THURSDAY, APRIL 25, 1895.

CONTROVERSIAL GEOLOGY.

Collected Papers on some Controverted Questions of Geology. By Joseph Prestwich, D.C.L. (Oxon), F.R.S., F.G.S., Corr. Inst. France (Acad. Sci.); Acad. R. Lyncei, Rome; Imp. Geol. Inst., Vienna; Acad. Roy., Brussels; Amer. Phil. Soc., Philad.; &c. (London: Macmillan and Co., 1895.)

"WITH respect to the main facts of Geology, we geologists are in general of one opinion, but with respect to the explanation of many of those facts, we hold very divergent opinions." In these opening words of his preface, the author explains and justifies the publication of this collection of essays. Prof. Prestwich's position, as the acknowledged *doyen* among British geologists, demands that these articles—the latest fruits of his ripe experience—should receive the most thoughtful consideration from his fellow geologists; but, quite apart from the position and authority of their author, all of the memoirs included in this volume are of the greatest value as contributions to science; and in reading them it is difficult to say whether we are more impressed by the wealth of knowledge or the literary grace which they display.

The key-note of the volume is struck in the first article, "The Position of Geology—a Chapter on Uniformitarianism," published in the *Nineteenth Century* of October 1893. In this short and admirably written essay, the author clearly defines his own attitude with respect to the doctrine of uniformity. He credits most English geologists with a belief in an absolute uniformity *both in kind and degree*, while he and many continental geologists, who fully accept uniformity *in kind*, altogether reject the notion that the actions going on at the present day can be accepted as *measures* of the rate of similar changes in the past. We cannot help thinking, however, in reading this essay, that the issue is not quite so simple as the author implies. The strictest uniformitarian would never maintain that no action that has taken place in past geological times could possibly have exceeded in violence, or in the effects produced by it, the phenomena which we may have happened to have witnessed during that century or two, in which systematic studies of terrestrial changes have been carried on. In 1783 a volcano in Iceland threw out lava having a volume equal to that of Mont Blanc; and in 1883, another volcano in the Sunda Straits projected materials to the height of sixteen miles into the atmosphere. Now no geologist would maintain that there could not possibly have occurred, in the long periods of the past, more violent eruptions than these. The uniformitarian only asks that in the explanation of the past we confine ourselves to operations *of the same order of magnitude*, as those now occurring upon the earth. We should be surely justified, for example, in asking for very definite evidence that in past times a single geological eruption had thrown out materials equal to the volume of the whole Alpine chain, or that another had projected materials to the height of 150 miles. If a gorge can be shown to have been cut by an existing river in 1000 years, it would hardly be legitimate to infer that a similar gorge was cut in ten years by a river of 100 times the volume, unless at the same time it were shown that there were very strong reasons for believing that rivers of the proportions assumed actually existed in the past.

Prof. Prestwich puts what he conceives to be the position of the uniformitarians in the following simile:—"What if it were suggested that the brick-built pyramid of Hawâra had been laid brick by brick by a single workman? Given time, this would not be beyond the bounds of possibility. But nature, like the Pharaohs, had greater forces at her command to do the work better and more expeditiously than is admitted by the uniformitarians." We cannot accept the parallel as a just one. Large brick structures are not at the present day erected by a single bricklayer, and the historian—who is equally uniformitarian in his practice with the geologist—does not feel called upon to suggest any such improbable origin for a pyramid. But if, on the contrary, it were asserted that the pyramids are so vast that they must have been erected by a race of beings of larger stature and greater physical strength than the men of the present day, a position would be taken up similar to that of the opponents of a rational uniformitarianism. The historian justly asks that before such a view be accepted, it shall be shown that the work of pyramid-building could not be performed by ordinary men working in sufficient numbers for a long period of time. Nor would the historian be very greatly concerned if it were argued that by ordinary men such a task of pyramid building might extend over several reigns, or would even require centuries for its accomplishment. Every historian, in fact, takes up the same attitude as the uniformitarian geologist when he refuses to credit the men of bygone ages with gigantic stature, prodigious strength, abnormal wisdom, or extraordinary longevity.

While, however, we demur to the principles and ideas ascribed by the author of this volume to the uniformitarians, we gladly accept his work as an additional proof, if such were required, that old-fashioned "catastrophism" in geology is now quite extinct. More than this, we think that the protests and cautions of so distinguished and able a reasoner as Prof. Prestwich will render a real service to geology in calling attention to somewhat unwarrantable assumptions that have been made by some theorists. With our author's complaint against what he justly compares to *the closure*, as applied by physicists and mathematicians to the legitimate speculations of the geologist, we entirely sympathise. "It would," as he justly says, "be an unfortunate day for any science to have free discussion and inquiry barred by assumed postulates, and not by the ordinary rules of evidence as established by the facts, however divergent the conclusions to which those facts lead may be from the prevailing belief."

The second essay in the volume is a weighty criticism of the astronomical theory of glacial epochs. The only objection which we think can be taken to the essay is that the author identifies the upholders of this theory with the uniformitarians. The late Sir Charles Lyel never accepted the theory of Mr. Croll, and many holding the strongest uniformitarian views have always maintained that geological facts are opposed to any of those

explanations of vicissitudes in climate in past geological times, which are based on astronomical considerations.

In the third article, Prof. Prestwich discusses "the primitive characters of the flint implements of the chalk plateau of Kent, with reference to the question of age and make." The author of this essay, thirty-six years ago, took a leading part in making known the evidence in the Somme Valley and elsewhere, which is now universally accepted as establishing the antiquity of man. In the essay before us, he insists that, before the times when men fashioned the beautifully chipped implements of our river valleys and caves, a still more primitive people employed rough flints as scrapers, just as did the recently extinct race of Tasmanians. The beautiful series of plates accompanying this article will, we think, carry conviction to the minds of most archæologists and geologists, that the existence of such primitive races has been established by the author. Prof. Prestwich, however, argues that the antiquity of the men of the river valleys and caves, and of still more primitive people who used the flints of the Plateau period, though very great, was probably less than some theorists have imagined.

The three last articles, "On the Agency of Water in Volcanic Eruptions," "On the Thickness and Mobility of the Earth's Crust," and "On Underground Temperatures," are well known to all geologists; but for the present volume these memoirs have been revised, and some very important and valuable additions have been made to them. They will be much more convenient for purpose of reference than in the journals in which they originally appeared.

There is one aspect of the work before us to which we cannot avoid alluding before concluding this notice. All the articles are controversial, as indicated by the title; but the work might fairly be cited as an example of the spirit in which scientific discussions ought to be carried on. No geologist, who takes up this work, but will find cherished ideas reasoned against, or pet notions boldly assailed. But from beginning to end of the volume, he will find that no word has been written which is calculated to give pain to the most sensitive opponent. This is high praise; but it is not higher than might have been anticipated as the due of one who has in a long career inspired such universal admiration, esteem, and affection as the successor to the chair of Buckland and Phillips in the University of Oxford. JOHN W. JUDD.

POPULAR WEATHER FORECASTS.

My Weather-wise Companion. Presented by B. T. (Edinburgh and London: William Blackwood and Sons, 1895.)

DOES "B. T." stand for Barometer and Thermometer, the instruments which some people are foolish enough to think necessary for forecasting the weather, or in this simple guise does modesty shelter itself from too great publicity and the evils that popularity brings? The connection is curious, but probably accidental, for the book is free from all scientific technicalities, and the author would like us to forget that such things existed, and adopt processes that can be practised by all, without any outlay on costly apparatus, without telegraphic information, and the weariness of preparing synoptic charts. Herein "B. T." is wise, for he is assured of a much larger audience, since the instruments with which he works are in the hands of every one, and no previous knowledge is required for their use. The sky, the clouds, the moon, animals, plants, &c., these are the tools our author uses; but even these may at times be a little inconvenient and difficult in their application. For instance, some of us might very well have wished to know that the winter through which we have just passed was likely to prove more than ordinarily severe, in order to take necessary precautions about water-pipes and such-like necessary evils. Here is the method of test: "If the mole dig his hole two feet and a half deep [this sounds like a sum in simple proportion, but such a conclusion would be premature], expect a very severe winter; if two feet deep, not so severe; if one foot deep, a mild winter." No one would probably care to contradict this; it may be perfectly true, but then as a rule people do not go about the country with pickaxe and shovel, looking for mole-holes, and laboriously and exactly determining their depth. Such severe exercise would be undertaken only by a very ardent meteorologist, and even he might be discouraged, for the author does not say that the winter will be severe or otherwise, but only that it may be expected.

In another respect our author shows much worldly wisdom. It may be assumed that what the public look for from the maintenance of Weather Bureaus and Meteorological Offices, is to know whether it is going to rain. A forecast that says that the wind will be from the south-east, possesses little general interest; what a man wants to know is whether it be possible to dispense with an umbrella, or whether one must submit to the extra care and anxiety the carriage of one entails. It may be to some a matter of the keenest excitement to know whether a depression exists on the coast of Ireland; while some, again, will even speak disrespectfully of an anticyclone in Central Europe; but the "man in the street" will be perfectly satisfied if he can be assured that the next hour or two will remain fine. Hence the author wisely concerns himself principally with the signs that make for rain. This kind of information, as the author is careful to point out, is welcome alike "to the prince and peasant, to the anxious hostess who trembles for the success of her garden-party, to the tinker who seeks the friendly shelter of a wayside hedge, down to the dandy in Pall Mall, who hates to carry an umbrella." And on the subject of this umbrella we think we have some right to complain. He, it would seem, has carried one and the same umbrella through a period of fifteen years, carried it, nay used it, amidst aristocratic surroundings, and occasionally under circumstances likely to test the constitution of the most carefully constructed; and yet we gather that it is still a presentable article, and one that could be unfurled in Piccadilly with confidence by the most fastidious. Why could he not have given us the recipe that preserves to an umbrella such a long life of usefulness? This contribution to economics would have been a valuable testimony to the accuracy of his conclusions and the keenness of his observation, since it might be fairly inferred that this protection was not carried when it was not wanted. But, alas, we have to

content ourselves with a collection of rules and portents, the belief in which we fondly thought the Education Act and the School Board had utterly abolished.

And even here our old friends, when brought out for our edification, are not in the form in which they are familiar, and have been long beloved. Look at the baldness of the assertion—"Expect bad weather if cats wash their faces and lick their bodies." Contrast it with the majestic roll of the well known couplet—

> Puss on the hearth, with velvet paws,
> Sits, wiping o'er her whiskered jaws.

We distinctly feel that we are robbed of something; there is such a pleasant jingle in the old rhyme, that it carried conviction with it. How disappointing, too, to be told o nly to *expect*. We may just mention, in passing, that this is not the conclusion which we should expect the aver age fourth standard boy to draw from witnessing the operation on the part of "puss." We should expect that young gentleman to remark that "cat's hair appeared to be slightly hygroscopic."

Altogether this little book reminds us of those admirable compilations in which the theory of whist is sometimes exposed: a vast number of rules is given, which if one could remember and select at the right time he would never make a mistake; but, unfortunately, the combinations on which the rules are founded have a knack of eluding the unlucky player, and never seem applicable to the hand in play, with the consequence that in his efforts to remember some rule, he trumps a thirteenth at an inopportune moment, and earns the contempt of a long-suffering partner. In the same manner one can conceive the city man, armed with this collection of precious and invaluable rules for determining the weather of the coming day, debating with himself whether it was last night or this morning that the sky was red; did he, while shaving, see his dog eating grass on the lawn; and what is the exact age of the moon—finally getting confused by the knowledge that the train is nearly due, rashly seizing his mackintosh and umbrella in the middle of a well-determined summer anticyclone, and so forfeiting his hard-earned position of a trustworthy weather prophet and a man of keenness and nicety of observation.

THE MYCETOZOA.

A Monograph of the Mycetozoa; being a Descriptive Catalogue of the Species in the British Museum. Illustrated with seventy-eight plates and fifty-one woodcuts. By Arthur Lister. (Printed by order of the Trustees. London: 1894.)

ALTHOUGH this is an official publication of the Natural History Department of the British Museum, that part of the title referring thereto is somewhat misleading, because the author includes everything published belonging to this curious group of organisms. At the same time it is not a monograph in the strict sense of the word, because the author had no opportunity of examining a large number of the reputed species inhabiting Central Europe, Scandinavia and North America. Thus, out of 15 species of *Badhamia*, only 9 came under his observation; of *Physarum*, 30 out of 45; of *Didymium*, 8 out of 17, and so on all through. It is true that he repeats, in English, the authors' descriptions, and frequently suggests the affinities of the species in question.

Further, apart from the fact that the book was published under the authority of the Trustees of the British Museum, and the fact that "every species of which I have given the characters can be examined either in bulk, or as a mounted object in the British Museum," it might with equal propriety have been entitled a descriptive catalogue of Mr. Lister's own herbarium, or of the Kew herbarium, because, as he acknowledges, he had full use of the Kew set, including all Berkeley's numerous types.

However, this does not affect the character and quality of the work. Mr. Lister's previous contributions to the literature of these curious and debatable organisms were a sufficient guarantee of good and really original work, and he has no doubt met all reasonable expectations on this point. Indeed few works have recently been issued embodying so much original research. The *Mycetozoa*, as limited by De Bary, Rostafinski, Lister, and others, are essentially the same as the *Myxogastres* of Fries and the *Myxomycetes* of Wallroth. The first name was substituted for the older ones because it was discovered that the spores, instead of producing a mycelium as in fungi, gave birth to swarm-cells which coalesce to form a plasmodium; thus indicating a relationship with the lower forms of animal life. Mr. Lister adopts this designation, and defines the group as follows:—

"A spore provided with a firm wall produces on germination an amœboid swarm-cell which soon acquires a flagellum. The swarm-cells multiply by division and subsequently coalesce to form a plasmodium which exhibits a rhythmic streaming. The plasmodium gives rise to fruits which consist of supporting structures and spores; in the *Endosporeæ*, these have the form of sporangia, each having a wall within which the free spores are developed. A capillitium or system of threads forming a scaffolding among the spores is present in most genera. In the *Exosporeæ* the fruits consist of sporophores bearing numerous spores on their surface."

He then proceeds to describe in detail the development and various stages, in fact the life history of these organisms, and this he has done in a simple and lucid style worthy of all admiration. The movements of the swarm-cells—creeping and dancing movements—are most interesting, as well as that of the plasmodium, or aggregation of cells; but the feeding of the swarm-cells is most exciting. Mr. Lister had previously published accounts of his o bservations of the ingestion of food-material by the *Mycetozoa* in this stage of their development; yet a sh rt extract relating to this process is not out of place:—

"If bacteria are introduced into a cultivation of swarm-cells on the stage of the microscope, they are seen to be laid hold of by the pseudopodia and drawn into the body of the swarm-cells, where they are enclosed in a digestive vacuole. Several bacteria are brought in turn to the same chamber, or fresh captures are conveyed into one or more additional vacuoles. The protrusion of pseudopodia usually ceases after such ingestion, and that part of the swarm-cells takes a rounded form. In the course of an hour or two the bacteria are assimilated and the digestive vacuoles disappear. Unicellular algæ and inorganic matter are sometimes taken in, which after a time are again discharged. Both ingress and egress are observed to take place only at the posterior end."

It should be explained that an ordinary swarm-cell in the feeding stage is an elongated body tapering at one end into a long cilium or lash, and more or less truncated at the end with several short cilia, the so-called pseudopodia. Within the body of the cell is a nucleus and several vacuoles.

With regard to hybrids between the plasmodia of different species, Mr. Lister is in accord with De Bary, and doubts the accuracy of Mr. Massee's observations.

Another point of great interest is the very wide geographical distribution of most of the species; and the main characters, Mr. Lister states, are remarkably constant in specimens gathered in all parts of the world. Mr. Lister gives a number of instances in which specimens obtained from Europe, India, and North and South America are identical in the most minute microscopic detail. But there are exceptions, in which individuals of the same species from tropical and temperate regions exhibit differences in form; the tropical ones being of more elegant growth.

In his description of the sclerotium, or resting stage, of the plasmodia, Mr. Lister states that the sclerotium of *Badhamia utricularis* can be revived, after preservation in a dry state for three years, by being placed in water. He also gives the results of a number of interesting experiments on the vitality of various other *Mycetozoa*. Altogether Mr. Lister's "Introduction" is most instructive, and his descriptions are so clear, that this book should go far to popularise the study of these organisms. The plates, which are collotype reproductions of water-colour drawings, are very good, but much of the beauty of the originals is lost in the process. It is a pity that they were not reproduced in colour. And this leads one to ask why the coloured figures in Massee's "Monograph" are not cited. It is true there are references to the pages of that work, which would lead one to the figures, if one knew of their existence. It is disappointing, too, that the author has attempted no review of the previously existing literature, and has not even thought it necessary to devote two or three pages to bibliography. These omissions are all the more surprising when one considers the facilities the author enjoyed in the prosecution of his studies.

A NEW WORK ON DYEING.

La Pratique du Teinturier. By Jules Garçon. Two vols. Pp. 148 and 391. (Paris: Gauthier-Villars et Fils, 1893 and 1894.)

THE art of dyeing has in recent years developed so rapidly—having been practically revolutionised and to a large extent remodelled during the last thirty years—that text-books and works of reference dealing with the subject rapidly become defective. We are therefore always glad to welcome any new work which, as far as possible, epitomises the information up to date.

The great energy and enterprise exhibited by the large firms of colour manufacturers in such a marked degree, has, moreover, a tendency to develop what may be distinguished as the *art* of dyeing, more rapidly than the *handicraft*. It is, therefore, pleasant to note that, as an engineer, the author of the book under review fully appreciates the importance of the manipulative and mechanical side of the subject, and gives a lucid description of many of the recently introduced appliances.

The plan of the book differs somewhat from that usually found in works on dyeing. There is, for instance, no description of the character and properties of the textile fibres or of the colouring matters; but the various theories which have been put forward to account for dyeing processes, although of necessity based on such facts, are discussed at considerable length. Again, chemistry, as expressed by symbols and equations, is conspicuous by its absence; but a lengthy chapter on the elements of chromatics is introduced. However, as the book is as yet incomplete (a third volume being in course of preparation), it is too early to definitely consider these as omissions.

Volume i. contains a very short and sketchy historical introduction, followed by a few notes regarding the relative advantage of the natural and artificial dye-stuffs. A classification of the colouring matters—following the usual lines—is then given, with some very general notes with regard to the application of each class of colours to the various fibres. This section of the book might certainly have been considerably extended with advantage, since undue compression necessitates a too-free generalisation and an inadequate explanation of the facts. For instance, it is not sufficient to state (p. 13) that the acid used in dyeing with sulphonic acid colouring matters (always employed as salts) serves to liberate the free colour acid. This is really a very secondary action, requiring only a small fraction of the amount of acid used, the principal function of which is to prepare the wool for combination with the dye.

The methods of dyeing linen, jute, China grass, feathers, &c., are also noticed, a useful bibliography on the dyeing of feathers being introduced. This commendable feature is also noticed in several other sections of the book.

The second part of the first volume is concerned with the actual processes of scouring, dyeing, and finishing. The space allotted to this is again very small; the description of the bleaching of cotton and of wool occupying less than half a page. Some useful hints are, however, given with respect to the choice of dye-stuffs, the storing, dissolving and examination of colours, the causes of defects, &c.

