THURSDAY, JANUARY 9, 1908.

THE HISTORY OF AERONAUTICS.

Histoire de la Navigation aérienne. By W. de Fonvielle. Pp. 271. (Paris: Libraire Hachette et Cie., 1907.)

THE subject of aërial navigation is steadily developing into one of importance. Invention in this line is progressing so rapidly that the expert who wishes to be up to date must perforce be busy with much new literature. The work before us, by so well-known an aëronaut as M. de Fonvielle, will, then, be eagerly sought for. The student who expects to receive full information on all the recent developments may, however, feel some disappointment when he has looked through the book, since, out of its 270 pages, only some forty are devoted to the very important work which has been accomplished during the last ten years. The rest of the book is historical, throwing, no doubt, much new light on certain points, but, as a whole, containing nothing of importance that is not to be found in older works.

The first chapter deals with the soap bubbles of Tiberius Cavallo, a story well known to Englishmen who have read that savant's most interesting book, "The History and Practice of Aërostation," which was published in London so long ago as 1785. In June, 1782, Mr. Cavallo read a paper before the Royal Society in which he described how he had attempted to fill a light paper bag with hydrogen, in order to make it float in the air, but found it impossible to retain the "inflammable air," and how he then managed to blow out soap bubbles with hydrogen which rose in the air. In the following year both hot-air balloons and gas balloons were invented in France, and the accounts of them are described by M. de Fonvielle in following chapters. Elongated "dirigible" balloons, worked by hand, were designed very soon after the first ascents, but, of course, proved of little practical use.

The chapters on the first scientific ascents refer to those of Robertson, Gay-Lussac, Barral, and Green, but the better-known and more complete work of Glaisher and Coxwell is not more than touched upon in a following chapter.

The chapter on "Les Ballons-sondes" contains much that may be of interest to modern meteorologists, since this means of studying the atmosphere is now so much employed.

Three chapters are devoted to ascents during the siege of Paris, and one to aëronautical photography, but perhaps the most complete and interesting accounts in the book are those of the *Lebaudy* and other dirigible airships. It was in November, 1902, that the first free ascent was made with that vessel, which has now proved itself to be the first really practical aërial machine. Many more trials are described, including one on July 24, when 98 kilometres were covered; on November 12, when the airship travelled 60 kilometres to Paris; and on July 3, 1905, when a journey of 96 kilometres was performed in 3 hours 21 minutes.

The last chapter, on the development of aërial navigation, is somewhat disappointing, for after referring to the *Patrie* and the *Ville de Paris*, the two most recent practical airships in France, it recounts shortly what has been attempted in this line in other countries, but makes no reference to the important experiments recently made with the "heavier-than-air" type of machine.

As a history the work is not very satisfactory, since it jumps to and fro from period to period, and anecdotes are frequently narrated without specifying the dates.

The book is fully illustrated, but though they include some reproductions of photographs of recent events, by far the greater number of the illustrations are from woodcuts which have already done service in "Travels in the Air" (published in 1871) and other older works. We must take strong objection to some of these old blocks being reproduced with new titles, such, for instance, as that on p. 185, entitled "Les Concours de Vincennes en 1900," and that on p. 201, "Ballon couvert de neige . . . . ascension de l'Aéro Club," both of which appeared in the above-named book; and especially that on p. 139, "Descente de Lhoste en Angleterre," which appears in "Travels in the Air," p. 307, as "Descent of the *Neptune* at Cape Griznez." As this picture is a landscape with cliffs and a lighthouse, it cannot faithfully represent a scene on the English coast as well as one on the other side of the Channel!

TREATMENT OF HOME-WOODS.

The Garden Beautiful: Home-woods and Home Landscape. By William Robinson. Pp. xii+170. (London: John Murray, 1907.) Price 7*s.* 6*d.* net.

THE author's expressed object in writing this book was to induce people fortunate enough to possess woodlands to make them attractive and accessible. Having already written the "English Flower Garden" and the "Wild Garden," he is careful in this case to point out that just as in the latter book his purpose was not to destroy the flower garden, so in the present instance the arguments in favour of beautifying the home-woods are intended to persuade proprietors "after thought of the needs of a true garden, to think more of their woods from æsthetic and other points of view."

