of Jupiter, 1904-5, made at Trincomali, Ceylon: Major P. B. Molesworth.—Mean Areas and Heliographic Latitudes of Sun-spots in the year 1904, deduced from Photographs taken at Greenwich, at Dehra Dûn, at Kodaikánal Observatory (India), and in Mauritius: Royal Observatory, Greenwich.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Lecture on the Theory of Machines: Prof. J. D. Cormack.

MALACOLOGICAL SOCIETY, at 8.—Note of the Dates of Publication of C. L. F. von Sandberger's "Die Land- und Süsswasser-conchylien der Vorwelt," 1870-75: B. B. Woodward.—New Species of Siphonaria, Terebra, and Maugilia, and a Remarkable Form of *Cypraea cruenta*, from South Africa: G. B. Sowerby.—Remarks on some Forms of Chloritis with Description of a New Species: G. K. Gude.—Notes on the Anatomy of S. African Aplysiidæ with Descriptions of two New Species: R. H. Burne.—Notes on *Voluta kenyoniana*, *V. papillosa*, var. *costata*, *V. roadknighti*, Juv., *Cypraea tigris*, var. *lineata*, and *Conus waterhousae*, var. *mauritiana*: Mrs. Kenyon.—Description of a New Species of Crepidula from Victoria: Mrs. Kenyon.

MONDAY, JANUARY 15.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—British East African Plateau Land and its Economic Conditions: Major A. St. Hill Gibbons.

VICTORIA INSTITUTE, at 4.30.—Evolutionary Law in the Creation Story of Genesis: Rev. A. Irving.

TUESDAY, JANUARY 16.

ROYAL INSTITUTION, at 5.—Impressions of Travel in China and the Far East: Prof. E. H. Parker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Continued Discussion*: The Elimination of Storm-water from Sewerage Systems: D. E. Lloyd-Davies.—On the Elimination of Suspended Solids and Colloidal Matters from Sewage: Lieut.-Colonel A. S. Jones and Dr. W. O. Travis.

ZOOLOGICAL SOCIETY, at 8.30.—On Bones of the Lynx from Cales Dale, Derbyshire: W. Storrs Fox.—On Mammals from South Johore and Singapore collected by Mr. C. B. Kloss: J. Lewis Bonhote.—Contributions to the Anatomy of the Ophidia: F. E. Beddard, F.R.S.—On the Minute Structure of the Teeth of Creodonts, with Especial Reference to their Suggested Resemblance to Marsupials: Charles S. Tomes, F.R.S.

WEDNESDAY, JANUARY 17.

SOCIETY OF ARTS, at 8.—The Scientific Aspects of Voice Development: Dr. W. A. Aikin.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

ROYAL MICROSCOPICAL SOCIETY, at 8.—President's Annual Address: The Life and Work of Bernard Renault.

ROYAL METEOROLOGICAL SOCIETY, at 7.45.—Meteorology in Daily Life: Richard Bentley.

THURSDAY, JANUARY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Factors which Determine the Production of Intraocular Fluid: E. E. Henderson and Prof. E. H. Starling, F.R.S.—A Critical Account of some Anomalous Conditions of the Cerebrum in the Human Fœtus: Dr. W. L. H. Duckworth.—A Case of Regeneration in Polychæte Worms: Arnold I. Watson.—On the Infection, Histology, and Development of the Uredo Stage in certain Uredineæ: I. B. P. Evans.—On the Synapsis in Amphibia: J. E. S. Moore and Miss Embleton.—On the Constancy of Form among the Synaptic Gemini (Heterotype Chromosomes) in certain Animals: J. E. S. Moore and G. Arnold.—The Growth of the Oocyte in Antedon: a Morphological Study in the Cell Metabolism: Gilbert C. Chubb.

CHEMICAL SOCIETY, at 8.30.—The Refractive Indices of Crystallising Solutions with Especial Reference to the Passage from the Meta-stable to the Labile Condition: H. A. Miers and F. Isaac.—The Determination of Available Plant Food in Soils by the Use of Weak Acid Solvents. Part II.: A. D. Hall and A. Amos.—The Action of Ammonia and Amines on Diazobenzene Picrate: O. Silberrad and G. Rotter.—The Preparation of *p*-Bistriazobenzene: O. Silberrad and B. J. Smart.—Gradual Decomposition of Ethyl Diazoacetate: O. Silberrad and C. S. Roy.—Studies on Nitrogen Iodide. Part III. The Action of Methyl and Benzyl Iodides: O. Silberrad and B. J. Smart.—Silicon Researches. Part X. Silicon Thiocyanate: J. E. Reynolds.—The Relations between Absorption Spectra and Chemical Constitution. Part I. The Chemical Reactivity of the Carbonyl Group: A. W. Stewart and E. C. C. Baly.—Halogen Derivatives of Substituted Oxamides: F. D. Chattaway and W. H. Lewis.—The Effect of Constitution on the Rotatory Power of Optically Active Nitrogen Compounds. Part I.: Miss M. B. Thomas and H. O. Jones.—Menthyl Benzene Sulphonate and Menthyl-β-Naphthalene Sulphonate: T. S. Patterson and J. Frew.—An Apparatus for the Continuous Extraction of Liquids with Ether: R. S. Bowman.—Action of Bromine on Benzeneazo-*o*-Nitrophenol: J. T. Hewitt and N. Walker.—Some Reactions and New Compounds of Fluorine. Part I.: E. B. R. Prideaux.—The Relation between Absorption Spectra and Chemical Reactivity. Part II. The Quinones and α-Diketones: E. C. C. Baly and A. W. Stewart.—The Relation between Absorption Spectra and Chemical Reactivity. Part III. The Nitroanilines and the Nitrophenols: E. C. C. Baly, W. H. Edwards, and A. W. Stewart.—Contributions to the Chemistry of the Rare Earths. Part I.: M. Esposito.—A Synthesis of Aldehydes by Grignard's Reaction; G. W. Monier Williams.—The Condensation of Dimethyldihydroresorcin and of Chloroketodimethyltetrahydrobenzene with Primary Amines. Part I. Monamines, Ammonia, Aniline, and *p*-Toluidine: P. Haas.

SOCIETY OF ARTS, at 4.30.—The City of Calcutta: C. E. Buckland.—At 8.0.—High Speed Electric Machinery, with Special Reference to Steam-Turbine Machines: Prof. S. P. Thompson, F.R.S.

LINNEAN SOCIETY, at 8.—The Life-history of *Margaritifera Panasesae*: A. W. Allen. On some Endophytic Algæ: A. D. Cotton.—Jacobson's Organ of Sphenodon: Dr. R. Broom.

FRIDAY, JANUARY 19.

ROYAL INSTITUTION, at 9.—Some Applications of the Theory of Electric Discharge to Spectroscopy: Prof. J. J. Thomson, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Behaviour of Materials of Construction under Pure Shear: E. G. Izod (*Resumed Discussion*): Worm Contact: R. A. Bruce.

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