M. Garçon devotes considerable attention to the question of the fastness of colours, and discusses the influence, in respect to this property, of the nature of the fibre and the colouring matter employed, of the method of applying the colour, of the character of the light and the atmospheric conditions. With regard to the relationship between the chemical constitution of the colouring matter and its behaviour on exposure to light, it is noted that although most members of any particular group act in a similar manner, a slight difference in constitution is sometimes sufficient to cause a great difference in permanence; thus, although most of the anthracene colours are "fast," and all the triphenylmethane derivatives "fugitive," gallein is much more resistant than the closely allied eosin dyes, and by simply sulphonating indigotin, one of the most permanent dyes is changed into a very fugitive colour. It may be added that derivatives of methyl anthracene appear to be comparatively fugitive to light.

It is thus not safe to put forward any assumptions, based either upon chemical relationship or similarity of general properties, concerning the behaviour of colouring matters in this respect; and therefore, recognising the value of a systematic examination, the author gives, at considerable length, the results obtained in recent years by Hummel.

When discussing certain experiments in which arc lamps have been employed as the source of illumination, it is stated that the electric light behaves similarly, but less energetically, than sunlight; the average bleaching action of sunlight having been estimated at 30 per cent. of its total luminosity, while that of the electric arc is only about 6 per cent.

The third section of the first volume deals with operations subsequent to dyeing, such as soaping, milling, steaming, &c. It is very short, extending only to four pages. Two appendices, the first dealing with theories of dyeing, and the second with the elements of chromatics, are added, and the volume ends with a very complete bibliography of the works on dyeing published during the last 100 years.

The second volume is devoted to a description of the machinery used in dyeing and allied processes, a very large space, equal in fact to the whole of the first volume, being occupied by the subject of water purification; which, although of great importance to the dyer, certainly receives undue prominence. The great fault of the work, as a whole, is indeed a certain lack of proportion; many essential points receiving scant attention, while valuable space is occupied to smaller advantage by long descriptions of less important subjects—such, for instance, as the Westinghouse air-pump. Nevertheless, the book should prove a valuable reference work for managers of works, or students of dyeing, to whom it can be heartily recommended.

WALTER M. GARDNER.

OUR BOOK SHELF.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by W. T. Blanford. "Moths," Vol. iii. By G. F. Hampson. (London: Taylor and Francis, 1895.)

WE have already noticed the two preceding volumes of this work in some detail; and it is therefore unnecessary to say more respecting the general execution of this volume than that the letterpress is arranged in a similar manner, and that the execution of the woodcuts is equally good. The present volume includes the last two subfamilies of the *Noctuidæ*, the *Focillinæ*, and the *Deltoidinæ*, and one or two small families of the *Geometridæ*. Respecting the *Deltoidinæ*, Mr. Hampson remarks: "It exhibits a gradual development from forms with straight palpi fringed with hairs above, such as *Hypenæ*, which is closely allied to the *Sarrothripinæ*, and to the ancestors of the *Noctuidæ* and *Nolinæ*, through forms with oblique palpi, to a group possessing palpi of an extremely curved sickle-shaped type; from this group arose the stouter-built, more typically noctuiform and nocturnal *Focillinæ* and *Quadrifinæ*." We seriously doubt the advisability of speaking in such a positive manner on questions which cannot, in the present state of our knowledge, be anything more than very doubtful inductions, at the best.

After the *Noctuidæ*, Mr. Hampson places the families *Epicopiidæ*, *Uraniidæ*, *Epiplemidæ*, and *Geometridæ*, for the last of which he has followed Mr. Meyrick's classification. Under the *Uraniidæ* he includes a considerable number of genera, most of which, except *Nyctalemon*, were included by previous authors in the *Microniidæ*, and other families of *Geometridæ*. A fourth volume is to conclude the Indian *Macro-Lepidoptera*, and to contain the *Pyralidæ* and a supplement; and we are glad to learn that Lord Walsingham is working at the *Micro-Lepidoptera* of India.

Mr. Hampson speaks of the difficulty of the sub-family *Boarmiinæ* in the *Geometridæ*; and under the genus *Boarmia* itself he includes no less than eighty-five species, divided into several sections, to some of which sub-generic names are applied. As, however, no less than twenty-eight generic names are included as synonyms of *Boarmia*, we think it would have been better to have treated some, at least, as provisionally entitled to generic rank. And this leads us to a consideration of the most serious defect in all Mr. Hampson's work, which has already been pointed out in more than one quarter. He is too much inclined to place forms together as varieties, and then to treat them as actual synonyms. It is true that in a few instances in the present volume he discriminates between named varieties; but far more frequently he gives a description of a species in a few lines, preceded by a string of half-a-dozen or more names, without any hint of how far these names represent distinct forms, or which names represent his idea of the species he is describing, even when he notices that the species is variable. While making allowance for exigencies of space, this is hardly fair to those who will use his books; for even if we assume that Mr. Hampson is always correct in his views as to which forms are entitled to specific rank, and which are only to be regarded as varieties, it is not to be supposed that every one will take exactly the same view of a doubtful case; and we greatly fear that if an entomologist meets with an insect which does not correspond with the description of a species given by Mr. Hampson, he will at once describe it as new, and, in many cases, redescribe one of the forms which Mr. Hampson has rejected, with a light heart, as a mere synonym.

Apart from this serious defect, we can recommend the book as a most useful and, indeed, quite indispensable manual for all who are interested in East Indian Moths.

W. F. KIRBY.

LETTERS TO THE EDITOR.

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

The Origin of the Cultivated Cineraria.

RETURNING from abroad, I have just seen Mr. Dyer's letter in NATURE, March 14. Of the matters there treated I ask leave now to deal with one only, that numbered (18). This is a point of fact—the origin of the cultivated Cineraria. At a meeting of the Royal Society, on February 28, Mr. Dyer exhibited a specimen of *Cineraria cruenta* from the Canaries, side by side with a plant of the common cultivated form. With the object of minimising the value of "sports" in evolution, this exhibition was made to illustrate what can be done "by the gradual accumulation of small variations." Mr. Dyer stated, if I rightly understood him, first, that of the two forms exhibited, the one had been produced from the other; secondly, that, as far as is known, this process of evolution had been accomplished by the gradual accumulation of small variations, and not by the selection of "sports" or seedlings presenting notable and striking variations. That in the case of a plant much modified by gardeners in recent times such a history would be highly unusual, Mr. Dyer will, I think, admit.

Doubting this account, and searching records of the early culture of the Cineraria for my own satisfaction, I found a good deal of miscellaneous information on the subject. The history is not yet quite complete; but as Mr. Dyer's account has now appeared in print, the following notes may be of use.

In the ordinary manuals (*e.g.* Burbidge, *Propagation* &c., 1877, p. 250) it is said that the florists' Cinerarias are *hybrids*, obtained by crossing and recrossing several species of *Cineraria* (or more strictly *Senecio*). As to the exact parentage, there is not entire certainty. Burbidge gives *C. cruenta*, *aurita* and *lanata* as the parents. Other writers mention *C. maderensis*, *multiflora*, *tussilaginis* and *populifolia* as having contributed (*cp. Jour. d'hort.* Gand, ii. 1846, p. 231). General statements of a like nature are made by many. For the account given by Mr. Dyer I find no authority except one, an article by Rolfe (*Gard. Chron.* 1888 (1), p. 653). Here *C. cruenta* is given as the sole parent, and a figure of this species raised at Kew, from wild seed, is shown beside two extreme flowers of the modern type. Excepting this statement, it seems agreed that the species originally concerned are at least four: *cruenta*, *aurita*, *populifolia* and *lanata*. The first three have comparatively small flowers in corymbs or cymes. Those of *cruenta*, introduced from Canary by Masson to Kew in 1777, are purple. This species was originally described from Teneriffe by L'Héritier, *Sert. Angl.* 1788, pl. 33, and is figured *Bot. Mag.* t. 406, and elsewhere. The lower surface of the leaves is purplish. The petioles have auricular expansions. *C. aurita*, sent to Kew from Madeira 1790, figured by L'Héritier, pl. 31, and *Bot. Mag.* t. 1786, is a somewhat different plant, of more slender habit, said to be more akin to *populifolia*. The flowers are purple. Ray-florets few and irregular. Petiolar expansions variable, mostly much smaller than in *cruenta*. *C. populifolia* L. Hér., Canaries, brought by Masson from Teneriffe 1780, is a form with yellow flowers. *C. lanata*, L'Hér. pl. 30, and *Bot. Mag.* t. 53, is a plant very different from any of the others. It bears large purple flowers, some two inches across, only one to a peduncle. The leaves are cordate-subrotund and sept-angular, and woolly underneath. L'Héritier gives it as from Teneriffe. The *Bot. Mag.* wrongly says it had been introduced from Africa (perhaps confusing with *lanosa*, DC. = *lanata* Thunb.). The large flowers and peculiar leaves at once distinguish this species from the rest.

It should be added that *populifolia* in its native state showed considerable diversity in the forms of its leaves, three varieties being specified by Decandolle, *Prodr.* vi. p. 409. A natural variety of the same species with *white* flowers was brought from Teneriffe by Webb. This is the β. *leucanthus* DC. It is figured in *Flor. Cab.* i. p. 73, from a specimen grown in Birmingham Botanic Garden. As to these species, references to further information may be found in Decandolle, *Prodr.*, and in Webb, *Phytogr. Canar.*, &c.

These four species with others were at the beginning of this century pretty generally distributed in greenhouses in England, France, and Germany. They are enumerated in most of the horticultural treatises of the period, with directions for their propagation. *C. lanata* was thought the best. "It far exceeds all others cultivated here in the beauty of its flowers. . . . It is valuable on account of its hardiness, its readiness to flower, and the facility with which it may be propagated." Rees' *Cycl. of Arts and Sci.* viii. 1819. Others speak to like effect.

The first mention I have found of any distinct garden form is that of Willdenow, who in "Enum. Pl. Berol." 1809, p. 893, gives *C. hybrida*, saying that this plant is grown in gardens under the name of *C. cruenta*, but that it in reality differs much from the latter, and has flowers almost like those of *C. lanata*.

Between 1820 and 1830 definite efforts were made to improve the Cineraria. The first published is that of Bouché. Writing in the "Verh. zur Beförd. d. Gartenbauer, Berl.," i. 1824, p. 139, he says that having grown *C. lanata* L'Hér., *C. cruenta* L'Hér., and *C. hybrida* Willd., and noticed that the first two seeded freely, it occurred to him to try to raise varieties or sports (*Spielarten*), and at the same time to test the distinctness of these species. His seedlings flowered in the following year. Those from *C. cruenta* had the flowers rose-red, except one which was quite white, the flowers of the parent being dark red. The seedlings from *C. hybrida* varied so much that they might be mistaken for separate species. His words are as follows:—"Unter denen von der Cin. hybrida zeichneten sich besonders fünf Abänderungen aus, welche eine ganz eigenthümliches Ansehen bekommen haben, und leicht von Botanikern, denen die Entstehungsart derselben nicht bekannt ist, für neue, noch unbeschriebene Arten dieser Gattung gehalten werden könnten." His description follows. In particular, the foliage had varied greatly from the parent form, somewhat resembling *lanata*, suggesting to Bouché that there may have been hybridisation with that species.

About the same time Mr. Drummond, then Curator of the Botanic Garden, Cork, published a paper in the *Gard. Mag.* ii. 1827, p. 153. He says that Cinerarias are favourites with him, especially *cruenta*, "for besides the great beauty and variety in the flowers, its fine purple blossom: form a beautiful contrast, &c." "We seldom see it cultivated to the extent it merits. The following account of the method I have followed for some years of growing this plant. . . may turn the attention of your readers to the cultivation of the *C. cruenta*, the effects of which *will, in all probability, be the production of fine double and single varieties of different colours, as it sports greatly from seed.* [Italics are mine.] Except in cases when it becomes desirable to preserve any particular variety for its superior beauty, I prefer raising the *C. cruenta* from seeds. . . . Care should be taken to select the finest varieties, and those that produce the largest and finest heads or corymbs of flowers." "The other greenhouse species I cultivate are *lanata*, *hybrida*, *geifolia* and *amelloides*. These I increase by cuttings, &c."

It happens that in the same year (1827) of the *Gard. Mag.* p. 446, there is a reference to Bouché's paper. Not improbably Drummond may have read the latter, for in Loudon's *Ladies' Mag. of Gard.* 1842, p. 111, I find this passage: "Most of the purple Cinerarias are varieties or hybrids of *C. cruenta*. . . . It was long a favourite in greenhouses, and was generally propagated by dividing the roots; but about 1827, Mr. Drummond, Curator of the Botanic Garden in Cork, having raised it from seed, and found the seedlings vary considerably, conceived the idea of hybridising it with *C. lanata*, *C. geifolia* and *C. amelloides*. The trials, however, with *C. geifolia* [a true Cape Cineraria] and *C.* [*Agathæa*] *amelloides* do not appear to have succeeded; but between *C. cruenta* and *C. lanata* some handsome hybrids were raised. Since that time numerous experiments have been made and hybrids have been raised, &c." A summary follows.

Soon after this a number of definite seedlings or "sports" came into existence. Of some of these there are good records. I will mention four which are represented by good coloured plates. *C. waterhousiana* is said to have been a hybrid, the result of the seed of *C. tussilaginis*, fertilised by the pollen of *cruenta* (*Paxton's Mag. of Bot.* iv. 1838, p. 43, and *Ladies' Mag. l.c.*). In general appearance it rather resembled *tussilaginis* (one of L'Héritier's species which had died out, and was introduced again in 1832 by Webb. See *Bot. Mag.* t. 3215.) This must have been a very fine plant. It had large *red* flowers, about two and a half inches across, with long narrow ray-florets something like *lanata*.

The next case I shall take is a plant which first flowered in a garden near Belfast, called var. *cyanophthalmus* in *Bot. Mag.* 1840, t. 3827. It had long white rays and a *blue* disc. Sir W. J. Hooker says of it: "Notwithstanding the very unusual colour of the flowers for one of the Compositæ, I have little hesitation in referring it to . . . the old *C. lanata* of our gardens. The foliage is the same, and the structure of the flowers; but the colour of the blossoms is very different, and in our variety of a most unusual character." He then recalls Decandolle's well-known remark that *yellow* in Compositæ may vary to red or white, but not to blue, and, on the other hand, that *blue* may vary to red or white, but never into yellow. He adds: "Not only in our plant is the lilac-coloured ray of the flower changed to white, and the deep lilac or blood-red purple of the ray [disc] changed to a very bright blue, but the stigmas, which are deep orange in the original stock, are also intensely blue, and the anthers are purple-black."

Another seedling of a very different type, famous in its day, was *webberiana*. It was figured in *Paxt. Mag. Bot.* ix. 1842, p. 125. The flowers were of a deep blue, the rays being short and wide, compared to those of *waterhousiana*, for example. "It was raised from seed ripened promiscuously on a number of plants of various kinds blooming together, &c." In the *Gard. Chron.* 1842, it was advertised at 10*s.* 6*d.* a plant.

Another sport, pinkish and white, is figured in the *Botanist*, v. 1841, No. 215. "It came up accidentally, some years ago, from self-sown seeds, in one of the pots of the greenhouse, so that I cannot say anything certain about its parentage." The

writer conjectures it to be a hybrid between *lanata* and *populifolia*, var. *leucanthus*.

If any one will look at the plates to which I have referred, he may satisfy himself of the astonishing diversity of these forms. In *Gard. Mag.* 1839, p. 430, is an early record of the appearance of the new seedlings at shows. At the Caledonian Horticultural Show, the Cinerarias "were very brilliant, and partook of novelty." The names of the seedlings successful, including *waterhousiana*, are given. At the beginning of the forties the named kinds became very numerous, and were at first offered at high prices in the trade advertisements. Henderson and Ivery were the two chief English cultivators at that time.

During this period, 1830–1840, the progress was very rapid, and there can be no doubt that the florists' Cinerarias came into existence within some ten or twelve years. Such a plate as that in *Jour. d'hort.* Gand, 1846, shows the ordinary kinds much as we know them. From those plants up to the perfected plants of ten years ago, the change was undoubtedly slow and gradual. The alterations have consisted chiefly in increase in size and symmetry of the flower, and in promotion of compactness of habit (see, *e.g.*, Glenny, *Ann. of Hort.* 1850, p. 37, also *Gard. Chron.* 1879 (1), p. 532).

The next point is of some interest. As compared with other "improved" herbaceous plants, the Cineraria is a little peculiar in the fact that it is now generally raised from seed. This is done partly to ensure that the plants shall not be overgrown, and partly to avoid green fly, a pest to which these plants are specially liable. In consequence of this, the old "named" kinds, that is to say, kinds propagated by asexual methods, went out of fashion, though till lately they still had supporters. It was found that seeds of good strains could be fairly relied on —not, of course, to reproduce the form of their particular parents, but to give fine plants. For instance, Henderson, *Scot. Gard.* i. 1852, p. 22, says: "in raising seedlings you should select three or four dwarf varieties, which number is quite sufficient to produce all the different colours." In *Gard. Chron.* 1887 (1), p. 549, are some interesting particulars of the methods used by Mr. James, to whom the later improvement of the plant in England is largely due. The plants of each colour are grouped in blocks, and the bees are freely admitted to the houses. It is not found necessary to separate the plants further, and in saving seed all the colours are mixed together. In the case of the Cineraria therefore, as in that of Calceolarias, Begonias, and other plants much grown from seed, it is desirable not only to create a fine variety of which the stock can at once be multiplied asexually, but also to raise a good strain of which the seedlings come fairly true. The latter process may undoubtedly often take time.

Even in recent times a "sport" has been recorded. In *Gard. Chron.* 1880 (1), p. 277, it is stated that Mr. James "has succeeded in obtaining a new 'break' that promises to be the forerunner of another host of new flowers. The colours of the flower do not shade off into one another, as is usually the case, but are arranged in bold and well-defined belts. . . . We understand that it flowered for the first time last season, and that it has reproduced itself from seed." A figure is given.

To these particulars might be added many more, relating to the origin of double varieties, variations in the foliage, and other matters. The foregoing notes of the history must, I think be taken to show (1) that the modern Cinerarias arose as hybrids derived from several very distinct species; (2) that the hybrid seedlings were from the first highly variable; (3) that "sports" of an extreme kind appeared after hybridisation in the early years of the "improvement" of these plants; (4) that the subsequent perfection of the form, size and habit has proceeded by a slow process of selection. Mr. Dyer's statement that the modern Cinerarias have been evolved from the wild *C. cruenta* "by the gradual accumulation of small variations" is therefore, in my judgment, misleading, for this statement neglects two chief factors in the evolution of the Cineraria, namely, hybridisation and subsequent "sporting."

I have ventured to deal with this case because it seems to be generally supposed by those not acquainted with the facts, that the origin of the modern florists' flowers has in general been very gradual. As a matter of fact it would, I believe, be more true to say that the new departures have in general been at first very rapid, subsequent improvement being commonly slow. "Sporting," usually after hybridisation, has been the chief factor in the production of these new developments, just as in the case of the Cineraria. To speak of no more, I may refer to the new forms of Begonia, of Gladiolus, and of Erica now so familiar. With what special propriety the Cineraria was chosen by Mr. Dyer to support his contention is not evident to me.

Whether any of these sports exhibit the phenomenon of organic stability I cannot now discuss. W. BATESON.

St. John's College, Cambridge, April 17.

The Age of the Earth.