We are quite in sympathy with Mr. Robinson when he states that there are hundreds of acres of beautiful woods in his district never seen by anyone but the gamekeeper. Yet how delightful the effects that may be obtained by opening up such woods, in a manner that paths are made available for foot visitors at all seasons of the year! On most estates no such thing is done, but we have in our mind several instances that afford striking testimony to the deprivations voluntarily or ignorantly suffered by those who maintain the woodlands as a closed book, so to speak, to all but sportsmen. One of these is at Keele Hall, in Staffordshire, the present residence of the Grand Duke Michael of Russia, where the woods, extending for a mile or more beyond the pleasure grounds, were

laid out with suitable paths about forty years ago by the late Ralph Sneyd, uncle to the present owner of the estate.

The idea in carrying out such work should be that of bringing the most picturesque portions of the wood into view, and the paths should be arranged accordingly. It would be contrary to the spirit of the thing to try and make the woodlands a kind of pleasure-ground, for the woods are capable of yielding effects perfectly distinct from those which may be obtained from a pleasure-ground. No great amount of planting need be done, but by this statement we do not mean that regard for a supposed principle need prevent one from planting decorative shrubs, trees, or bulbs in positions where suitable sites are available for them, and the effect can thereby be greatly improved. In many situations where close planting has caused trees to develop fine, straight stems or trunks, there is no need for any under-shrub to complete the scene, for the lover of trees will have his delight in viewing the magnificent stems, often devoid of branches for twenty, or even thirty, feet from the ground.

But it is necessary, for change of scene, that in some places there should be a dense undergrowth of an evergreen shrub, such as the rhododendron, which is capable of thriving and even flowering well in comparative shade. The author of the present work rightly insists on the necessity of obtaining rhododendrons on their own roots for woodland planting, as they are usually capable of succeeding better than grafted plants, especially if the grafts have been worked on stocks of *R. ponticum*. Many gardeners have the idea that the old and somewhat unattractive *R. ponticum* is the hardiest of all rhododendrons, but this is erroneous. Some of the North American kinds are much hardier, and their effect when in flower is brilliant. Mr. Robinson specially recommends a variety known as "Cunningham's White," a most hardy plant of vigorous constitution, and bearing flowers of a rosy-lilac colour in bud, gradually becoming paler as the flowers expand. Other suitable species for forming undergrowth of a similar nature would include *Berberis aquifolium* (the evergreen barberry), *Ligustrum ovalifolium* (common privet), *Laurus nobilis*, *Gaultheria Shallon*, species of Hedera (ivy), Bambusa species, also common briars, bracken and furze, &c.

When once the owner of a wood, however, determines to make it accessible and attractive, he will soon discover various ways in which the views from the paths may be improved without interfering with the character of the wood itself. The sides of the paths can easily be planted with attractive, low-growing shrubs, and the scope for securing spring effects from flowering bulbs will be almost infinite. The bulbs from the forcing houses need never be thrown away, for suitable situations for them will present themselves in numerous instances, and snowdrops, crocuses, bluebells, and even the cheery little cyclamens may be planted in thousands.

The author reproduces two chapters from "The English Flower Garden," and then in subsequent chapters goes on to deal with the evergreen and deciduous trees of the northern forest, the best of native and European trees for the British Isles, how to produce wood and covert from seeds, and many other details connected with the subject, there being in all thirty-three chapters. We cannot agree with the suggestion on p. 76 that trees growing in isolated positions on lawns have their roots robbed by the grasses! in anything like the measure that obtains when the trees are growing together in a plantation. Mr Robinson's plea for the use of English names in garden literature we regard as unfortunate, unless the botanical names are employed also, as the use of popular names alone usually leads to the greatest confusion.

WATER SUPPLY.

Clean Water and How to Get It. By Allen Hagen. Pp. x+178; illustrated. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1907.) Price 6*s.* 6*d.* net.