IN Dr. Hobson's letter on this subject, he confuses the argument by the introduction of a new factor (never alluded to in the former discussion, or in my theory as stated in "Island Life"), the *bulk* or *volume* of the matter deposited. This has nothing whatever to do with the practical problem, because it is admittedly impossible to form *any* estimate of the total bulk of all the stratified rocks of the earth during all geological time; while it is equally impossible to form any estimate of the total bulk of the denuded matter, since we have no clue whatever to the number of times the same areas have been again and again denuded. But the maximum *thickness* of the same rocks, compared with the average *rate* of denudation, and the coincident maximum *rate* of deposition, *do* furnish materials for an estimate, since they can all be approximately determined from actual observation; and the result is what I have given. If Dr. Hobson had referred to the former discussion he would have avoided imputing to me "fallacies" which I never made. I never said a word about "equal bulks" of material being deposited in less time than they were denuded. But, as the only available data are those of *thickness*, not bulk, then it is clear that, if the area of deposition is one-nineteenth of the area of denudation, the *rate* of deposition of a known *thickness* of rocks will be nineteen times as great as the known *rate* of denudation. It was necessary for me to point this out when first discussing the subject, because one eminent writer had made the rate of deposition *less* than the rate of denudation, because the water-area is greater than the land-area of the globe; while an eminent geologist has quite recently taken the rates of denudation and deposition as being *equal*. If, however, the area of deposition is very much *less* than the area of denudation, which is now admitted to be the fact, then the *rate* of deposition *per foot of thickness* will be many times *greater* than the *rate* of denudation.

I should not have thought it necessary again to state this very obvious conclusion, had not Prof. Sollas, while so clearly pointing out Dr. Hobson's misconception as to the area over which the maximum thickness of the strata extended, omitted to refer to the confusion he has now for the first time introduced into the problem, by references to the *bulk* or *volume* of the sedimentary rocks, a factor which all previous writers have seen to be wholly beyond even an approximate determination.

ALFRED R. WALLACE.

So little is really known about the earth's age that any additional mode of approximating to it, however rough, may possess some value. The following method of finding a lower limit is, with one or two alterations, the same as that given in a paper in the *Geological Magazine* for 1887 (p. 348). It depends, not on the rate of denudation, but on the rate of subsidence within the area of sedimentation.

Part of the sediment brought down by a river is used for keeping the surface of the delta close to the level of the sea; and the fact that the deposits formed from it are generally shallow-water deposits, shows that the amount of sediment is, as a rule, sufficient or more than sufficient for the purpose. The remainder of the sediment is carried out seawards, and enlarges the delta laterally.

If there were no surplus sediment, it is evident that the mean rate of subsidence over the delta would be obtained by dividing the volume of the sediment brought down annually by the river by the area of the delta. But if there be an excess of sediment, then the same quotient will give a value greater than the mean rate of subsidence, for only part of the sediment is used for keeping the delta-surface in shallow water. In the case of the Mississippi, the amount of sediment brought down annually is 7,459,267,200 cubic feet, and the area of the delta 12,300 square miles, or 342,204,320,000 square feet; so that the mean rate of subsidence is not greater than $\frac{1}{4\frac{1}{6}}$ of a foot per year, or 2·18 feet per century.

Prof. Sollas estimates the total maximum thickness of the different layers of sediment since the beginning of Cambrian

times at 164,000 feet (NATURE, vol. li. p. 534). If these layers tapered off uniformly in either direction from the region of maximum deposit, the total mean thickness would be half this, or 82,000 feet; and if the mean rate of subsidence were never greater than 2·18 feet per century, the total time required for the accumulation of Cambrian and post-Cambrian rocks would be not less than 3¾ millions of years. But there may have been long unknown gaps in the process of their accumulation; the outer margin of the deposits may have extended far beyond the area of subsidence, and the mean rate of subsidence may have been at all times considerably less than the upper limit given above. On these accounts, as well as on others that might be mentioned, it seems possible that much more than 3¾ million years has elapsed since the beginning of the Cambrian period.

Birmingham, April 8. C. DAVISON.

The Burmese Chipped Flints Pliocene not Miocene.

IN the *Geological Magazine* for November of last year, p. 525, is a review by Prof. T. Rupert Jones, of the important paper, published in the *Records of the Geological Survey of India*, by Dr. Fritz Noetling, the Palæontologist of the Survey, "On the occurrence of Chipped (?) Flints in the Upper Miocene of Burma." Another paper, by Prof. T. R. Jones, on "Miocene Man in India," appeared in *Natural Science* for the same month.

From the fact that the mammals *Rhinoceros perimensis* and *Hipparion antelopinum*, of which bones were found associated with the flint chips, have only been found in India in Pliocene beds, and from a slight acquaintance, gained, it is true, more than thirty years ago, with the Burmese strata in which Dr. Noetling's most interesting discovery was made, I felt assured that there must be some error in believing that the flint chips occurred in Miocene deposits, and I wrote to Dr. Noetling on the subject. I have just heard from him in reply. In a letter from Upper Burma of March 11, he tells me he has now definitely ascertained that the bed containing the chipped flints is Pliocene.

Further particulars will, I hope, be published before long by Dr. Noetling; and I should not have written on the subject but that a serious error is caused by its being supposed that "Miocene Man" has been shown to have existed in India, and it is desirable that this error should be corrected without delay. The importance of the discovery is in no way diminished by the correction of the geological date to which the flint-bearing stratum is referred. W. T. BLANFORD.

April 17.

The Mandrake.

WITH regard to Prof. Veth's exhaustive account of the mandrake (referred to in NATURE of April 11, p. 573), it may be useful to students of folklore to call their attention to the occurrence in the Chinese literature of a similar superstition, wherein *Phytolacca acinosa* (Shang-luh) takes the place of *Mandragora officinarum*. Sie Tsai-Kang's "Wu-tsah-tsu," written about 1610 (Japanese edition, 1661, tome x. p. 41), contains the following passage:—"The Shang-luh grows on the ground beneath which dead man lies; hence its root is mostly shaped like a man.[1] . . . In a calm night when nobody is about, the collector, offering the owl's flesh roasted with oil, propitiates the spirit of the plant until *ignes fatui* crowd about the latter; then the root is dug out, brought home and prepared with magic paper for a week; thus it is made capable of speech. This plant is surnamed 'Ye-hu' (*i.e.* Night Cry) on account of its demoniacal nature.[2] There are two varieties of it: the white one is used for medicine; the red one commands evil spirits, and kills men when it is internally taken by error." KUMAGUSU MINAKATA.

April 16.

[1] Here the author says: "It is popularly called 'Chang-liu-Kan' (= Witch-tree-root)." The name shows that the root was used in witchcraft, similarly with that of the Mandragora (*cf.* Hone, "The Year-Book," *sub.* "December 28").

[2] Another explanation suggested for this name is that, as long as the fruit of the Phytolacca remains unripe, the cuckoo continues to cry every night (Sie Tsai-Kang, *ubi supr.*). However, seeing that the belief in the shrieks of the Mandragora was once current among the Europeans ("Encyclopædia Britannica," 9th ed. vol. xv. p. 476), it would be more just to derive the Chinese name "Night Cry" from an analogous origin.

A Claim for Priority.

I SEND you, under separate cover, a copy of an address, "Radiant Matter," &c., delivered at the International Electrical Exhibition, held in Philadelphia in 1884, reprinted from the *Journal* of the Franklin Institute, September 1885, and would call your attention to the description of the method of preparing films of gold and other metals of extreme thinness, far exceeding in tenuity those described in NATURE as novelties in metallurgical methods (prepared in identically the same manner), and exhibited at a conversazione of the Royal Society, June 13, 1894. The first published note regarding this subject may be found in the *Proceedings* of the American Phil. Soc., vol. xcix. February 16, 1877. Later and fuller notices will be found in *Journ. Franklin Institute*, April 1877, June 1877, September 1885, and September 1894. In addition to the above, the process was fully described in *U.S. Patent*, 198, 209, December 18, 1877. ALEX. E. OUTERBRIDGE.

Philadelphia, April 5.

AN IMPROVED METHOD FOR THE MICROSCOPIC INVESTIGATION OF CRYSTALS.

A MEMOIR of considerable importance to all who are interested in the microscopic determination of the characters of crystals, is contributed by Prof. Klein to the *Sitzungsberichte* of the Berlin *Akademie der Wissenschaften* for January 31, 1895. The two essential points of the communication are that a form of stage goniometer is described, which permits of the most complete examination of many of the principal zones of the crystal with one and the same setting of the crystal upon its holder, and that the crystal is immersed during the observations in a liquid whose refractive index is about the mean of the refractive indices of the crystal. The idea of the "Universaldrehapparat," as the new stage goniometer is termed, appears to have suggested itself almost simultaneously to Prof. Klein and to Herr von Federow, for the former described an earlier form of it in the *Sitzungsberichte* of April 1891, while the latter published a description of an "Universaltischen" for the microscope in the *Zeitschrift für Krystallographie* of May in the same year. Herr von Federow had previously contributed to the *Zeitschrift* a remarkable memoir concerning a theodolitic universal goniometer, and the application of the principle of that instrument to the microscope goniometer followed naturally therefrom. The present memoir of Prof. Klein affords so admirable a description of the improved instrument, which has been constructed for him by the well-known Berlin crystallographical optician, Herr Fuess, and likewise of the mode of employing it in connection with the immersion method, that readers of NATURE may find a brief account of it not uninteresting. Unfortunately this description cannot well be illustrated, as Prof. Klein's illustrations are photographic reproductions which are unsuitable for further reproduction.

The microscope should of course be one of the petrological type, fitted with the usual accessories for the examination of crystals in parallel and convergent polarised light. The particular instrument constructed for Prof. Klein is somewhat similar to the largest Fuess model. It is so arranged with respect to the centre of gravity that it can be rotated into the horizontal position whenever desired, a point of some importance with regard to the use of an immersion liquid. The stage is of course circular, and is divided so as to read with the aid of a pair of verniers to single minutes; it is further provided above with two graduated rectangular traversing movements, one of which is supplied with a micrometer registering 0·01 m.m., while the other is capable of much more rapid motion. The advantages of the simultaneous rotation of the polarising and analysing nicols, as adopted in the microscopes made by Mr. Swift under the direction of Mr. Allan Dick, have been so well appreciated by

Prof. Klein, that this has been arranged for in the new Fuess instrument. The carriers of the nicols are each furnished with a toothed flange capable of gearing with a smaller pinion, and the two pinions are arranged at the ends of a connecting rod furnished at a convenient height near the upper pinion with a milled flange by means of which rotation can be effected. Provision is made for the lengthening of the connecting rod when the focussing of the microscope by the rack and pinion or by the fine adjustment is effected, and care is also taken that the rotation by means of the connecting rod shall occur without dead-space or backlash. Prof. Klein states that some important details in connection with improvements in the mode of carrying out this simultaneous movement of polariser and analyser will shortly be published by Herr Fuess. Provision has likewise been made for correcting at any time the setting of the nicols in their carriers, experience having shown that the setting invariably alters slightly in course of time. In addition to the eyepiece nicol capable of being connected with the polariser in the manner just described, there is likewise provided the usual nicol capable of sliding in or out of the microscope tube just over the objective. Above this, and just below the eyepiece, a Bertrand lens for observing interference figures in convergent light is capable of sliding in and out of the tube, and is intended to be employed in conjunction with a converging system of lenses capable of being carried in a tube attachment beneath the level of the stage. The remaining details of the microscope are the same as are usually supplied with the No. 1 Fuess instrument.

The stage goniometer is intended to be employed with the microscope arranged horizontally, as it is found inconvenient to employ an immersion liquid with a vertical arrangement. The base-plate of the goniometer, consisting of a stout metal plate with fairly large central aperture, is fixed by a suitable clamping arrangement upon the now vertical stage of the microscope. The plate is continued into a short arm on that side which is uppermost when fixed in position, and this arm carries near its end, and at right angles to it (horizontal when in position), a projecting piece terminating in the supporting cone for the goniometer circle, and which also carries the vernier reading to five minutes and the fine adjustment. The circle is hollowed in its upper central part, and perforated with a central aperture; this permits of the sliding movement within the hollow, for centering purposes, of a disc which carries the axis of the instrument. To the lower end of this short axis are attached the movements for adjusting the crystal, and the lower of which carries the crystal. The adjusting movements are a pair of circular quadrants arranged at right angles to each other and graduated. They are simpler in construction, and lie much closer together than those of the best forms of goniometer now in use for ordinary goniometric and spectrometric work, and are therefore particularly suitable for use in connection with the microscope. The upper quadrant is fixed to the axis; over it a slider is capable of moving, which carries a vernier, and below it the lower quadrant, which in turn is fitted with a slider terminating in the holder which carries the crystal cemented by wax. The verniers enable readings of five minutes to be obtained, the same degree of accuracy as in the case of the circle.

The glass cell containing the immersion liquid is supported in position normal to the axis of the microscope by means of a stand with an adjustable arm placed to the left of the microscope. It is recommended to have a series of cells, ready for filling with various media of the most frequently required refractive power. The advantages of Adams' method of determining optic axial angles may also be combined with those of the method now described, by use of a cell consisting of an upper cylindrical portion terminating below in a sphere filled with the liquid. As regards suitable liquids, an admirable list is given by Herr Pulfrich in his book descriptive of the construction and use of the total-reflectometer recently devised by him (p. 64). Two errors in that list, however, are corrected by Prof. Klein; he has been unable to prepare the solution of mercuric iodide in aniline and quinoline of refractive index 2·2, and the refractive index of the phenyl sulphide kindly supplied by Prof. Klein's colleague, Prof. Emil Fischer, is only 1·56 instead of 1·95. If the dangerously poisonous and inflammable liquids are excluded, the list consists chiefly of oils, the well-known Thoulet solution, monobromnaphthalene, and methylene iodide. The solution of iodine in the latter frequently renders it insufficiently transparent for the purpose.

The determination of the true angle, 2V, between the optic axes within the crystal, supposing it to be biaxial, can at once be determined with the aid of the new apparatus, by immersing the crystal in a liquid whose refractive index is equal to the β (the intermediate) refractive index of the crystal. The condensing system of lenses is first inserted between the polarising nicol and the stage, and the Bertrand lens above the analyser; as objective, either the ordinary wide angle combination usually employed for convergent light work, or a specially constructed one supplied for the particular purpose of convergent light observations through an immersion liquid, is employed. This objective is so constituted that as large a field of vision as possible is afforded, while the distance between objective and crystal is considerably greater than with the ordinary systems in use. The apparent angle of the optic axes in air, 2E, may first be measured, if desired, after adjustment of the crystal by means of the adjusting movements, by bringing the hyperbolic brushes to the cross wire of the microscope eyepiece in the usual manner. The immersion cell not being in position while this is being achieved, the objective can be approached nearer to the crystal and one of the ordinary forms of convergent light objective employed, which affords a larger angle of vision, reserving the special objective for the determination of the true angle of the optic axes. If, however, the Adams spherical cell is employed, there is no necessity even here to use the special objective, as the older wide angle form serves admirably. With the parallel sided cells it is preferable to use the special objective. The Adams sphere is not supported similarly to the rectangular cells, but is conveniently held by its cylindrical neck in a small support directly attached to the lower quadrant of the adjusting apparatus. The measurement of the true angle of the optic axes is then carried out in the usual manner, similarly to the determination of the apparent angle in air, while the crystal is immersed in the liquid contained in one or other of the two forms of cell. Monochromatic light should of course be used in making the observations, a sodium flame some little distance in front of the polariser being employed by Prof. Klein.

The great advantage of this method of determining the true inner angle between the optic axes lies in the fact that it is totally unnecessary to prepare section-plates of the crystal, the whole crystal itself being employed, and thus material saved. Prof. Klein does not claim for it the highest attainable accuracy, and for the class of work such as that with which the writer of this article has become identified, the determination of the crystallographic characters of series of isomorphous compounds closely resembling each other, where every endeavour must be made to attain the upper limits of experimental accuracy, such a method is of course inadequate. But for the ordinary description of minerals and the crystals of isolated chemical preparations unlikely to be injured by the immersion liquid, and particularly for laboratory teaching, the method is one of

the simplest and most interesting yet described. The accuracy depends entirely upon the closeness of the approximation of the refractive index of the liquid to the β index of the crystal. Of course it will rarely happen that coincidence of these values will occur for all colours of the light employed, the dispersion of the crystal and the liquid in general being different. So that although the values may be coincident for sodium light, they would in all probability be different for other colours. But if the observations are only conducted for sodium light, a process which is frequently sufficient for the purpose in view, then this objection entirely disappears. Moreover, the errors introduced by the discrepancy for different wave-lengths of light would not be sufficiently large in most cases, if observations for other colours were made, to materially reduce the value of the method for the purposes for which it was designed.

A consideration of the simple formulæ connecting the optic axial angle with the β refractive index and the refractive index of an immersion liquid will at once render the value of the method, within the above specified limits, clear. Representing as usual the real semi-acute angle between the optic axes within the crystal by Va, the semi-obtuse angle by Vo, and the apparent semi-acute and obtuse angles in the immersion liquid by Ha and Ho respectively, the refractive index of the medium for light of the same wave-length being n, then:

$$\text{Sin Va} = \frac{n}{\beta} \text{ sin Ha and sin Vo} = \frac{n}{\beta} \text{ sin Ho.}$$

These two equations are of the same kind, for both Va and Vo are less than 90°; and the only variables are n sin Ha and n sin Ho, for β, sin Va, and sin Vo are constant quantities for this wave-length of light. If, now, the sum of the angles 2Ha and 2Ho is greater than 180°, the common factor n must, in order to bring the sum of these angles down equal to 180°, be increased, that is, a liquid of higher refractive power be employed. Conversely if the sum is less than 180° the refractive power of the liquid must be diminished in order to bring the sum of the angles up to 180°. For the specially interesting intermediate case where $n = \beta$, the sum of 2Ha and 2Ho will be exactly 180°, and sin Va = sin Ha and sin Vo = sin Ho, when also Va = Ha and Vo = Ho.

From the above theoretical considerations one can immediately deduce the course to be taken to render the immersion liquid exactly equal to the β index of the crystal; if the measured values of 2Ha and 2Ho add up to over 180° a liquid of higher refraction must be obtained, and *vice versa* if the sum is less than 180°. There are, however, several ways of determining the closeness of approximation of the indices without going to the trouble of actually making preliminary measurements. In the first place the crystal will disappear in the liquid, that is to say, will be invisible, provided that it is colourless, when its refractive power is equal to that of the surrounding medium, especially when the line of the observer's vision lies in the plane of the optic axes. This is very beautifully observed when calcite is immersed in monobromnaphthaline, and particularly when it is arranged so that the observer looks along the direction of the vertical axis of the crystal; under these conditions the latter is completely invisible. In the second place, instead of hyperbolic curves passing through the positions occupied by the optic axes, the brushes will take the form of almost straight lines when the refraction of crystal and liquid is about the same.

In choosing crystals for observation by the new method, Prof. Klein recommends that individuals or fragments should be selected which are equally thick in two perpendicular directions in the plane of the optic axes, that is, such as are almost cylindrical in appearance, and not too thick to prevent the interference figures being observed. When immersed in the liquid, it is as if at each moment, and for every position during rotation of the crystal, a parallel section-plate were being examined, the natural faces of the crystal—however rich in faces the zone may be—not entering into consideration whatever.

The advantages of the use of an immersion liquid of equal refractive power in the examination of crystals have been pointed out by several previous observers, as Prof. Klein is careful to state. So long ago as 1841 Biot, in his memoir concerning lamellar polarisation, describes the use he made of it. The method has long remained dormant, however, as far as is known from the literature of this branch of study. In the eighth edition, however, of the *Lehrbuch der Physik und Meteorologie* of Joh. Müller, edited by L. Pfaundler in 1879, it is stated that if the refractive index of the liquid in which a plate perpendicular to one of the medium lines is immersed is equal to that of the crystal, the true angle between the optic axes is at once afforded. Latterly, however, the evident advantages of the method have suggested themselves to several crystallographers. M. Fouqué mentions it in his memoir in the *Bulletin* of the French Mineralogical Society of 1894 on the felspars.

The writer of this article has frequently made use of the method for certain specific purposes, and it may be of use to other workers to give a brief indication of one or two modes of extending its sphere of usefulness not touched upon by Prof. Klein. In the course of the investigation of the normal sulphates of potassium, rubidium, and cæsium, the results of which were laid before the Chemical Society last year (*Journ. Chem. Soc.* 1894, 628, and *Zeitschrift für Krystallographie*, 1894, xxiv. 1), a difficulty was found in determining the true optic axial angle of rubidium sulphate by means of the very accurately orientated section-plates prepared by use of the new grinding goniometer described to the Royal Society (*Phil. Trans.* 1894, Series A, 887) earlier in the same year. The difficulty, which is one not uncommonly met with, was owing to the fact that the extremely low double refraction, necessitating the use of very thick section-plates, combined with the slight separation of the optic axes, rendered it impossible to measure the obtuse angle in monobromnaphthaline, and so to calculate the true angle by means of the formula $\tan \text{Va} = \frac{\text{Sin Ha}}{\text{Sin Ho}}$. The difficulty was surmounted, as fully described in the memoir referred to, by measuring the acute angle by means of section-plates perpendicular to the first median line immersed successively in two liquids, benzene and cedar oil, whose refractive indices were nearly, and the mean of them exactly, equal to the mean refractive index of rubidium sulphate. The two series of values obtained for six wave-lengths of light (the monochromatic light producer recently described by the writer, *Phil. Trans.* 1894, Series A, 913, being employed) were almost identical, differing only by a very few minutes, and the mean for each wave-length was taken as representing the true angle of separation of the optic axes for that particular wave-length. The method is applicable to all cases where it is found impossible to see the hyperbolic brushes through a section perpendicular to the second median line on account of the slight separation of the optic axes. The suggestion to employ it was made to the writer by Mr. Miers, of the British Museum, who has had a goniometer constructed for the express purpose of studying the use of an immersion liquid.

Another case in which observations in such a liquid are of great value is when it is found desirable to confirm, in some independent manner, the mode of dispersion of the optic axes for different colours indicated by the calculated values of 2Va obtained from the formula last quoted. Several of the compounds which the writer has lately been engaged in studying exhibit very low dispersion of the optic axes, and the calculated values of

2Va for five wave-lengths, obtained from the measurements of the apparent acute and obtuse angles in monobromnaphthalene by the use of accurately orientated section-plates, are so close together that it was considered advisable to ascertain in some other manner whether the order of dispersion was truly represented; that is, whether the angle for one end of the spectrum was really very slightly greater than that for the other end, or whether the amount of dispersion thus indicated did not really fall within the limits of experimental error, thus leaving it possible that the dispersion might even be of the contrary order. By immersing a plate perpendicular to the first median line in a liquid of refractive power equal to the medium refractive index of the crystal, the interference figure in white light usually at once indicates, by the colours exhibited on the margins of the axial brushes, the order of dispersion, and measurements of the axial angle for the two extreme wave-lengths afford an immediate check upon the accuracy of the calculated angles. It is a considerable source of satisfaction to be able to confirm such calculated optic axial angles in so simple a manner.

Prof. Klein further describes how admirably the new apparatus is adapted for the determination of the extinction angles upon the various faces of a zone, in parallel polarised light. For this purpose the converging lenses are removed, and the eyepiece analysing nicol is employed, so that the polarising and analysing nicols may be arranged for simultaneous rotation. The measurements are carried out while the crystal is immersed in the liquid as in case of the determinations of optic axial angle. The only precaution necessary is that the crystal should be uniformly illuminated in order that the exact position of extinction may be ascertained by use of one of the usual half-shadow stauroscopic plates.

The memoir concludes with a description of the general mode of investigating a biaxial crystal immersed in a liquid of equal refractive power, indicating how the principal planes of optical elasticity may be found, the positions of the optic axes ascertained, and the true internal angle of the latter measured. One of the most important advantages of the method is the simplification which it introduces into the study of triclinic crystals, hitherto almost dreaded by the crystallographer for the trouble they involve. It would appear that their optical investigation by the immersion method offers but slightly more difficulty than that of crystals of higher symmetry, the positions of the optic axes being readily found, and the true angle at once afforded. This alone would entitle Prof. Klein to the thanks of crystallographers and mineralogists for perfecting so admirable an aid to investigation.

A. E. TUTTON.

MICROBES AND METALS.

THE effect of metals on the growth of bacteria has been examined by Miller, Behring, and others, and another contribution to this subject has lately been published by Dr. Meade Bolton, in the December number of the *International Medical Magazine*. According to Uffelmann, who smeared the surface of copper coins with liquefied jelly-cultures of cholera bacilli, the latter were destroyed in seventeen minutes; whilst on a brass coin they were alive after thirty hours, but dead after sixty hours. Bolton employed Miller's method of inoculating a tube of melted jelly with particular microbes, and pouring the contents out on a sterilised glass-plate, after which bits of the metal under examination were laid on the jelly whilst it was still soft. If the metal has an inhibitory action on the microbes, then a clear zone is left around the metal after the colonies have developed in the other parts of the jelly. The width of this zone, Dr. Bolton found, varied very considerably with different organisms, as well as with different metals. Thus carefully purified bits of silver produced in the case of cholera bacilli a clear zone 5 millimetres broad, in the case of typhoid bacilli a zone of about 1 millimetre, whilst with the closely allied colon bacillus a zone of about 5 millimetres was produced. In the case of purified gold, no inhibition was observed with the staphylococcus pyogenes aureus, colon bacillus, typhoid bacillus, or cholera bacillus. Freshly "glowed gold" had invariably no inhibitory action; and in the few cases where inhibition was observed, the gold had not been glowed for several weeks. Pure nickel, platinum wire, and platinum black aluminium, silicon, and niobium, again, also failed to give any reaction with most of the microbes examined. Throughout the investigations it was found that those metals that are resistant towards chemical reagents in general, failed to produce any effect on microbes; whilst, on the other hand, those metals which are readily attacked by chemical reagents, all exhibited a marked inhibitory action upon the growth of bacteria. This result is probably due to a solution of the metal taking place in the medium. The length of time it is necessary to leave the metals in contact with the jelly, to produce an effect on the microbes present, was tried with brass, copper, cadmium, and zinc, on the staphylococcus pyogenes aureus. The metals were put on and removed at various intervals. When cadmium was left on for a minute, there was a clear space underneath where it had rested, which extended to 1 millimetre round; when it was left on for three or four minutes, the clear space usually extended over 3 millimetres. Very similar results were obtained with zinc. With brass no effect was produced when it was left on thirty-six minutes, but after this there was more and more marked inhibition up to fifty minutes; but to produce a clear space, it was necessary to leave it on for still longer. Copper produced no visible effect under thirty-six minutes, and fifty minutes was required to produce a clear space.

G. C. FRANKLAND.

PROFESSOR JAMES DWIGHT DANA.

BY the sudden death of Prof. J. D. Dana, from heart-failure, on April 15, America has lost a veteran man of science, who in his time has not only played many widely varied parts, but has reached the highest excellence in each. As a mineralogist he published, so long ago as 1837, the first edition of a "Descriptive Mineralogy," which by reason of its completeness and accuracy soon became a standard work of reference throughout the civilised world, and of which the sixth edition (1134 pages), issued in 1892 under the superintendence of his distinguished son, Prof. Edward Salisbury Dana, still maintains the high reputation attained by the original work. As a geologist and palæontologist, he published in 1863 a similarly excellent and well-illustrated "Manual of Geology," having special regard to the geology of the North American continent, and of which the fourth edition (1087 pages) was issued only two or three months ago. Of his work as a zoologist, we may cite as example his elaborate report on the zoophytes, collected by an expedition in which he took a very active part. The report is illustrated by 61 plates, and in it are described no fewer than 230 new species. Attainments so diverse belong only to the few.

James Dwight Dana was born on February 12, 1813, at Utica, in the State of New York, U.S.A., and was therefore in his eighty-third year at the time of his death. He was educated at Yale College, New Haven, Connecticut, receiving there a sound training in mathematics, physics and chemistry, which was of the greatest service to him in his subsequent career; he proceeded to his

degree in the year 1833. His appointment as Instructor of Mathematics to the midshipmen of the United States Navy gave him splendid opportunities for the study of nature in various parts of the world, particularly in France, Italy, and Turkey, opportunities of which he was not slow to avail himself; more especially was his attention attracted to the study of volcanic phenomena by an ascent of Vesuvius, a sight of Stromboli, and an excursion in the Island of Milo in the year 1834. Settling down for a short time, he acted as chemical assistant at Yale College to his old teacher and friend, Prof. Silliman (1836–38); but an opportunity again presenting itself of making a long voyage of marine observation, he accepted the appointment of mineralogist and geologist to the United States exploring expedition, which was to proceed round the world. This expedition, under Charles Wilkes as Commander, was admirably equipped for the objects in view, and consisted of two sloops-of-war, a store-ship, and a brig; the cruise extended over four years (1838–42), and the scientific staff included, in addition to Dana, Pickering, Couthoy, and Peale as zoologists, Rich and Breckenridge as botanists, and Hale as philologist. The memory of the events, scenes and labours of this cruise was a constant joy to him during the remaining fifty-three years of life. On at least two occasions, however, he was in imminent peril: at one time his vessel narrowly escaped destruction on the rocks of Southern Fuegia, when the sea was dashing up the cliffs to a height of two or three hundred feet, and all the anchors had given way; at another time his party had to take to the boats empty-handed, and some hours afterwards they saw the last vestige of the vessel which had been their home for three years disappear beneath the waves.

The study of the material collected by the expedition and the preparation of his reports occupied all the available time during the next thirteen years. The first two or three years were spent at Washington, but after his marriage to the daughter of Prof. Silliman he removed back to New Haven, where he passed the rest of his life. In 1850 he was appointed Silliman Professor of Geology and Natural History at Yale College. In 1846 Mr. Dana had become associate-editor of the *American Journal of Science*, and after the death of Prof. Silliman, in 1864, he became the principal editor of that important scientific organ.

Dana gave special attention to corals and coral islands, and also to volcanoes. The Wilkes expedition of 1838–42 followed in part the course taken by the *Beagle* in 1831–36, and even where it diverged from that route visited coral and volcanic islands such as have been carefully described by Charles Darwin. When the Wilkes expedition reached Sydney in 1839, Dana read in the papers a brief statement of Darwin's theory of the origin of the atoll and barrier forms of reefs; this mere paragraph was a great help to him in his later work, and he afterwards regarded Darwin with feelings of the deepest gratitude. A visit to the Fiji Islands in 1840 brought before him facts such as had been already noticed by Darwin elsewhere; but there they were on a still grander scale and of a more diversified character, thus enabling him to speak even more positively of the theory than Darwin himself had thought it philosophic to do. On other points the conclusions arrived at by Darwin and Dana, independently of each other, were for the most part the same, and differed only in comparatively unimportant details. Dana's special labours relative to corals ceased with the publication of his report on the zoophytes collected by the expedition, but an elaborate account (406 pages) of Corals and Coral Islands was prepared by him and issued in 1879: this was an extension of his expedition-report on Coral Reefs and Coral Islands, which had been separately published in 1853. In 1890 appeared another considerable work (399 pages) entitled "Characteristics of Volcanoes, with contributions of facts and principles from the Hawaiian Islands," which placed on record much useful information collected by him during his travels.

In addition to these larger works, he was the author of about two hundred separate papers. Some of them are of a physical character: his first paper, published as far back as 1833, dealing with the connection of electricity, heat and magnetism; subsequent papers treated of galvano-magnetic apparatus and the laws of cohesive attraction as exemplified by crystals. Other papers, of a purely crystallographic character (1835–52), treated of the drawing and lettering of crystal figures, of crystallographic symbols, and of the formation of twin growths; a series of volcanic papers discussed both lunar and terrestrial volcanoes, the latter including those of Vesuvius, Cotopaxi, Arequipa, Mauna Loa, and Kilauea (1835–68); a set of coral papers treated of the temperature limiting the distribution of corals, on the area of subsidence in the Pacific as indicated by the distribution of coral islands, on the composition of corals and on fossil corals (1843–74).

About forty papers are on mineralogical topics: many of them are descriptive of particular mineral species; others treat of general subjects, such as nomenclature, pseudomorphism, homœomorphism, the connection between crystalline form and chemical constitution, and the origin of the constituent and adventitious minerals of trap and the allied rocks. As illustrations of the variety met with in his geological publications, we may cite his papers on the origin of the grand outline features of the earth, the origin of continents, mountains and prairies, the early condition of the earth's surface, the analogies between the modern igneous rocks and the so-called primary formations, on erosion, on denudation in the Pacific, on terraces, on southern New England during the melting of the great glacier, on the degradation of the rocks of New South Wales, and the formation of valleys. The remaining papers, about seventy in number, deal with biological subjects, both recent and fossil, and have a similarly varied character; some being descriptive of species, others treating of classification and similarly general problems.

The importance of this scientific work was widely recognised, and many marks of distinction were conferred upon him, both at home and abroad. He was an original member of the National Academy of Sciences of the United States, and in the year 1854 occupied the presidential chair of the American Association for the Advancement of Science. In 1851 he was elected a Foreign Member of the Geological Society of London, and in 1872 received from that Society the Wollaston Medal, the highest compliment the Geological Society can pay to the man of science; in the same year the University of Munich honoured him with the degree of Ph.D.; in 1877 he was the recipient of the Copley Medal of the Royal Society, and in 1884 was elected one of the foreign members; in 1886 Harvard conferred upon him the degree of LL.D.; he was also an honorary member of the Academies of Paris, Berlin, Vienna, St. Petersburg and Rome, and of the Mineralogical Societies of England and of France.

NOTES.

WITH the École Normale at Paris, which has just celebrated its centenary, the names of a number of distinguished men of science are associated. At the present time, no less than twelve of its old students are members of the Academy of Sciences. Pasteur left Lille to become the director of scientific studies at the school, and carried on, while in connection with it, the researches which have made his name known throughout

the world. M. Bertrand, the Perpetual Secretary of the Academy, is an old student of the school, and among other eminent names included in the list of its alumni are MM. Darboux, Joubert, Serret, Hermite, Puiseux, Briot, Bouquet, Giard, Baillaud, Chaive, Floquet, Pellet, Tisserand, Appell, Picard, &c. ; while the teaching staff now contains such men as Goursat, Tannery, Gernez, Dufet, Houssay, Constantin, Raffy, Violle, Joly, and Wallerant.

AN influential committee has been formed for the erection of a monument to the late Prof. Hermann von Helmholtz, the German Emperor having promised 10,000 marks and a free site for the purpose. The committee is international and thoroughly representative, as shown by the names of Berthelot, Blaserna, Boltzmann, Geikie, Holmgren, Kékulé, Kelvin, Lippmann, Lubbock, Pictet, Rayleigh, Roscoe, Sidgwick, Siemens, Tait, Thalén, Virchow, Weber, and others among the 180 distinguished men of science forming the committee. Funds will be collected in Germany and in other countries, and may be sent to any member of the committee, or to Messrs. Mendelssohn and Co., Berlin W., Jaegerstrasse 49 and 50. Letters may be sent to Prof. Dr. A. König, Berlin N.W., Flemmingstrasse 1. The appeal issued by the committee concludes as follows: "Friends and admirers of Hermann von Helmholtz, far and near, unite with us! Bear witness to the homage paid by science, which knows no frontiers, to one of its heroes; show your gratitude for the benefits which life has received from his scientific labours, and give expression to the love which his harmonious spirit won wherever he appeared."

PROF. HUXLEY'S condition during the past week has caused his friends considerable anxiety, but we are glad to learn that a change for the better set in on Monday.

DR. JOHN H. REDFIELD, one of the founders of the American Association for the Advancement of Science, died recently at Philadelphia.

THE Prince of Wales has signified his intention to be present at the celebration of the jubilee of the Royal Agricultural College, Cirencester, on July 25.

THE sixty-seventh meeting of the Society of German Naturalists and Physicians will be held this year at Lübeck, September 16 to 21. The secretaries of the zoological section are already making preparations for this event, and will issue a preliminary programme of communications and demonstrations early in July.

THE London Geological Field Class will commence their series of Saturday afternoon excursions, under the direction of Prof. H. G. Seeley, F.R.S., next Saturday, when they will visit Otford and Eynsford. Further particulars can be obtained from the General Secretary, R. Herbert Bentley, 31, Adolphus Road, Brownswood Park, N.

MR. EDWARD CROSSLEY has signified his intention of presenting to the Lick Observatory the 3-foot reflecting telescope, with its dome, which now form part of his private observatory at Halifax. This information comes to us directly from the Lick Observatory, together with an expression of high appreciation of Mr. Crossley's most generous gift.

APPLICATIONS for appointment to the Medical Research Scholarships of the Grocers' Company must be sent in before the end of this month. The Scholarships are three in number, each of the value of £250, and are open only to British subjects; they were instituted by the Company as an encouragement to exact research into the nature and prevention of important diseases.

AT Stevens's sale room on Tuesday, a fine and well-preserved specimen of the Great Auk, from the collection of the late Sir William Milner, was put up to auction. About eighty skins of the bird are known to be in existence, of which twenty-four are in Great Britain, ten of these being in museums, and fourteen in private hands. The bidding for the specimen offered for sale by Mr. Stevens started at 100 guineas, and went up slowly to 350 guineas; but as this was lower than the reserve price, the bird did not change owners. A Great Auk's egg, offered at the same sale, reached the price of 180 guineas, while an egg of Æpyornis maximus was sold for 36 guineas.

A PARTY, consisting of Dr. Geo. Becker, Prof. W. H. Dall, and Mr. Parington, of the U.S. Geological Survey, will leave Washington on May 16 for Alaska, and will be away until September. Congress recently directed an examination of the gold and coal deposits of the territory to be made, and this will be the work of the party; directed more especially towards an estimate of the economic value of the known deposits, rather than toward a search for new ones.

THE new system—the "Système français"—proposed by the French Société d'Encouragement to regulate the pitch of screws, and the metric wire gauge—the "Jauge décimale métrique"—in which the number of a wire is the same as the diameter expressed in tenths of millimetres, have been adopted in the French Navy by the Minister of Marine. The approva thus officially shown to the new scales will greatly assist the Society in its efforts to establish uniform gauges for wires and screw-threads.

THE news that the office of Superintendent of Agriculture, held by Mr. C. A. Barber in the Leeward Islands, has been abolished, and that the Department of Agriculture, as such, no longer exists, is altogether surprising. The Department was only opened towards the end of 1891, but, under Mr. Barber's direction, the four botanical stations in connection with it, at Antigua, Dominica, St. Kitts, and Montserrat, have done a large amount of work, which is daily becoming more and more known and appreciated. No agricultural community can afford to be without scientific advice in these days of competition and plant disease. Why the local Legislature should dispense with this advice just when the Superintendent of their Department of Agriculture had, by incessant stndy of the climatal and economic conditions of the islands, attained the position to give it authoritatively, is quite beyond our comprehension.