THERE is probably no engineering topic at the present day of more striking importance to the public welfare than that relating to the supply of pure water for domestic purposes to large centres of population. Health, physical fitness, comfort and general well-being are all bound up in the solution of a problem which becomes daily increasingly difficult, and, at the same time, increasingly urgent, with the rapid growth and development of manufacturing towns, quite apart from the consideration of its equally essential application to the smallest hamlet and to the individual. An age which no longer recognises disease and degeneration as the unalterable and inscrutable decrees of a mysterious Providence, but as evils to be resolutely combated, with every hope of a successful issue, cannot for one moment tolerate the idea of polluted sources and germ-ridden channels for its supplies of water—that element so indispensable to existence and so inseparable a constituent of nature itself.

Any publication, therefore, which tends to throw additional light on the subject, or which collates and classifies data and information already acquired for the use of those engaged in the prosecution of waterworks, must be readily welcome. Mr. Hagen's book belongs to the latter class, and his object has been to set down some useful facts and principles for the guidance of those who have had no previous experience in the matter, and yet who are called upon, in connection with civic and urban duties, to participate in the control and distribution of water for their respective districts. The book is avowedly not intended for the expert, though even he may find some serviceable data among its pages. It is for the beginner and the "man in the street," in order that they may thereby be led to understand and appreciate something of the rudiments of a science of such vital concern to themselves and their fellow citizens.

Written exclusively from an American standpoint and based entirely on American practice, it is difficult on this side of the Atlantic to offer very effective criticism of its contents. Conditions here differ in so many respects as to afford little scope for useful com-

parison. Thus in this country we have no cases of towns corresponding to the Great Lake cities—Chicago, Cleveland, Buffalo, Detroit, Milwaukee and Duluth—drawing their water supplies from the same limited area into which their sewage is discharged. The risk of pollution is so abundantly evident that it is not surprising that Chicago has attempted to minimise the evil by diverting her sewage outfall, at considerable cost, into the Mississippi River. The wonder is that the example has not been copied in other cases.

Another strikingly distinctive feature is the enormous excess of supply *per caput* over that generally provided in this country. London and Liverpool are each content with less than forty gallons per head daily, whereas ten large American cities severally and individually exceed a demand of 100 gallons per head. New York takes 129 gallons; Boston, 151 gallons; Chicago, 190 gallons; and Pittsburg, 250 gallons. The discrepancy is tremendous. One feels that Mr. Hagen has hardly put it sufficiently strongly when he remarks that, "taking it right through, probably one-half the water supplied to American cities is wasted."

Mr. Hagen, in his book, first describes the various available sources of supply, viz. artificial reservoirs, small and large lakes, rivers, wells, and springs. He then discusses the chemical action of water on iron pipes and the means of effecting and maintaining the purification of stored water. There are chapters on pressure and on metering; the financial side of the subject is also considered. Altogether, the book is a most useful compendium of information relating to American methods of water supply.

VETERINARY PHYSIOLOGY.

A Manual of Veterinary Physiology. By Colonel F. Smith, C.B., C.M.G. Third edition, completely revised and in parts re-written. Pp. xvi+715. (London: Baillière, Tindall and Cox, 1907.) Price 15*s.* net.

AN interval of twelve years has passed between the issue of the last edition of this text-book and the present, third, edition. So many and notable have been the advances in physiology during that time that the book has had to be practically re-written; only the chapters on the senses, locomotion, and the foot stand nearly as they were. The chapter on the nervous system has been read, and some new matter added to it, by Prof. Sherrington, F.R.S., and other sections have been amplified by the cooperation of men who have special knowledge of the particular subject dealt with.

The book is not a text-book of human physiology with a little veterinary material added, but is a treatise which takes the horse as the type, and preserves that type throughout. Other animals of interest to the veterinary surgeon are not thereby excluded; the ox, sheep and pig, where differing essentially in their physiology from the horse, are fully considered. A special feature of the work is the interest it arouses in the reader; the physiology is applied to the practical requirements of the student and practitioner, and the book is, in its way, partly a clinical manual. An appendix to many of the chapters takes up shortly the more common features of pathological interest liable to occur in the organ or organs the physiology of which has just been considered. The addition of a little pathology is, in the words of the author, meant to enforce the lesson that pathology is only physiology out of health. It certainly adds greatly to the interest of the book, and serves to emphasise the importance of a thorough understanding of the normal.