THE "Exposition annuelle" of the French Physical Society was held last week. Many new and ingenious pieces of apparatus, for use in all branches of physical investigation and instruction, were on view. Electrical instruments occupied a large share of the exhibits, but there were also to be seen new forms of barometers, thermometers, calorimeters, spectroscopes, dynamometers, balances, and other engines of research. M. Violle exhibited photographs of the electric arc, and MM. Loewy and Puiseux showed their lunar photographs obtained at the Paris Observatory. Useful accessories to micrometers for astronomical telescopes were shown by M. Maurice Hamy. There were also on view, among numerous other things, metals of new compounds prepared by M. Moissan in his electric furnace; a radiometer which turned in the opposite direction to that of the ordinary form of the instrument; M. Janssen's long-period meteorograph, designed for the Mont Blanc Observatory; M. Raoul Pictet's apparatus for the experimental study of the critical points of liquids; and the spectrum of argon. Visitors to the Exhibition must have derived considerable benefit from an inspection of the many physical instruments and devices which were to be seen.

MAJOR CARDEW'S report on the inquiry which he has made into the circumstances connected with a series of explosions which occurred on February 1, on Southwark Bridge, has just been printed as a Parliamentary Paper. It will be remembered that there were four explosions; the first, and by far the most intense, occurred in the culvert under the pavement and roadway on the west side of the bridge, and it was immediately followed by three explosions in the street boxes of the Electric Lighting Company, on the east side of the bridge. On opening the ground over the culvert, shortly after the explosions, a large crack was found in the 3-inch gas main, out of which the gas was coming in volumes. How the gas was fired could not be exactly ascertained, but Major Cardew confidently asserts that it was not by means of the electric lighting mains. The most striking features about the accident seem to be: (1) The distance to which it appears that a series of explosions may travel along the electric mains which form a gigantic network under the whole of the streets of the city; and (2) the proof it affords of the insufficiency of any ordinary system of ventilation of these pipes and street boxes, if gas can find an easy access to them, and the necessity of exercising great care to make and keep the street boxes impervious to gas. In a former report it was recommended that "accumulation of gas should be prevented by thorough ventilation, by making the sides and bottoms of street boxes impervious to gas, and by filling up the boxes as far as practicable with incombustible material"; to this Major Cardew now adds—"by thoroughly plugging pipes and conduits at each street box to prevent passage of gas along the system," and he puts the filling up the boxes first, as the most simple and certain method of preventing danger of explosion. It is admitted that the main cause of the explosions was the defect in the gas-pipe, and this again directs attention to the very serious danger to the public arising from the condition of the gas-pipes in many districts, and the way in which they are laid and supported; a danger which is continually increasing, owing to the spread of the use of wood paving and other impervious surfaces, and which is temporarily intensified by every severe frost. No want of care on the part of the gas companies can, however, relieve electric lighting companies of the duty of sufficiently protecting their conduits and street boxes against an accumulation of gas, by acting on the recommendations made.

IT is very commonly believed that in Ireland, on account of the mild climate, the Arctic or Mountain Hare does not turn white in winter, but remains in its brown summer fur. Writing in the *Zoologist*, Dr. R. F. Scharff brings evidence that there is no change in the colour of the Irish hare in most winters. But, on the other hand, Major-General Warrand states that—"At Finnebrogue, near Downpatrick, a very large number of hares are taken or killed every year, and it is found that a considerable number of them turn very white in the winter, while nearly all assume a much lighter shade of fur when the cold weather sets in." The editor of the *Zoologist* says that this view is supported by a number of sportsmen and good observers, and that he himself has shot several Irish hares in all stages of change from brown to white.

THERE is an interesting paper in the *Electrician*, by Messrs. Campbell and Lovell, on the supposed magnetic fatigue. Prof. Ewing has recently shown that in the case of good wrought iron, when subjected to very many reversals in weak magnetising fields, there is no perceptible change in the magnetic qualities. The authors have made use of strong magnetising fields, and have experimented on cast as well as wrought iron. The specimens to be tested were in the form of rings wound over with primary and secondary coils. A single **B.H.** curve was taken by the ordinary ballistic method, and then an alternating current of about 1·4 amperes at 83 alternations per second was kept passing through the primary coil for nearly a month. Another series of tests were then made, and it was found that the **B.H.** curve obtained coincided exactly with that given before the repeated reversals, both in the case of wrought and cast iron.

THE current number of *Wiedemann's Annalen* contains a paper, by Herr A. Bock, on the ratio between the lateral contraction and the longitudinal dilatation (Poisson's ratio) in magnetised iron rods. In the method employed the rod under test is rigidly supported at its middle, so that it lies in a horizontal plane. At either end of the rod a cross-piece is attached, as well as a plane mirror. These cross-pieces serve as lever arms, from the ends of which weights can be hung. In this way the bar is both bent and twisted, the amount of bending and twisting being read off by means of a vertical telescope, two scales at right angles, and the mirrors attached to the ends of the rod. The difference of the readings on the scale parallel to the length of the rod (B) is proportional to the bending, while the difference in the readings on the scale at right angles to the length of the rod (T) is proportional to the twist. Then using Kirchhoff's formula, Poisson's ratio is given by $\mu = \frac{T}{B} \cdot \frac{s}{2l} - 1$, where s is the half length of the rod, and l is the length of the lever arm, at the end of which the deforming weight acts. Neither in the case of hard steel or soft iron (a magnetising coil being used in this latter case) was a difference in Young's modulus, or of the torsional rigidity greater than 0·5 per cent. observed. In the case of soft iron, the author considers that his experiments are sufficiently accurate to show that after magnetisation the torsional rigidity and Young's modulus both diminish. Since, however, B diminishes faster than T, the value of Poisson's ratio increases. The author finds that frequent magnetisation and deformation causes the differences in the elastic constants between the magnetised and unmagnetised states to diminish, and he therefore concludes that it is not possible to detect the effect on the elasticity of magnetisation in a rod by the change in the pitch of the note it emits when struck.

THE field experiments now in progress in various parts of the country partake rather of the character of demonstrations than of incursions into the domain of original research. The experiments made in Carnarvonshire last year, in connection with the agricultural department of University College, Bangor, included a series in which a mixture of rye grass and clover seeds was pitted against mixtures containing the seeds of other grasses than rye grass, in addition to or exclusive of the latter. The crops were cut in July, and weighed green, when the crop containing clovers and rye grass only was found to be the heaviest. All the plots are to be grazed for the next three years, and it is obvious that considerable time must be allowed before definite conclusions can be arrived at. Experiments made in Anglesey "to test the best quantity of seed to sow for oats," appear provisionally to demonstrate that four or six bushels of seed (black Tartarian) broad-casted per acre, give better crops than are obtained from eight bushels of seed, the quantity sown under the usual practice of the island. In both counties comparative manurial experiments are in progress upon pasture land and field crops.

THE work of the Aberdeenshire Agricultural Research Association in 1894 was largely concerned with an inquiry into "degeneration of rye grass and possible recovery." It is argued that, in permanent pasture, "starvation of plants, and non-utilisation of the plants when grown, are the features to be remedied, in order to secure permanent pasture of the valued rye grass." The supreme value of *Lolium perenne* in pastures,

as demonstrated by Sir John Lawes and others a few years ago, appears to be steadily acquiring additional confirmation in different parts of the country, and the economic importance of the question is beyond all doubt. We are afraid that confusion is likely to arise from the adoption of a practice in vogue at some of the American experiment stations, where the word "legume" is used to denote "leguminous (papilionaceous) plant." In this report we read, "Legumes (*i.e.* tares, peas, clover, lucerne, &c.)." The word "legume" has already a definite meaning attached to it by English botanists, whilst in colloquial use in France it has another and a wider application. Exception should also be taken to the use of the term tubercules (or tubercles) to denote the structures on the roots of leguminous plants. Lawes and Gilbert have, with admirable consistency, adhered throughout to the word "nodules," and it is unfortunate that this example has not generally been followed. Students of agriculture are hearing more and more of tubercle in animals, and of the disease termed tuberculosis, and there is a tendency, at least on the part of beginners, to think that all tubercles must be alike. The general adoption of the word "nodules," as used by Lawes and Gilbert, would lessen the possibility of confusion.

MISS CHRISTINE LADD FRANKLIN publishes an interesting paper on "The Normal Defect of Vision in the Fovea" in the current number of the *Psychological Review*. Recent investigations of Königs on the relative absorption of different portions of the spectrum by the visual purple, the curve of which corresponds with the curve which expresses the distribution of brightness along the spectrum for (1) the totally colour-blind and (2) the normal eye in a faint light, suggest that vision both in (1) and (2) is conditioned by the presence of visual purple in the retina. But this visual purple is absent in the fovea. If this be so, the eye in (1) and (2) should be blind in that part of the retina. Careful observations and experiments were made to test the validity of this conclusion. "The blindness of the fovea for faint light did not at once reveal itself; the act of fixation means holding the eye so that an image falls on the part of the retina best adapted for seeing it, and hence it would involve keeping the image *out of* the fovea in a faint light, if the fovea were then really blind. But after the total disappearance of the small bright object looked at had several times occurred by accident, it became possible to execute the motion of the eye necessary to secure it at pleasure. It was then found that the simple device of presenting a group of small bright objects to the eye of the observer was sufficient to demonstrate the 'normal night-blindness of the fovea' without any difficulty—one or other of them is sure to fall into the dark hole of the fovea by accident." Observations on a totally colour-blind boy showed the blindness of his fovea. The function of the retinal purple is, it is suggested, for the reinforcement of waning light, and is especially adapted for the absorption of the faint green light of dense forests.

THE Calendar of Queen's College, Galway, for 1894–95, has just been published, and also that of the Royal University of Ireland, for the year 1895.

THE current number of the *Journal* of the Royal Agricultural Society of England contains a long report, by Sir J. B. Lawes, F.R.S., and Sir J. H. Gilbert, F.R.S., on "The Feeding of Animals for the Production of Meat, Milk, and Manure, and for the Exercise of Force."

A NEW edition has been published of "Stephens' Catechism of Practical Agriculture" (W. Blackwood and Sons), revised and largely rewritten by Mr. James Macdonald. The popularity of the book is vouched for by the fact that more than twenty-one thousand copies have been sold.

TWENTY-EIGHT short essays by Dr. Jean Rey, "On an inquiry into the cause wherefore tin and lead increase in weight on calcination," form the contents of No. 11 of the Alembic Club Reprints. The essays, which originally appeared in 1630, are interesting because they contain descriptions of experiments and results which anticipated, to some extent, the work done by Lavoisier a century and a half later.

PARTS of the first and second editions of Malthus' essay on the principle of population, have been published, in a handy volume, in Messrs. Macmillan's series of Economic Classics, edited by Mr. J. Ashley. Of the first edition, published in 1798, about one-third has been reprinted; but of the second edition, which contained about four times as much matter, the selected chapters are only one-twentieth of the whole work.

AN account of principles and practice of the methods adopted by Dr. T. Schott in the treatment of chronic diseases of the heart by means of mineral baths and exercises, has been written by Dr. Bezly Thorne, and published by Messrs. J. and A. Churchill, together with a description of the Nauheim baths, and of the therapeutic exercises. The volume is full of diagrams and other illustrations of interest to students of cardiac affections.

A GERMAN edition of Mr. Benjamin Kidd's "Social Evolution," with a preface by Dr. A. Weismann, has just been published by Gustav Fischer, Jena.

FIVE new volumes belonging to the "Encyclopédie scientifique des Aide-Mémoire" have come to us from the joint publishers, Gauthier-Villars and G. Masson, Paris. They are: "Le Fonctionnement des Machines à Vapeur," by G. Leloutre; "Des Marées," by P. Hatt; "Balistique des Nouvelles Poudres," by E. Vallier; "La Théorie des Procédés Photographiques," by A. de la Baume Pluvinel; and "La Distillation," by E. Sorel.

INDEXES to the literature of cerium and lanthanum, by Dr. W. G. Magee, have been published together as No. 971 of the "Smithsonian Miscellaneous Collections," in accordance with the recommendation of the Chemical Literature Committee of the American Association for the Advancement of Science. The difficulty and labour involved in the preparation of these indexes can only be fully understood by those who have attempted similar tasks. All chemists should be grateful to Dr. Magee for his very valuable bibliography.

A FULL notice of the life and numerous works of the late Mr. F. Buchanan White appears, with a portrait, in the April number of the *Annals of Scottish Natural History*. A report on the remarkable visitation of the Little Auk to Scotland, during the past winter, is contributed to the same number by Mr. W. E. Clarke. The whole of the records of occurrences of the bird from December 22, 1894, to February, are shown upon a map which accompanies the report, and are also precisely tabulated in chronological sequence.

DR. HENRY MAUDSLEY'S "Pathology of Mind" (Macmillan) has recently been published in such an altered and enlarged form, that it is virtually a new book, "for," to quote from the preface, "while old matter has been left out, and much fresh matter added, the whole has been recast, the form of the presentation changed, and the text entirely rewritten." The present contents of the work, as expressed by the new subtitle, constitute a study of the distempers, deformities, and disorders of the mind.

IN the third *Bulletin* of the Madras Government Museum appears a revised edition of Mr. Edgar Thurston's "Rámésvaram Island and the Fauna of the Gulf of Manaar." The

situation of Ràmésvaram, on the reef which, under the name of Adam's Bridge, almost connects Ceylon with the mainland of India, renders an account of its flora and fauna particularly interesting; and the present brochure, which is illustrated with several charts and photographs of the coast, furnishes a useful supplement to Haeckel's graphic pages upon the island of Ceylon. The observations recorded are admitted to be far from exhaustive of the biological features of the Gulf of Manaar, but they are more than sufficient to indicate the existence of a fauna well worthy of further examination.

THE Malacological Society of London, instituted for the study of the Mollusca and Brachiopoda, only came into existence in February 1893, but its performances up to now give every promise of a successful future. It publishes *Proceedings*, in which appear anatomical papers, and papers devoted to descriptions of recent and fossil shells. A valuable address by Dr. H. Woodward, F.R.S., dealing largely with scientific investigations of the sea and its inhabitants, appears in the fourth number of the Society's *Proceedings*, with a number of other papers. In this connection we notice that the *Journal of Malacology* contains a contribution, by Dr. J. C. Thresh, on "Oysters as Disseminators of Disease," and, together with several other communications and a bibliography of recent literature, an interesting note, by Mr. W. M. Webb, on "The Dimyarian Stage of the Native Oyster."

THE Natural History Societies in our public schools probably do more to foster scientific research than all the systematic instruction in lecture-room and laboratory; therefore every encouragement should be given to the work of observation and collection which is carried on by them. Increased demands of both school work and games on half-holidays leave little time to cultivate interest in natural things, and this accounts partly for the statement in the report of the Rugby School Natural History Society for 1894, that the interest shown in the Society by members of the school has decreased. Possibly, now that the new museum is completed, and the collections in it are being systematically arranged by Mr. Collinge, the Society will commence a new era of prosperity.

THE Danish Meteorological Institute and the Deutsche Seewarte have conjointly published daily synoptic weather charts of the North Atlantic Ocean and adjacent continents for a year ending November 1889. These valuable charts were first issued for September 1873 by the late Captain Hoffmeyer, of Copenhagen, and they afford excellent materials for tracing the connection between the weather conditions of the Atlantic, this country, and Western Europe. For some years past the charts have been accompanied by explanatory text, which greatly enhances their value. The discussion of the charts for the year in question is divided into two parts: (1) general investigations of the conditions over the North Atlantic, and (2) application of this knowledge to navigation; while the position and movement of the areas of high and low barometer, in interesting cases, are shown in forty special charts accompanying the text.

SEVERAL aromatic esters of arsenious acid have been prepared for the first time by Dr. Fromm, of Rostock. The new substances are either viscous liquids or crystalline solids, and are prepared with considerable facility. The first member of the series, the triphenyl ester, $As(OC_6H_5)_3$, is obtained by allowing arsenic trichloride diluted with ether to fall drop by drop into sodium phenylate suspended in ether. The reaction commences vigorously at the ordinary temperature, but the mixture eventually requires warming over a water bath in order to obtain the theoretical yield. The ethereal liquid is then allowed to stand until the finely-divided precipitate of common salt subsides, when it is decanted from the latter. The ether is then removed by distillation over the water bath, and the thick residual liquid subsequently subjected to distillation under reduced pressure. Arsenious triphenyl ester is a colourless viscous liquid endowed with an odour somewhat resembling that of phenol; it boils under a pressure of 57 m.m. at 275°. The liquid is remarkably sensitive to moisture, for water instantly decomposes it into arsenious oxide and phenol. Halogens do not form additive compounds with it, but chlorine and bromine convert it into arsenic trichloride or tribromide and trichlor- or tribromphenol. The second member, the para cresyl ester, $As(OC_6H_4CH_3)_3$, is similarly obtained, and is likewise an oily liquid, boiling at 290° under 20 m.m. pressure, and endowed with similar properties. The benzyl ester, $As(OCH_2C_6H_5)_3$, has also been isolated in an analogous manner, but is not quite so stable as the two esters just described, being more or less decomposed upon distillation *in vacuo*; it may be obtained practically pure, however, by heating the product of the reaction in an oil bath to 200° under low pressure. It reacts with water similarly to the two other esters. In addition to these liquid aromatic arsenious esters, the β-naphthyl ester, $As(OC_{10}H_7)_3$, has been prepared by the action of arsenic trichloride upon the sodium derivative of β-naphthol. As the sodium compound is in this case completely soluble in ether, the arsenic chloride reacts with great energy. The arsenious naphthol ester crystallises from the ethereal solution after decantation from the precipitated common salt, in colourless aggregated crystals, which melt at 113°–114°, and are readily soluble in alcohol and benzene in addition to ether. Water immediately decomposes them, and in boiling water the products of the decomposition, arsenious oxide and β-naphthol, dissolve completely.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*, ♀) from West Africa, presented by Miss Florence Greffin; a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by Mr. R. J. Davidson; two Polar Hares (*Lepus glacialis*) from Norway, presented by Mr. O. Gude; a Common Badger (*Meles taxus*) from Berkshire, presented by The Duke of Wellington; an Irish Stoat (*Putorius hibernicus*) from Ireland, presented by Viscount Powerscourt; two Antipodes Island Parrakeets (*Cyanorhamphus unicolor*) from Antipodes Island, New Zealand, presented respectively by Sir Walter L. Buller, K.C.M.G., and Mr. William E. Collins; two Scarlet Tanagers (*Ramphocælus brasilius*) from Brazil, presented by Mr. Robert E. Graves; a Red and Blue Macow (*Ara macao*) from South America, deposited; two Griffon Vultures (*Gyps fulvus*) from Egypt, purchased; an Egyptian Gazelle (*Gazella dorcas*, ♂) from Egypt, received in exchange; a Great Kangaroo (*Macropus giganteus*, ♂), a Rufous Rat Kangaroo (*Hypsiprymnus rufescens*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE VARIABLE STAR Z HERCULIS.—This recently discovered variable star turns out to be one of exceptional interest. It was first suspected of variability by the Potsdam observers, and subsequent observations by Chandler and Hartwig seemed to show that it was a star of the Algol type. Early in the present year Dr. Dunér announced that the new variable was probably of the Y Cygni type with unequally bright components, since he found unequal minima alternating in periods of forty-seven and forty-nine hours. Returning to the subject (*Astrophysical Journal*, April), Dr. Dunér gives the data on which his conclusion was based, and derives some interesting results as to the probable constitution of the system. The normal magnitude of the star is 6·89; at principal minimum it falls to 8·05, and at secondary minimum to 7·35. Hence,

the relative degrees of brightness at these times are 1, $\frac{2}{3}$, and $\frac{1}{3}$, and assuming that the eclipses are central, it is easily shown that the observed magnitudes may be explained by supposing that the two components are of equal size, while one is twice as bright as the other. The unequal duration of the minima further indicates that the orbit is an ellipse with an eccentricity of 0 2475, and it is calculated that the semi-axis major of the orbit is six times the diameter of the stars. The plane of the orbit passes through the sun, and the line of apsides is inclined at an angle of 4° to the line of sight. The stars revolve in this orbit in a period of 3 days 23 hours 48 minutes 30 seconds.

It seems probable that this variable may form a connecting link between Algol, which consists of a bright and a dark body, and Y Cygni, consisting of two stars of equal brightness.

THE DIAMETER OF NEPTUNE.—With the Lick telescope and an eyepiece magnifying 1000 diameters, Prof. Barnard finds the mean angular diameter of Neptune, when reduced to the mean distance from sun 30"·0551, to be 2"·433. This corresponds to an actual diameter of 32,900 miles, which is from two to four thousand miles less than that stated in most of our text-books.—*Astronomical Journal*, No. 342.

INDUCED MAGNETISM IN VOLCANIC ROCKS.

AN interesting note by G. Folgheraiter, on the magnetism induced in volcanic rocks by the earth's magnetic field, appears in the *Atti della Reale Accademia dei Lincei* (vol. iv. part 5, March 3, 1895). The author has performed a number of experiments on volcanic rocks, in order to determine the amount of induced magnetism left when, after heating to such a temperature that they entirely lose their permanent magnetism, they are either allowed to cool slowly or are suddenly cooled, in each case under the influence of the earth's field. From such observations he hopes to be able to deduce some conclusions as to the conditions under which the rocks experimented on, which were originally permanently magnetised, became magnetised. The rocks are cut into small parallelopepedons weighing about 50 grams, and such that the length is about two or three times the depth or breadth, care being always taken to cut the rock so that the axes of these pieces were vertical when the rock was in its place in the earth. The intensity of magnetisation was in every case measured by the method of deflection; a freely suspended magnetic needle being deflected by the sample, which was placed with its length east and west. After measuring the intensity of magnetisation of the samples, they were heated to redness, and then either allowed to cool slowly, or are rapidly quenched with their axes vertical. Their magnetic moment was determined, first immediately they were cool, and then after they had stood under the influence of the earth's field for three months. The specimens of basalt examined may be divided into two groups: in the first may be placed those specimens which were originally only slightly magnetised, and in this case, after heating to redness, the magnetisation is always increased, but to a very different degree in the different specimens. The second group includes those basalts which were originally strongly magnetised, and in this case after heating the magnetisation was considerably reduced. In both groups the magnetisation underwent no change during three months, and sudden cooling gave the same results as slow cooling. Experiments have also been made on tuff and peperino. The results obtained with the first of these rocks are similar to those obtained with the first group of basalts. Peperino, however, differs in that, before being heated, its coercive force seems almost nil, the bar becoming only temporarily magnetised. After heating, the character of the rock is altered, as it can now become permanently magnetised and behaves just like the tuff. From this the author concludes that peperino has been formed at a low temperature, probably by the action of water on cinders, &c.

THE FREEZING-POINT OF DILUTE SOLUTIONS.

CORRECT determinations of the freezing-point of dilute solutions are of fundamental importance in connection with the general theory of the subject, and it is therefore anything but satisfactory to find that, in spite of the closeness with which the individual results of the same observer agree amongst themselves, the results of different observers are in many cases widely separated. For example, the following values have been given as the molecular depression of the freezing-point in the case of a 1 per cent. aqueous solution of sugar:—2·02, Arrhenius; 2·07, Raoult; 2·01, Pickering; 2·18, H. C. Jones; 1·81, Loomis. The results of Jones and Loomis, both of whom claim increased accuracy for the methods they employ, differ by some 18 per cent. The theoretical value of the molecular depression, calculated from the melting-point and heat of fusion of ice, is 1·86. The cause of these differences has given rise to much discussion. Pickering has attempted to show that Jones's results, wherein the temperature was read to the ten-thousandth of a degree, were affected by thermometer errors. Jones has replied that his thermometer was tested. Kohlrausch has drawn attention to probable sources of error in Jones's method, but is compelled to admit that the differences between the results of Jones and Loomis must, in the main, be due to some unknown source of error.

A definite step in the direction of clearing up this point is made in a recent number of the *Zeitschrift für physikalische Chemie*. Here Nernst and Abegg emphasise the fact that the observed freezing-point must in general be different from the true freezing-point, or the temperature at which solid and liquid are in equilibrium. They point out that a partly-frozen liquid, uninfluenced by the temperature of its surroundings, will strive to reach the true freezing-point at a rate which, at any instant, may be taken as proportional to the difference between its actual temperature and the true freezing-point. Again, in practice, on account of the limited amount of substance employed, and the effect of the temperature of the surroundings, &c., unfrozen liquid strives to reach a definite temperature, which may be termed the "convergence temperature." On these assumptions it is easy to show that the observed freezing-point, or the temperature at which the thermometer becomes steady, will only be the true freezing-point if the "convergence temperature" is equal to the true freezing-point, or if R, the rate at which the temperature of the partly frozen liquid approaches the freezing-point, is infinitely great as compared with r, the rate at which the temperature of the unfrozen liquid approaches the "convergence temperature." If one of these conditions is not fulfilled, corrections determined experimentally have to be applied. For dilute solutions of alcohol and common salt the corrections were found to be inappreciable under the experimental conditions described in the paper. Here the value obtained for R, although, as is always the case, it was largely diminished by the lag of the thermometer, still was sufficiently large as compared with the value of r. In the case of sugar, however, R was so small that by varying the experimental conditions, a 1 per cent. solution gave molecular depressions varying between 1·6 and 2·1—limits which are even further apart than those given by the results of previous observers. On correcting the observed depressions in the manner described, they all gave practically the theoretical value.

Without these corrections, observed freezing-points are thus held to be functions of the size of the apparatus used, the temperature of the cooling-bath, the rate of stirring which largely affects the "temperature of convergence," &c.

Evidence is also given of the futility of expressing freezing-points to the ten-thousandth of a degree. It may readily happen that the above correction is as high as 0°·01, and as the mode of deducing it is but approximate, in such a case 0°·001 or 0°·002 would be a favourable estimate of the error of the end result, even if satisfactory corrections could be applied for the alteration in the concentration of the solution produced by freezing, and the ordinary sources of error incidental to the method of experiment.

J. W. RODGER.

THE EXAMINATION CURVE.

IF the results of the examination of a mixed body of candidates be plotted out on the graphic method, they will be found, in accordance with a well-known law of statistics, to approximate to a curve having a more or less rapid gradient at either end, and a mid-region of gentler ascent. Fig. 1, for example, shows the results of an examination of 27 students in physical geography, the scale of marks running vertically from 10 to 90, the examinees being arranged horizontally at equal distances apart from the lowest to the highest. The larger the number of candidates the more flattened does the mid-region of the curve tend to become. Again, in any series of examinations, the mean results of which are plotted out, the more uniform

the standard of difficulty of the papers set, the flatter is the mid region of mediocrity. Fig. 2 shows the mean results of ten separate examinations, of different students conducted by six examiners, in history, English literature, geography, physical geography, physics, botany, arithmetic, and Euclid. They are taken without special selection from the returns of class examinations in University College, Bristol. The standards were somewhat markedly different; in some the head, in others the tail, being excessive; hence the mid-region is not so flattened as it probably would have been had a larger series been taken. The results indicate, however, sufficiently well

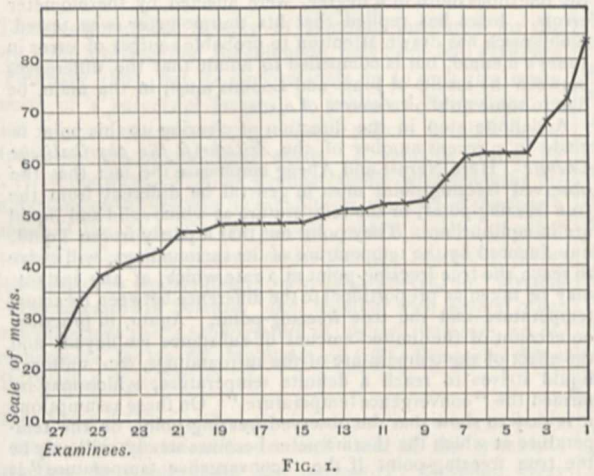

FIG. 1.

the general nature of the examination curve. The total range of marks being from 17·5 per cent. to 84 per cent., 15 out of the 30 students fall within the mid-region of from 40 per cent. to 60 per cent.

It is not my purpose to attempt to determine how far the form of the lower end, or tail, of the curve is due to incapacity on the one hand, or to sheer idleness on the other, and how far that of the upper end, or head, of the curve is due to exceptional ability on the one hand, or to industry and hard work on the other. Whichever cause preponderates, we may say that, at any rate with pupils who have got beyond the school-boy stage,

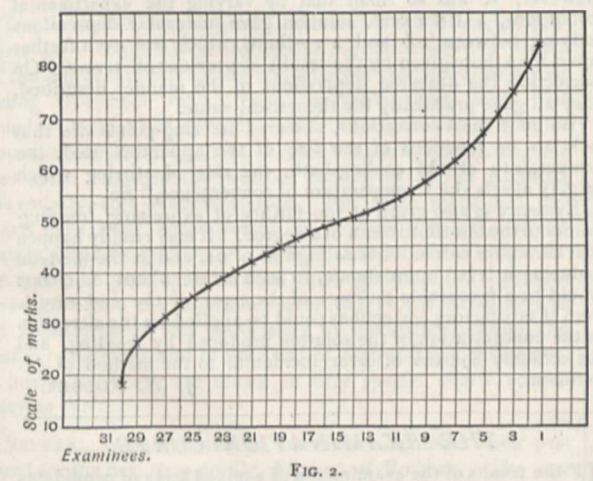

FIG. 2.

and very largely with them too, the teacher's chief field of influence is in the preponderant mid-region of mediocrity. Those in the tail of the curve either cannot or will not profit by his ministrations; those at the head of the curve may be trusted to do well without his aid, or even in spite of his interference. It is on the body of the curve that he can do his best work.

It is, at first sight, somewhat remarkable that the general form of the curve persists as we ascend through a series of graded examinations. It might well be supposed that the tail would be eliminated in the lower examinations; and the results of my own observations show that the tail does tend to flatten out and become raised as we ascend. But it is by no means got rid of. It flattens because we have eliminated the hopelessly idle and those who have altogether mistaken their vocation. It persists because at each stage there are those whose limits of capacity have been reached. A student whose capacity may bring him into upper mediocrity in matriculation, may drop hopelessly into the tail when he proceeds to work for the degree. I was informed, on good authority, at the Cape, that whereas the Kaffir lads were often ahead of white boys in the early stages of education, the limits of their capacity were soon reached, and they were left behind by those whom they had before easily beaten. At each stage there are pupils for whom the work is beyond their powers; and they inevitably fall into the tail.

In the traditional division of candidates into three classes, the most rational method is to place in the first class those at the head of the curve, the mediocrities in the second class, and the tail in the third class. For many years it has been my custom as an examiner to plot out on the graphic method the results of each examination. The advantage of doing so is that one thus sees at a glance the distribution of the examinees. One can also more readily see where the divisions should run between the several classes. It is irrational to fix beforehand some arbitrary number of marks to form the limiting line above which the candidates are to be called first class, those below this and above another arbitrarily chosen number being ranked in the second class. The limit must be determined—and even then it is often only determined with difficulty—by an inspection of the curve. The form of the curve, and the level of mediocrity in the scale of marks, enable one to decide whether the paper has been too hard or too easy. If too hard, the level of mediocrity will be low, and the tail inordinately large; if too easy, the level of mediocrity will be high, and the head not well differentiated from the body.

The examination curve may be commended to the special consideration of those who have to deal with large numbers of candidates in connection with the Education Department and that for Science and Art. And I would recommend to the consideration of those who have the control of Civil Service and Army Examinations the excellent suggestion made by Dr. J. Venn, in a paper on the "Correlation of Mental and Physical Powers," contributed to the *Monist* for October 1893. In these examinations large numbers of candidates compete for a limited number of vacancies. Let the results be expressed in an examination curve. It will have a well-marked head, a longish body of mediocrity, and a decided tail. We may cheerfully eliminate the tail; it consists of duffers intellectually. We may select the head for entrance; it consists of men of marked intellectual superiority, so far as the examinations are an adequate test thereof. If the head exhausts all the vacancies, well and good. But if the number of vacancies involves an extensive incursion into the body of mediocrity, then it will be found that the lower selected candidates will be very little superior intellectually to the higher rejected candidates. The last ten selected, and the ten seniors among the rejected, will probably be separated by a comparatively small number of marks. Moreover, it is a well-known fact, *experto crede*, that, if, after an extensive set of papers has been looked over and carefully marked, an interval of time be allowed to elapse, and then the papers are gone over again, the result of this re-examination is that the head and tail remain practically unchanged, but that there is not a little redistribution among the mediocrities. Furthermore, if a different examiner look over the papers, the head and tail of his curve will not differ markedly in arrangement or form from those of his predecessor; but among the mediocrities there will be not a little shifting of places. While, therefore, such an examination as that for entrance to Woolwich or Sandhurst serves to select the intellectual head, and to reject the intellectual tail, it is by no means so effectual in classifying the candidates who fall within the body of mediocrity.

Now if the same body of candidates be further examined by some physical test (and Dr. Venn regards lung-capacity and breathing power the best single physical test), it will be found that in this respect there will be a curve with well-marked head, a mediocre body, and a rapidly descending tail. But the intellectual head and tail will not include the same candidates as the physical head and tail. Let us therefore select from our intellectual mediocrities those who fall within the head of the

physical examination curve. If we must admit intellectual mediocrity, let us, at any rate, secure that we have, in compensation, physical excellence.

In practice this would necessitate the preliminary testing, when they are undergoing their medical inspection, of all candidates by means of the spirometer; neither a difficult nor a lengthy operation. No doubt, as Dr. Venn points out, breathing power may to some extent be improved by practice, and candidates would all flock to a "spirometer-crammer." But probably all of them would be the better for some physical cramming in this way. C. LLOYD MORGAN.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. W. Watson Cheyne, F.R.S., has been appointed an additional Examiner in Surgery for the present term.

An inter-collegiate Examination in Mechanical Science and Engineering, for candidates for the Mechanical Sciences Tripos, will be held, under the direction of Prof. Ewing, at the end of this term, commencing on June 4.

THE Somerset County Education Committee have adopted a resolution in favour of establishing in the county a fixed Dairy Farm School for adults of both sexes. Instruction in cheese and butter making, and in subjects allied thereto, would be given. Provision is made for granting thirty scholarships, giving free board and tuition at the school for two months, to farmers' sons and daughters engaged in dairy work. The Committee have agreed that it is desirable to set up an agricultural side to one or more of the existing secondary schools in the county. It is hoped that in due course an agricultural college for the West of England will be provided by the combined efforts of the local counties.

WITH the view of acquainting teachers with a course of experiments in accordance with the British Association Committee's programme for the teaching of Chemistry in schools, the Evening Schools Code, and the syllabus for Major Scholarship examinations recently prepared by a committee of the Incorporated Association of Head Masters, Prof. Armstrong, F.R.S., will give a series of demonstrations at the City and Guilds Central Technical College, on Saturday mornings, in May. The special object of the course will be to explain the exact method to be followed in carrying out a carefully arranged series of very simple qualitative and quantitative experiments calculated to impress the chief and most generally useful facts of chemistry on children's minds whilst developing their powers of observing and reasoning.

IT has often been urged against the educated natives of India, that they are admirable at adaptation, but are altogether at a discount where original research is concerned. The Hon. Mr. A. Cadell commented upon this failing in a recent address to Convocation of Allahabad University. His advice was that debating societies, which are so common a feature of student-life, should give place to natural history societies; the object would be to foster the true scientific spirit in the native mind. In this connection, some remarks (which we quote from the Allahabad *Morning Post*), made by Prof. Ingram, of the Madras Educational Service, indicates that the complaint as to the want of scientific research by natives of India is not without foundation. In a recent contribution he says:—"Now, if India is not helping in this work, if she is supplying no additional information, and is offering no aid towards the consummation of this unity, her claim to be regarded as in any sense a scientific country, is null and void. No matter how assiduously her students may devote themselves to studying the science course of their University curriculum; if it all end there, it is nothing. But need it end there? What country could offer greater facilities for scientific research than India? Here is a country teeming with animal and plant life; but the systematic biology of India is still in a nebulous condition. Why are no students devoting themselves to collecting and collating, and studying the plaints of their districts, or the insects that abound within their walls? It would be hard, too, to find a country better suited than India, with her clear atmosphere and cloudless skies, for the study of the stars or of other atmospheric phenomena. In these ways, and in a thousand others, we might be advancing the cause of knowledge. But we can scarcely be said to have begun yet." By way of remedy, Prof. Ingram suggests the formation of an Indian Royal Society, or some such association as would serve the same purposes here as the British Association does at home. It is possible, however, without going to that length, to utilise the resources already at hand. India is not without its scientific societies. There are the Asiatic Society of Bengal, the Indian Science Association, and the Bombay Natural History Society, all of which are amply sufficient for the purposes of scientific research.

SCIENTIFIC SERIALS.

American Journal of Science, April.—Niagara and the Great Lakes, by F. B. Taylor. By a correlation of the abandoned shore lines, moraines, and outlets, and the gorges, recently-submerged shores, and rivers of this region, the author is led to the view that the lakes were at first glacial and ice-dammed, falling by stages as the outlets changed on withdrawal of the glacier-dams. By the withdrawal of the glacier the Niagara river was opened, and the upper lakes became united. The land was gradually depressed at the north, and finally led to the opening of Nipissing outlet, which was then brought down to the sea-level, and marine waters filled the three upper lakes, the Ontario, St. Lawrence, and Winnipeg basins. The subsequent raising of the Nipissing outlet made the upper lakes fresh again. Then followed the stage of the second Lake Algonquin and that of the second (present) Niagara lakes. Lake Superior became independent. The Great Champlain uplift took place at the north-east, and the formation of the St. Clair delta began, and continues to the present day.—Disturbances in the direction of the plumb-line in the Hawaiian Islands, by E. D. Preston. There appears to be a disturbance of more than a minute in the direction of gravity at the south point of Hawaii. At Kohala the plumb-line is deflected half a minute towards the south, and at Kalaieha nearly as much towards the north, the disturbance being in both cases towards the mountain. The deflection at the south point is also northward, and is caused by the great masses of Mauna Loa and Mauna Kea.—Structure and appendages of *Trinucleus*, by Charles F. Beecher. The three posterior thoracic endopodites are very similar, and in a general way closely resemble those of *Triarthrus* from the same region of the thorax. They are, however, comparatively shorter and stouter, and could not be extended beyond the ends of the pleura. The two distal joints are cylindrical, with well-marked articular surfaces and ridges. The joints preceding these proximally become much wider, flattened, and produced into transverse extensions which carry large tufts of setæ at the end. The exopodites seem to be composed of slender joints, the distal exites being long and slightly curved outwards. They carry very long, close-set, overlapping lamellose fringes, which evidently had a branchial function. The characters of the appendages indicate an animal of burrowing habit, which probably lived in the soft mud of the sea-bottom, much after the fashion of the modern *Limulus*. In addition to its limuloid form, the absence of eyes seems to favour this assumption. So does the fact that many specimens have been found preserving the cast of the alimentary canal, showing that the animal gorged itself with mud, like many other sea-bottom animals.