For many of the discoveries in the physiology of the horse we are indebted to the researches of Colonel Smith himself, and no one is in a better position to unfold them. This he does in the simplest and clearest language; many of his statements, indeed, throw light on processes which go on in the human body, or are at least extremely suggestive. The observations, founded on universal experience, that, in order to get a horse fit for hard work, or cattle and sheep ready for the butcher, the diets given must be strongly nitrogenous and limited only by the appetite, are quite opposed to the recent theories so strongly advocated by Chittenden. This is not the only instance where theory and practice come into opposition; the custom of watering a horse before feeding it is physiologically correct, but, according to Ellenberger, a horse, in order to derive the fullest possible nutriment from its oats, should be given hay first, then water, and finally oats. This does not accord with the English views of watering and feeding horses, which, however, as Colonel Smith says, have stood the test of prolonged practical experience.

The chapter on digestion is particularly good; the horse, ox, pig, and dog are separately considered. Occasionally one meets with statements that require further amplification; that pilocarpine is antagonistic to atropin and produces a profuse flow of saliva reads as though pilocarpine overcomes the effects of atropin, and that nicotine paralyses ganglion cells is not quite exact. The text, however, bears evidence of careful revision, and the book will prove a most valuable one to veterinary students and practitioners. Recent discoveries have been generally incorporated. Special mention may be made of the chapter on generation and development, which are particularly well treated. The work is one that can be read with interest from beginning to end, and claims the attention of all interested in veterinary work.

PERCY T. HERRING.

OUR BOOK SHELF.

The Polarity of Matter. By Alex. Clark. Pp. vii+134; illustrated. (London and Edinburgh: Gall and Inglis, n.d.) Price 3*s.* 6*d.* net.

THIS book claims to be a trustworthy text-book for the student of physics, but we cannot recommend it in this respect. Very few of the statements of fact which it contains are correctly made; and the deductions from them are supported by little consistent proof. At least, these are the conclusions to which we have come after a genuine endeavour to understand the meaning of the book. At the present time, when there has been such a rush of new facts, there is abundance of room for a book of a speculative

character. The author must not think, therefore, that we speak unfavourably of his work because of its novelty. The true explanation of physical phenomena will sound exceedingly novel, we have no doubt, when it is first put forward. It may be that in the author's mind there is a germ of an idea which deserves developing. But if he wishes this to be recognised it would be well if he were to get some friend to assist him in the process.

The main aim of the book is to reduce all "forces" to one origin; and the secret by which it is done is the recognition of the "polarity of matter." Considering the thoroughgoing attempts of Sutherland and others to explain gravitation by means of polar systems of electrons, he would be a rash man who should say that the author's idea is absolutely chimerical. Whether or not he is qualified to develop it may perhaps be learned from the following extracts:—

"When the magnet is a straight bar . . . the distance between its pole being $2a$ . . . the magnetic force is 3·14 times the gravitational force. If the magnet be bent into the form of a horse-shoe so that the distance between its poles is a, the magnetic force is 12·5 times the gravitational force. . . When the poles of the magnet come together the force is unity. . . ."

"The position of a fragment of iron in a magnetic field may therefore be defined as tangential to an ellipse of which the magnetic poles are the foci."

"The force of attractive interest in each of two bodies forming the poles of an electric force is a constant quantity, and when the force radiates equally in all directions its magnitude is gravity."

"In all cases of magnetisation by means of an electric current, certain waves proceed from the current by which the effect is produced. These waves are commonly called Hertzian waves."

If the seeker after novelty finds in the above extracts the particular kind of novelty for which he seeks, we cordially commend the book to him; and we wish him greater success in unravelling its meaning than we have attained.

Wild Bees, Wasps and Ants, and other Stinging Insects. By Edward Saunders, F.R.S. With numerous illustrations in the text and four coloured plates by Constance A. Saunders. Pp. xiii+144. (London: Routledge and Sons, Ltd., n.d.) Price 3*s.* 6*d.*

SINCE the death of Frederick Smith, probably no man has given more attention to the study of our British Hymenoptera Aculeata (the section of the order which contains stinging insects, such as bees, wasps, and ants, &c.) than Mr. E. Saunders. This order of insects is much less hackneyed than the Lepidoptera or Coleoptera, and Mr. Saunders's work will be very useful to beginners commencing the study of perhaps the largest order of insects of all, and also of the most interesting section, for there are only four groups of insects known which include species living in organised communities, three in Hymenoptera—bees, wasps, and ants—and only one in Neuroptera—the termites, improperly called white ants. The non-aculeate Hymenoptera, not here dealt with, are far more numerous, and are very imperfectly known or studied at present; they comprise the sawflies and gall flies, and also the ichneumons, and other parasitic insects, hundreds of which are of very small size, including among them the smallest known insects.