Wiedemann's Annalen der Physik und Chemie, No. 3.—Electric conduction and convection in feebly conducting dilute solutions, by E. Warburg. The alteration of conductivity produced by a current in bodies like aniline, the phenomena of convection exhibited by them, and their apparent deviations from Ohm's law, can all be explained on the supposition that their conductivity depends upon an electrolyte of which the body is a very dilute solution. Bodies were investigated whose conductivities went down to 5×10^{-15}. The similar behaviour of still worse conductors, like xylol, benzol, oil of turpentine, is probably due to the same cause.—Ratio of sectional contraction to longitudinal dilatation of iron rods during magnetisation, by A. Bock. By magnetisation the constants of elasticity of soft iron are altered to an extent not exceeding 0·5 per cent. The observations indicate that flexure diminishes, torsion also decreases, and the ratio of sectional contraction to longitudinal expansion increases. Iron becomes more incompressible in the magnetic field (see p. 614).—Freezing points of some binary mixtures of heteromorphous substances, by Albert Dahms. Eutectic mixtures

give no uniform crystallisation product, but always a heterogeneous mechanical mixture, consisting of solid solutions of the components in each other, and in the limiting cases of the components themselves. The composition of eutectic mixtures—*i.e.* those mixtures of two bodies which have the lowest fusing points—does not correspond to simple molecular proportions of the components. In eutectic mixtures the process of solidification is in general more complicated than in chemically homogeneous bodies, owing to complex supercooling. Equimolecular solutions often show approximate correspondence of fusing points, also for the higher concentrations. Menthol, $C_{10}H_{19}OH$, exists in two modifications, which explains the divergences of the freezing points of even the most dilute solutions in menthol.—On glow discharge in air, by C. A. Mebius. Straight lines representing the relation between strength of current and difference of potential for different distances between the electrodes, are not parallel, the divergence increasing with the extent to which the air has been modified by the current. The fall of potential gradually decreases with a constant or an increasing current. These changes are probably due to the formation of nitric oxide, as was proved with the spectroscope.

Bulletin de l'Académie Royale de Belgique, No. 2.—On a new class of ethers: methylene lactate, by Louis Henry. Methylene monolactate, $CH_2.CH_3\,C_3HO_3$, obtained by heating lactic acid with polymerised methanal, is a colourless mobile liquid, with a strong odour resembling methanal, and an extremely pungent taste. Its density is 1·1974 at 2·5° C., and it boils with remarkable regularity at 153° to 154°.—Comparison of the astronomical coordinates referred to the instantaneous (astronomical) pole and the (geographical) pole of inertia respectively, by Ch. Lagrange. The discovery of the sensible character of the variations of latitude and longitude is not of such a nature as to render necessary the substitution of geographical axes to instantaneous ones in astronomy. The mean values of the latitude and the longitude will be the geographical characteristics of the spot. But for the points of the heavens, the result of the substitution of geographical for instantaneous axes would have the eminent disadvantage of affecting all their coordinates with diurnal variations 300 times greater. This is a simple geometrical consequence of the fact that every day the geographical and the instantaneous axes describe a cone about the resultant, and that the geographical cone is 300 times more open than the instantaneous cone.—Critical temperatures of mixtures and of water, by F. V. Dwelshauvers-Dery. The critical temperature of water was obtained by finding the critical temperatures of aqueous mixtures of alcohol or acetone containing more and more water. The limiting value for water, as derived from the acetone results, was 638° C., from the results with alcohol, 641° C.—Action of heat upon carbon bisulphide, by Henryk Arctowsky. Carbon sesquisulphide, CS_3, which is obtained by exposing the bisulphide to the voltaic arc, may also be obtained by keeping it at 250° C. for some time. It is this body whose presence in small quantities in commercial CS_2 gives this product its pungent odour.

THE number of the *Journal of Botany* for April is occupied almost entirely by papers on descriptive botany, viz. on African species of *Eriosema*, on South American species of *Polygala*, on British *Rubi*, on hybrid *Epilobia*, and others on special species or genera.

The Bulletin of the Minnesota Botanical Studies for March contains a paper on a period of growth in the fruit of *Cucurbita Pepo*, by Mr. A. P. Anderson, accompanied by an elaborate series of tables and plates of curves. The other articles in the same number refer exclusively to the Flora of Minnesota.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 21.—"Experiments upon the Influence of Sensory Nerves upon Movement and Nutrition of the Limbs." (Preliminary communication.) By Dr. F. W. Mott and Dr. C. S. Sherrington, F.R.S.

Claude Bernard first showed, by experiments upon frogs, the impairment of movement in a limb deprived of sensation by cutting the posterior spinal roots. The authors have, by an extensive and varied series of experiments on the monkey, demonstrated the important *rôle* played by sensation in the performance of voluntary movements.

The experiments deal separately with the upper limb and the lower limb. The phenomena do not essentially differ, but are more striking in the former.

Summary of Experiments.—The limbs were deprived of all sensation, superficial and deep, by cutting the "whole series" of posterior spinal roots. For the upper limb, 4th cervical to 4th thoracic inclusive. For the lower limb, 2nd to 10th post-thoracic inclusive.

Animals with a limb thus *deprived of all forms of sensation* from the time of operation onwards, even up to four months, have never been observed to use it in any finer and delicately adjusted movements. For example: the foot is not used in climbing or grasping, nor is the hand. The animal does not use the hand to defend itself, or even to satisfy hunger, when prevented from picking up food by any other way, than by using the desensitised hand. It must be concluded, therefore, that there is *actual inability* to perform the movements in question. Occasionally in struggling, coarse movements of the shoulder and elbow take place; but, as a rule, the arm hangs down helplessly. The movements abolished are those most literally represented in the cortex cerebri. Damage to the pyramidal tract is not the cause of the loss of movement, because degeneration is not found in the spinal cords; moreover, stimulation of the cortex cerebri evokes movements in the desensitised limb even more readily than the normal.

The effect of section of the "whole series," except the *one root* which supplies the *apex* of the limb, produces only a very slight impairment of movement. Any trophic changes that occur are due to pressure and microbic infection.

"Is Argon contained in Vegetable or Animal Substances?" By George W. MacDonald and Alex. M. Kellas.

At Prof. Ramsay's suggestion, experiments were undertaken by the authors to see whether argon could be obtained from nitrogenous vegetables or from animal tissues.

It is concluded that there is no appreciable quantity of argon in peas (or at least that the argon cannot be obtained with the nitrogen by Dumas' method).

An experiment with regard to the presence of argon in animal tissues was also negative in its results. Mice were selected for the experiment, because the nitrogen from the whole animal could be conveniently collected by Dumas' method.

Chemical Society, March 21.—Dr. Armstrong, President, in the chair.—The following papers were read:—The volumetric determination of sugars by an ammoniacal cupric solution, by Z. Peške. The author has devised a modification of Pavy's method of estimating sugars, and gives tables showing the reducing power of ammoniacal cupric solution for solutions of various sugars.—The action of hydrogen sulphide on antimonic acid solutions, by O. Bošek. The author demonstrates the existence of compounds of the composition SbX_4; he has obtained the tetrasulphide Sb_2S_4, and a double compound of the composition $3KCl, 2SbCl_4$.—Action of hydrogen sulphide on antimonic, arsenic and telluric acids, by B. Brauner.—The atomic weight of tellurium, by B. Brauner. From its position in the periodic table, tellurium should have an atomic weight between 123 and 125, whilst the number actually obtained is 127·71; for this and other reasons the author concludes that tellurium is not a simple substance, although attempts to effect a separation of its constituents have failed. The author suggests that tellurium is a mixture or compound of two elements, one of which occupies the position of tellurium in the periodic table, and the other of which is the hypothetical "triargon."—The hydrolysis of maltose by yeast, by G. H. Morris.—Studies in isomeric change. Part iv. Ethylbenzenesulphonic acids, by G. T. Moody. The sulphonation product of ethylbenzene yields only one sulphonic acid, and not two, as stated by Chrustschow. The para-acid is obtained thus: the ortho-acid can be prepared by sulphonating and subsequently reducing ethylbromobenzene. — β-Ethoxynaphthalenesulphonic acids. The arrest of isomeric change at an intermediate stage, by A. Lapworth. During the sulphonation of ethoxynaphthalene at a low temperature the 2 : 1-sulphonic acid is the first product. On allowing the mixture to stand, however, this spontaneously changes into the 2 : 1′-acid.—Some oxypyridine derivatives, by Miss A. P. Sedgwick and N. Collie. Starting from γ-chloro-αα′-dimethylpyridine and αγ-dichloro-α′-methylpyridine, the

authors have succeeded in preparing a number of new oxypyridine derivatives.—On the colouring principle of *Toddalia aculeata* and *Evodia meliæfolia*, by A. G. Perkin and J. J. Hummel.—Some ethereal derivatives of sarcolactic acid, by P. Frankland and J. Henderson. The molecular rotations, molecular deviations and asymmetry products of a number of alkylic salts of sarcolactic acid and its acidic derivatives have been investigated.—Electrolysis of potassium allo-ethylic camphorate, by J. Walker and J. Henderson. The chief products of the electrolysis of potassium allo-ethylic camphorate are salts of allo-campholytic acid, $C_9H_{14}O_2$, and allo-camphothetic acid, $C_{18}H_{30}O_4$.—Trimethylsuccinic acid, by W. A. Bone and W. H. Perkin, jun.—New isomeric sulphonic chlorides derived from camphor, by F. S. Kipping and W. J. Pope. The authors describe two isomeric chlorocamphene-sulphonic chlorides and their derivatives.

Royal Meteorological Society, April 17.—Messrs. F. C. Bayard and W. Marriott communicated a paper on the frost of January and February 1895 over the British Isles. The cold period which commenced on December 30 and terminated on March 5 was broken by a week's mild weather from January 14 to 21, otherwise there would have been continuous frost for sixty-six days. Temperatures below 10° F., and in some cases below zero, were recorded in parts of England and Scotland between January 8 and 13, while from the 26th to the 31st and from February 5 to 20, temperatures below 10° occurred on every day in some part of the British Isles. The coldest days were February 8 to 10. The lowest temperatures recorded were: −17° at Braemar and −11° at Buxton and Drumlanrig. The mean temperature of the British Isles for January was about 7°, and for February from 11° to 14° below the average, while the mean temperature for the period from January 26 to February 19 was from 14° to 20° below the average. The distribution of atmospheric pressure was almost entirely the reverse of the normal, the barometer being highest in the north and lowest in the south, the result being a continuance of strong northerly and easterly winds. The effect of the cold on the public health was very great, especially on young children and old people. The number of deaths in London due to diseases of the respiratory organs rapidly increased from February 2 to March 2, when the weekly number was 1448, or 945 above the average. Rivers and lakes were frozen, the ice being more than 10 inches thick. The frost will long be remembered for its effect on the water-pipes all over the country, in many cases householders being without water for more than nine weeks. As the result of inquiries the authors find that mains have frozen which have been laid as low as 3 ft. 6 in. from the surface of the ground to the top of the pipe. It appears, however, that the nature of the soil had far more to do with the depth to which the frost penetrated than the intensity of the frost itself. From a comparison of previous records, the authors are of opinion that the recent frost was more severe than any since 1814.—Mr. Birt Acres read a paper on some hints on photographing clouds.

Mineralogical Society, April 2.—A paper was read by Mr. Spencer upon *enargite*. Several new forms were discovered upon the specimens of this mineral examined. The parameters calculated from the measurements were

$$a : b : c = 0{\cdot}8694 : 1 : 0{\cdot}8308,$$

numbers which differ somewhat from those previously given by Dauber. The habits of the crystals and their mode of twinning were fully discussed, and the fact pointed out, bearing upon the possibility of the identity of clarite with enargite, that measurement of cleavage fragments of clarite gave angles identical with those existing between the prism cleavages of enargite when three crystals are twinned together.—Mr. A. E. Tutton exhibited his new instrument for cutting, grinding, and polishing accurately orientated section-plates and prisms of mineral or other crystals, and demonstrated the readiness with which the cutting disc or grinding or polishing lap may be driven by a small electric motor. Mr. H. A. Miers suggested the possibility of simplifying the instrument somewhat for the commoner purposes of the mineralogist, by employing only one driving gear and making the cutting disc and laps interchangeable; he also suggested the experiment of using carborundum for the cutting edge instead of diamond dust.—Mr. Miers exhibited a crystal of *lorandite*, the new arseno-sulphide of thallium discovered by Kreuner; also a fine crystal of *cléveite*, the mineral which had, at his suggestion, been examined for argon by Prof. Ramsay. The specimen exhibited was from the neighbourhood of Moss, and this variety, as well as that from Arendal, had been found to yield the spectrum of helium.

EDINBURGH.

Royal Society, January 21.—Prof. Sir W. Turner, Vice-President, in the chair.—Drs. Gulland and Noël Paton communicated a paper on the absorption of carbohydrates from the intestine.—Prof. Ewart read a paper, by Dr. J. D. F. Gilchrist, on the torsion of the molluscan body.—Prof. Tait communicated a note on a curious property of determinants.

February 4.—Prof. J. G. M'Kendrick, Vice-President, in the chair.—Prof. Crum Brown communicated a note on normal nystagmus.—Sir W. Turner read a note on M. Dubois' account of pithecanthropoid remains recently found in Java. The remains are a skull, a third molar tooth, and a left femur. They were found in a bank of a river in Java, at some distance from each other, and at different times. M. Dubois supposed that he had established the existence of a connecting link between the ape and man, and he named it the "erect ape man," in recognition of the differences from man and the ape. Sir W. Turner remarked that it was not at all certain that the three bones belonged to the same creature. A comparison of the skull with several specimens of the skulls of aboriginals, left him unconvinced that it might not have belonged to a human being. The features of the femur could all be made out in a large collection of human thigh bones, and the tooth had quite as much resemblance to the tooth of a human being as to the tooth of an ape. He considered that the remains were of a low human type.

February 18.—The Hon. Lord M'Laren, Vice-President, in the chair.—Prof. Chrystal discussed a theorem regarding the equivalence of systems of ordinary linear differential equations with constant coefficients, and its application to the theory of such systems.—Dr. C. G. Knott communicated a note on volume-changes in iron and nickel tubes when magnetised. He dealt specially with the effects which are caused when the tubes are closed by a non-magnetic cap instead of a cap of the same metal as the tubes themselves.—Dr. W. Peddie compared the case of yellow-blue blindness, described by him some weeks ago, with the case recently described by v. Vintschgan and Hering. In the present case, unlike the latter, the whole range of the spectrum is visible. So far as the tests have yet been carried out, the presence of red seems to be very easily recognised, but all other colours seem to be nearly, or entirely, grey. Only one neutral point (near D, in the yellow part of the spectrum) seems to exist.

March 4.—Sir Douglas Maclagan, President, in the chair.—At the request of the Council of the Society, Dr. Munro gave an address on lake-dwelling research. Whatever was the object of these dwellings, or the causes of their development, it is certain that they were for centuries the characteristic dwellings of the early tribes of Central Europe. Research on the subject began with the discovery of remains in a bog in Ireland, more than half a century ago. Another discovery was afterwards made in Switzerland, and gave new significance to the Irish discovery. Dr. Munro sketched the results of the investigations made in Switzerland and in other parts of Europe, especially Italy. Perhaps no part of Europe is more prolific in remains than the valley of the Po. The first great discovery made in Scotland was in a loch in Wigtownshire. When the loch was drained, several artificial islands were found, and evidences of early Scottish civilisation, previously unknown, were discovered. Among the articles found were canoes and Roman bronze dishes. Subsequent Scottish discoveries were described, and then the recent discoveries in Bosnia were dealt with. The coincidence of the style of art in the ornaments recently found at Glastonbury with that of the North German articles is peculiarly significant.

Scottish Meteorological Society, March 27.—Prof. Copeland, Astronomer Royal for Scotland, in the chair.—Mr. R. C. Mossman gave a paper on "The Frost of 1895," in which he pointed out that the severe frost began on December 28, and ended about February 20, covering a period of fifty-four days. During this time the average temperature of the British Isles as a whole was 8° below normal, the greatest deficiency being in the central highlands of Scotland and the midland districts of England. At the same time barometric pressure was highest in Scandanavia, Lapland, and West of Russia, and lowest about Spain; an almost exact reversal of the normal

winter distribution. Thus cold, dry, and therefore heavy, air was drawn from the north-east over the British Isles, not only lowering the air temperature directly, but clearing the sky of the usual winter cloud layer, and thus allowing free radiation at night, with consequent low night temperatures in valleys where the chilled air can accumulate and lie stagnant. Places thus situated recorded temperatures below zero Fahrenheit, the lowest being − 17° at Braemar, and − 11° at Drumlanrig. At western sea-coast places the frost seldom lasted for more than twenty-four hours without a break; while at inland stations, such as Kingussie and Braemar, the temperature never rose to the freezing point for fifteen consecutive days in February. No very low temperatures were recorded on Ben Nevis, the lowest being 2° above zero. On February 18, 19, and 20 the temperature on Ben Nevis averaged 18° higher than that at Fort William, 4400 feet below it, showing that the summit was in the down draught of the anticyclone then lying over Scotland; while at sea level the warmth and dryness of this upper current was not felt. The cold extended all over Europe, including the South of Spain and the Riviera, but scarcely touched North Africa. Though snow fell in Tunis, Algeria was beyond the cold area, the winds there being mostly westerly. To the north Iceland was the only part of Europe outside the influence of the north-east winds, and the winter there has been mild and open.—Mr. A. G. Herbertson presented an interim report on hygrometric work at Ben Nevis. He also gave an account of the Meteorological Observatory at Montpellier, France, describing many of the instruments employed there, and also pointing out the excellent results got from regular phenological observations.—Mr. Mossman gave some notes on "Auroras in the North-east of Scotland 1773 to 1894," mainly taken from data at Gordon Castle (Banffshire) and Inverness. The average number of auroras in this district for the 122 years is seven per annum, but the numbers vary from fifty cases in 1870 to none at all in sixteen years of the record. An intimate connection was shown between sun-spots and auroras; maximum sun-spot periods being the time when auroras were frequent and brilliant, while with the absence of sun-spots there were few or none. No aurora was observed in any year between May 23 and July 22, that is, within four or five weeks of the summer solstice; and the rest of the year shows two maxima, a primary in October and a secondary in February.

DUBLIN.

Royal Dublin Society, January 23.—Prof. J. Mallet Purser in the chair.—Mr. G. H. Carpenter read a paper on a collection of Lepidoptera from Lokoja, West Africa.—Prof. A. C. Haddon and Mr. J. E. Duerden described some species of Actiniaria from Australia and other countries. Ten species, most of them new to science, were described anatomically, and their relationship to other members of the group discussed.—Prof. Haddon then gave a paper on a branched worm-tube.—Mr. Duerden followed with some notes on the Hydroida and Polyzoa collected during the Royal Dublin Society's Fishery Survey on the West Coast of Ireland. In this paper the author describes two new species of *Perigonimus*, and records the occurrence of *Campanulina panicula*, G. O. Sars, for the first time for the British seas.—A voluminous monograph of the marine and freshwater Ostracoda of the North Atlantic and of North-Western Europe (Sections ii.–iv.: Myodocopa, Cladocopa, and Platycopa) was presented (through Prof. A. C. Haddon) by Dr. G. S. Brady and the Rev. A. M. Norman.—At the meeting held February 20, Prof. Grenville A. J. Cole in the chair, the following papers were read:—Dr. V. Ball, C.B., F.R.S., made a communication in which he gave an historical account of the gold nuggets found in the county Wicklow.—Prof. W. J. Sollas, F.R.S., read a paper descriptive of the systems of Eskers in Ireland. Some beautiful photographs of nebulæ and clusters of stars, taken at Daramona, co. Westmeath, were afterwards exhibited by Mr. W. E. Wilson.—At the meeting of March 20, Prof. G. F. Fitzgerald, F.R.S., in the chair, Prof. Sollas read a paper upon the age of the earth.—Prof. James Lyon demonstrated some of the errors that arise from the imperfect alignment of the slide lathe. If the line joining the centres of a slide lathe is not parallel to the line of motion of the saddle, the path of a cutter fixed in a bar which is rotated between the centres is a plane which is not perpendicular to the direction of motion. Any piece of material being bolted to saddle, and having a hole bored in it by the cutter, would be traversed by a hole the shape of which would be the projection of the cutting circle on a plane perpendicular to the line of motion of saddle—*i.e.* an elliptic cylinder would be the result. In the second case, if the poppet-head centre be higher than the fixed centre, and a bar of material be turned between the centres by means of a tool placed in the saddle at a height above the bed about equal to the height of the centre point of the axis of bar above the bed, the result will be a hyperboloid of revolution, since this surface is generated by a straight line (the path of the tool), which is always at a fixed distance from a given axis, is not parallel to it, and does not intersect it.

PARIS.

Academy of Sciences, April 16.—M. Marey in the chair.—Observations on argon, its fluorescence spectrum, by M. Berthelot. The fluorescence of argon, when charged with benzene vapour and submitted to the action of the silent discharge, is described at length. It is noted that, with the second sample of gas supplied by Prof. Ramsay, and under the conditions of the experiment, the condensation taking place amounted to only 6 to 10 per cent. The author cannot yet explain the different behaviour of the first sample as regards condensation. The following approximate measurements have been made in the spectrum of the fluorescent light: A yellow line at λ 579 corresponding to the 575 argon line and 578 of the aurora borealis; a green line at λ 547 corresponding with Crookes' group 549 to 555, and perhaps with 557 of the aurora; violet lines 438 and 436 corresponding with Crookes' 433 and 430, and with an important aurora line.—A contribution to the study of variability and capacity of transformation in microbiology, as illustrated by a new variety of anthrax bacillus (*Bacillus anthracis claviformis*), by M. A. Chauveau and M. C. Phisalix. The cultivation obtained from the lymphatic ganglion of a guinea-pig inoculated with attenuated anthrax bacilli consisted of a new type which retained only in a very slight degree the immunising power of the attenuated culture, and no longer had any toxic action beyond that evidenced by a certain rise in temperature of the inoculated subject. The authors believe the *Bacillus anthracis claviformis* to have been certainly derived from virulent *Bacillus anthracis*, but they have not as yet succeeded in bringing back the new variety to the original virulent form.—On the minimum temperatures observed this winter at the summit of Mont Blanc, by M. J. Janssen. A description is given of the mounting of the minimum thermometers. The following minima have been recorded: Mont Brévent − 26° C.; Mont Buet − 33° C.; Mont Blanc − 43° C.—Secular variation and ephemerides of terrestrial magnetism, by General Alexis de Tillo.—Researches on assimilable nitrogen and its transformations in arable land, by M. Pagnoul. The conclusions are drawn that: (1) Abundant rains may carry off from rich soils considerable amounts of nitric nitrogen. (2) Plants growing on the soil are able to prevent this loss. (3) Carbon disulphide arrests the action of the nitric ferment temporarily without killing it. (4) The ammoniacal form is a transition state for organic nitrogen passing into the nitric form; carbon disulphide causes the temporary suspension of the action at this stage. (5) The nitrous form is also an unstable transition state.—On the products of combustion in the electric arc, by M. N. Gréhant. Carbon monoxide is produced and, in confined spaces, has produced illness among the workmen employed in electric light stations.—On a question concerning the singular points of algebraical left-handed curves, by M. G. B. Guccia.—Summation of series by means of definite integrals, by M. Petrovitch. On types of groups of substitutions of which the order equals the degree, by M. R. Levavasseur.—On the theory of the system of differential equations, by M. A. J. Stodolkievitz.—On Rondelet's rule for woods, and beams loaded on end, by M. C. Maltézos. Rondelet's rule is reduced for wood to a parabolic formula. The curve of limit loads for wood, iron, and brass, between wide limits for the ratio of length of beam to smallest side of transverse section, may be replaced by an arc of a single parabola.—Electric discharge by illumination of substances which are mediocre conductors, by M. Edouard Branly.—On a new method for the measurement of temperatures, by M. Daniel Berthelot. The author proposes the determination of density of gases, by means of their refractive indices as investigated by interference fringes, as a basis for measurement of temperature by a property of gases independent of the envelope.—On the presence of helium in

clèveite, by M. P. F. Clève. A letter in which the author gives the wave-lengths of lines observed in the spectrum of gas obtained from clèveite by heating with potassium bisulphate. The argon lines were not observed.—On the definite combinations of metallic alloys, by M. H. Le Chatelier.—On the aliphatic aldehydes $C_nH_{2n}O$, by M. Louis Henry.—Action of halogens on pyrocatechol, by M. H. Cousin.—On the drying property of fatty matters in general and their transformation into elastic products analogous to linoxine, by M. Ach. Livache.—On the composition of some French and foreign oils of the 1894 crop, by M. Bolland.—On the existence of abnormal variations of pressure with the height, a vertical gradient, by M. L. Teisserenc de Bort.

BERLIN.

Physiological Society, March 1.—Prof. du Bois Reymond, President, in the chair.—Dr. Weintraud spoke on the formation of uric acid in man. After the view that the excretion of uric acid is in direct relationship to the proteids of the food had found no support from the experimental side, the theory had been propounded that it is related to the breaking-down of leucocytes. This view was supported by experiments in which the administration of nuclein and xanthin to man had increased the output of uric acid; but, on the other hand, similar experiments on dogs had always yielded negative results. The speaker had experimented on several individuals by substituting thymus gland, rich in nuclein, for the ordinary flesh of the food. The increased excretion of phosphoric acid in the urine showed that the nuclein was largely resorbed, and a constantly large increase in the execretion of uric acid was at the same time observed; the latter disappeared again at once when ordinary flesh was substituted for the thymus gland. Apart from theoretical considerations, it appears that foods rich in nuclein or xanthin should be avoided by patients suffering from excessive formation of uric acid.—The President and Dr. Sklarek made some communications as to argon, recently discovered by Lord Rayleigh and Prof. Ramsay.

March 15.—Prof. H. Munk, President, in the chair.—Prof. Liebreich stated that he had found in propyl alcohol a means of separating the cholesterin fats of the skin into those with a high and those with a low melting point. The former exhibit all the characteristics of a wax, and are distinguished by their fixed melting point and by their containing cerotic acid. By extracting human nails and vernix caseosa he had obtained a quantity of cholesterin fats which resembled in all points the cholesterin ethers of the skin. He further demonstrated a new chemical reaction which shows the existence of the inert region on the surface of fluids and in capillary tubes in which chemical changes are taking place. It consists in the interaction of chloral hydrate with sodium carbonate and gold chloride, and since all these reagents are solid it is evident that evaporation has no effect on the production of this inert space.—Dr. E. Flatau exhibited two series of nerve preparations, the first consisting of isolated ganglion cells and neurons prepared, by a modification of Golgi's method, partly from the cerebrum and partly from the cerebellum and medulla. The second series, prepared by Marchi's method, was intended to show that in the Wallerian experiment on degeneration, not only does the peripheral stump degenerate after the section, but that the central end also undergoes a secondary degeneration after the break-up of the now inactive ganglion.

Meteorological Society, March 5.—Prof. Hellmann, President, in the chair.—After the President had presented the fourth number of the *Reprints* containing the oldest charts of terrestrial magnetism, Dr. Süring gave an account of his observations on the temperature and humidity near a surface of snow. They were made last winter on the Brocken, and this winter in Potsdam, and in the following manner. One thermometer was placed on the snow, and another at the usual height above the surface, either exposed or protected, while at the same time an aspiration-thermometer placed 1 cm. above the snow recorded the temperature of the air. It was found that the size, shape and position of the thermometer lying on the snow, as well as the condition of the snow-surface, &c., had a considerable influence on the temperature recorded by this instrument; the observations had therefore been restricted to a determination of the difference between the temperature of the snow and that of the air above it, in its relations to clouds and to the motion and temperature of the atmosphere. It was found that the difference was lessened as the sky became more clouded, and when the sky was completely clouded during a fall of snow the temperature of the snow's surface was higher than that of the air. As the temperature of the atmosphere fell, the difference became greater, but was lessened as the motion of the air increased in rapidity. On the whole, the difference was much less on the Brocken than in Potsdam. As to the influence of the snow-surface on the humidity of the air, the speaker had arrived at the result that evaporation from the snow is much more frequent than condensation from the air, but that they are about equal in amount. Prof. Hellmann spoke on the, as yet, uninvestigated velocity of the wind in Berlin, basing his remarks on the indications during ten years of a self-registering anemometer placed at a height of 33·5 metres above the ground in the tower of a house which was originally quite isolated. In later years this house was surrounded by others, but this fact did not in any way affect the working of the anemometer, whose constants were determined at the marine observatory at Hamburg and the central observatory at St. Petersburg. Taking a year as a whole, the maximum rate was observed in March, the minimum in September, and during these months the variations were least. The average for the year is 5·1 metres per second. The above-named periods of maximum and minimum have also been observed at a number of other stations, viz. Paris, Munich, Prague, Vienna, and Cracow. Winds with a velocity less than the average are more frequent than those with one above the average. The frequency of storms, as measured in hours, is greatest in January and March; it increases in October, and sinks rapidly in April. The daily period of greatest velocity lies between one and two o'clock p.m.

Physical Society, March 8.—Prof. du Bois Reymond, President, in the chair.—After Prof. Lampe had referred to the death of their late member, Prof. Worpitzky, Dr. W. Wien spoke on the testing of pyrometers made, according to Le Chatelier, of platinum and platino-rhodium, and connected with an apparatus constructed by Keiser and Schmidt for measuring not only the voltage of the thermo-electric currents, but also the corresponding temperatures. The testing was carried out by determining the melting-points of copper, silver, platinum, palladium, and nickel, which, as fine wires, formed the solder-joints of the platinum and platino-rhodium thermo-elements. These were heated in porcelain tubes, and the current was broken when the respective wires melted. In these experiments platinum must be protected from carbon, copper from oxygen, and palladium from hydrogen. It is impossible here to enter into all the details referred to by the speaker.—Dr. W. von Uljanin gave an account of his experiments on polarisation by oblique radiation from silver, platinum, and black glass. Assuming that the radiation from the heated plates is determined by the refraction of their substance, it was found that the curves thus arrived at corresponded in the case of silver very closely with those obtained experimentally. In the case of platinum, whose surface is very easily altered by heating, the experimental values were always less than those required by theory; in the case of black glass the correspondence of the values was greater, but not so complete as in the case of silver.—Dr. Raps introduced an improvement in his automatic air-pump, designed to facilitate the filling and emptying of the mercury, and at the same time to protect the pump from the consequent risk of breakage. The result was arrived at by means of a chamber for the expansion of air.—Prof. Vogel demonstrated the experiment, already described in NATURE, whereby a half black and half white disc with black patches on it produces different colours, when rotated at a moderate speed, according to the direction of the rotation.

March 22.—Prof. Planck, President, in the chair.—Dr. Rubens exhibited several galvanometers, and explained in detail the arrangement and advantages of one he had constructed for the measurement of reversing currents, but which can also be readily adapted for currents in one direction.—Dr. Raps spoke on a new regulator for synchronous motion, especially as required in telegraphy, explaining its principle and construction on a model.

AMSTERDAM.

Royal Academy of Sciences, December 29, 1894.—Prof. van de Sande Bakhuyzen in the chair.—Mr. MacGillivray communicated the results of an investigation made by Mr. D. MacGillivray in the Boerhaave Laboratory at Leyden, and which proved that the germs of tuberculosis are not destitute of the power of locomotion, but possess this power, if the conditions of life are favourable.

February 23, 1895.—Prof. Hubrecht brought forward a new hypothesis to explain the origin of the amnion. Birds and reptiles have been looked upon as possessing the normal type of amniogenesis from which that of the Mammalia had to be further derived. The primitive Insectivores offer far better starting points. In the development of the hedgehog's amnion, another path is found along which it is easy to connect both the higher Mammalia and the Sauropsida. The hedgehog allows a comparison to be made between the trophoblast with the outer layer of the amphibian ectoderm. Thus it would be possible to trace the first origin of the amnion in the Anamnia.—A paper containing full particulars, and accompanied by several plates, was presented for publication in the Academy's *Verhandelingen*, under the title: "Ueber die Phylogenese des Amnions und die Bedeutung des Trophoblastes."—Mr. Suringar read a paper on "family relations in the vegetable kingdom," as set forth in a sketch in the form of a genealogical tree, designed by the author to illustrate his University lectures.—Mr. Franchimont presented, on behalf of Dr. P. van Romburgh, two papers. (*a*) On some nitro derivatives of dimethylaniline. By nitration of dimethylaniline in a great quantity of sulphuric acid, as well as by treating metanitrodimethylaniline with diluted nitric acid, two dinitro derivatives were obtained: a yellow one fusing at 176°, and a red one fusing at 112°. In the yellow one there is a nitro group that may easily be substituted. By further nitration it yields two trinitro derivatives: a yellow one melting at 154° and an orange-coloured one melting at 196°. The red dinitro derivative yields only the orange-coloured trinitro derivative. All of them are finally converted into the same tetranitrophenylmonomethylnitramine, viz.:

$$C_6H.(NO_2)_4\ (2, 3, 4, 6)\ (N.CH_3.NO_2)\ (1).$$

From their relations or properties the following structure is deduced:

Trinitro Dimethylaniline.

$$154° = C_6H_2N(CH_3)_2\ (1),\ (NO_2)_3\ (2, 3, 4).$$
$$196° = C_6H_2N(CH_3)_2\ (1),\ (NO_2)_3\ (3, 4, 6).$$

Dinitro Dimethylaniline.

$$176° = C_6H_3N(CH_3)_2\ (1),\ (NO_2)_2\ (3, 4).$$
$$112° = C_6H_3N(CH_3)_2\ (1),\ (NO_2)_2\ (3, 6).$$

(*b*) On addition products of symmetrical trinitrobenzol. Hepp has found that with aromatic amines S. trinitro-benzol yielded coloured addition products. With brucine, Dr. van Romburgh arrived at the same result: it formed brownish red needles fusing at 158°; strychnine did not do so under the same circumstances. With trinitro-benzol, indol yielded gold-coloured needles melting at 187°, skatol, orange-coloured ones melting at 183°, and pyrrol, gold-coloured ones melting at 95°; the last-mentioned gave off the pyrrol to the air in a few hours (at 25°). All these compounds consisted of one molecule to one molecule of trinitrobenzol. Pyridine and quinoline did not form such compounds; the former caused trinitrobenzol to crystallise in large crystals. Piperidine, nicotine and phenylhydrazine gave rise to red tints, but crystallised compounds could not be obtained. With other nitro compounds, too, as: $C_6H_3.NMe_2\ NH_2.NO_2$ (1 : 3 : 4), and $C_6H_3NMe_2.NHMe.NO_2$ (1 : 3 : 4), trinitrobenzol yielded crimson products, melting respectively at 130° and 144°, and being composed of a molecule of each of the constituents.

March 30.—Prof. Van de Sande Bakhuyzen in the chair.—Mr. Bakhuis Roozeboom has, in conjunction with Dr. Hoitsema, investigated the behaviour of hydrogen to palladium, from 0° to 190°, and from 0 to 6 atm. pressure. It results from the observations that, contrary to the opinion of Troost and Hautefeuille, there exists no such compound as Pd_2H, neither can the phenomena observed be explained by admitting the existence of two solid solutions. The absorption proceeds gradually, as if there exists but one solid solution. There is, however, at low temperatures a period in which the concentration rises much more rapidly with the pressure of hydrogen than before or afterwards. This behaviour presents an analogy to the conduct of gases near their critical temperature.

GÖTTINGEN.

Royal Society of Sciences.—In the *Nachrichten*, part 1, for 1895, appear the following contributions in the department of mathematics and physics:—

December 1894.—I. R. Schütz: Complete and general solution of a fundamental problem in the theory of the potential.—Robert Fricke: On the theory of ternary quadratic forms with integral complex coefficients.—J. Orth: On bacterial disorders of excretion in the renal medulla.

January 1895.—I. R. Schütz: Extension of Maxwell's law of the distribution of velocities, deduced from the principle of the minimum path.—E. Ehlers: On the viscera of *Lepidosiren*.—Ludwig Rhumbler: Sketch of a natural system of classification for the *Thalamophora*.—Hermann Wagner: The area of the land surfaces of the earth according to zones.—R. Dedekind: On the basis of the theory of ideals.—Heinrich Burkhardt: Contributions to researches on the foundations of geometry.—Franz Meyer: On the structure of the discriminants and resultants of binary forms.—Wilhelm Hallwachs: On an aperiodic amagnetic quadrant-electrometer, free from residual action.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Royal University of Ireland, Calendar 1895 (Dublin, Thom).—Société d'Encouragement pour l'Industrie Nationale, Annuaire 1895 (Paris).—Land-Birds and Game-Birds of New England; H. D. Minot (Boston, Houghton).—The Moon: T. G. Elger (Philip).—R. Bradshaw's Bathing Places and Climatic Health Resorts (K. Paul).—Soziale Evolution: B. Kidd, aus dem Englischen Übersekt von E. Pfleiderer (Jena, Fischer).—Motive Powers and their Practical Selection: R. Bolton (Longmans).

PAMPHLETS.—Indexes to the Literatures of Cerium and Lanthanum: Dr. W. H. Magee (Washington).—Reports of Observations and Experiments in the Practical Work of the Division of Entomology, U.S. Department of Agriculture (Washington).

SERIALS.—Journal of Anatomy and Physiology, April (Griffin)—Royal Natural History, Part 18 (Warne).—American Naturalist, April (Philadelphia).—Insect Life, Vol. vi. No. 5: Vol. vii Nos. 1-4 (Washington).—Ergebnisse der Meteorologischen Beobachtungen, Jahrg. xvi. (Hamburg).

CONTENTS