But it will be sufficient for most entomologists who are inclined to study Hymenoptera to follow the lines laid down by Mr. Saunders for the examination of the structure and habits of the more familiar and less difficult group of Hymenoptera Aculeata. The information given, though, of course, much condensed, is well arranged and thoroughly trustworthy, besides being expressed in an attractive manner. The last chapter, "On Structure," with a good diagram and clear descriptions, will be particularly useful, for nothing is more troublesome to an entomologist taking up the study of an order or group of insects unfamiliar to him than the absence of a clear explanation of the terms applied to the various details of insect structure.

Das Problem der Schwingungserzeugung. By Dr. H. Barkhausen. Pp. iv+113. (Leipzig: S. Hirzel, 1907.) Price 4 marks.

THE author of this book discusses the conditions under which an instrument or piece of apparatus can produce undamped vibrations when the source of energy does not vary periodically.

The organ pipe and violin string illustrate the phenomenon in the case of vibrations produced by mechanical means. For the mathematical theory, however, electrical vibrations are the most convenient, and as the problem of creating undamped electrical vibrations is of present-day importance in wireless telegraphy, the greater part of the book is devoted to its consideration.

The first result obtained is that a necessary condition for the production of permanent vibrations is the presence of a variable alternating resistance, self-induction or capacity in the current system. The variation of the resistance may be due to external action, as in the microphone and in a new arrangement called the resonance interruptor, which is capable of giving high frequencies, or it may arise from the current flowing through the apparatus as in the electric arc.

The author makes frequent use of graphical methods, especially in the discussion of three different types of vibration which can be produced with the arc. These are investigated separately, and compared with regard to their capacities for resonance, high frequency, and performance of work. The questions of stability show that permanent vibrations can be obtained only when the interval for re-kindling after extinction increases more rapidly at first than it does afterwards. Various methods are given by which this can be ensured.

The book concludes with a chapter on mechanical vibrations, particular attention being paid to those produced by friction. On the whole, the exposition is good, and we can confidently recommend the book to those who wish to obtain a grasp of the principles of the subject. H. B.

Album de Aves Amazonicas. By Dr. E. A. Goeldi. (Para: Museu Goeldi, 1907.)

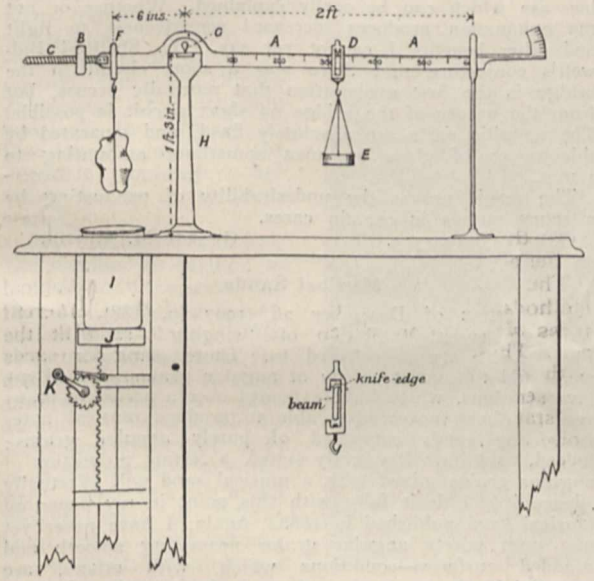
WE have been favoured with a copy of the third and final fasciculus of this superbly illustrated work, of which the first part was noticed in our issue of August 22, 1901. The present fasciculus includes plates 25–48, which are executed in the same first-class style as their predecessors, and a re-issue of the descriptions of the entire series, together with several well-arranged indices. We can add little in the way of commendation to what has been already written in our notices of the two earlier issues. Throughout the work the figures are for the most part well drawn, and coloured with such a near approximation to nature as to render the various species easily recognisable. That the work will tend to promote the study of Brazilian ornithology cannot be doubted, and the author is to be heartily congratulated on having given to the world such a splendid series of portraits of the most striking representatives of a tropical bird-fauna.

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.]*

A Specific Gravity Balance for Large Rock Specimens.

THE specific gravity balance represented in the accompanying illustration was devised by me some ten years ago for the determination of the specific gravity of hand specimens of rocks in the laboratory of the Geological Survey of India, Calcutta. In the ordinary form of Walker's balance the weight used on the short arm must be considerable in order to balance even a very small fragment of rock on the longer arm, and in consequence the specific gravity of an ordinary hand specimen has to be inferred from that of a small chip, which, unless the rock is of very homogeneous composition and texture, may give a very misleading result; and it is evident that if this form of balance were capable of accommodating a fairly



A specific gravity balance for large rock specimens. $\frac{1}{16}$ full size.

large specimen, the whole instrument would have to be immoderately large. It occurred to me that if the specimen could be substituted for the heavy weight of Walker's balance, not only would it be possible to construct a balance of moderate size by which the determination of large specimens could be made directly, but the manipulation of the specimen and of the vessel containing the water might be greatly facilitated.

This object was attained by counterbalancing the beam A (see diagram) by means of a weight B, which is made so that it runs fairly easily on the screwed rod C, attached to the shorter arm of the beam. The adjustment is made before commencing a series of determinations, after removing the sliding piece D from which the scale pan E depends (the back of this sliding piece being cut away for this purpose, as shown in the separate figure), but with the hook F for the suspension of the specimen in place. Both the frames to which the hooks are attached are supported on knife-edges, that at F being fixed to the beam, while that at D is attached to the sliding-piece, so that it can be placed at any point on the longer arm of the beam. The beam itself is balanced on a knife-edge at G, supported on grooved agate bearings let into the top of the pillar H. The beam is divided along its upper edge into millimetres, measured from the point of support at G. The dimensions of the instrument are indicated in the diagram; it was constructed by the Mathematical Instrument Department of the Survey of India in Calcutta.

On the left-hand side of the table supporting the balance is shown an arrangement for raising and lowering the jar I, containing water. The jar is supported by a block of wood J, to which is attached a rack and pinion actuated by the handle K, a ratchet wheel and pawl enabling the jar to be fixed at any convenient height. This apparatus has been found very convenient in manipulating large specimens, and it enables one to get rid of the air-bubbles which attach themselves to the specimen when first immersed, by raising and lowering the jar two or three times before moving the scale pan.

In making a determination the knife-edge carrying the scale pan is placed at the 500 mm. division on the beam, and small shot are poured into the pan until the specimen in air is exactly balanced. The water-jar is then raised until the specimen is entirely immersed, and then the scale pan is moved to the left along the beam until equilibrium is again established, the weight in the pan remaining the same. The number of millimetres at which this occurs is noted, and the specific gravity corresponding is found at once from a table suspended near the instrument. A portion of this table is given here :—

mm.	sp. gr.	mm.	sp. gr.
300	2·500	—	—
301	2·512	—	—
302	2·525	348	3·289
303	2·538	349	3·311
304	2·551	350	3·333
—	—	351	3·355

The specific gravities corresponding to each division might, of course, be engraved on the beam, but with millimetre divisions the figures would have to be inconveniently minute. In practice the balance has been found to be very accurate, on comparison with a large balance of the ordinary description, the error only affecting the third place of decimals; and where a large number of hand specimens has to be determined, the saving in time made possible by its use is very great.

Broken specimens and small fragments of rock may be enclosed in a cage of fine copper wire, the error introduced by which can be easily calculated. In Calcutta, when the cage is in use, the error is corrected by adding 1 to the number of millimetres read when the specimen is immersed in water.

There is, of course, nothing new in the principle of this balance, but the general arrangement, especially the water-lift, is, I think, novel, and it has been found so convenient where large numbers of hand specimens have to be dealt with that I trust it may be introduced into other geological laboratories; I shall be happy to furnish more precise details of the dimensions of the instrument to anyone desirous of having a similar one constructed if he will kindly communicate with me.

T. H. D. LA TOUCHE.

Kingstown, Ireland, December 7.

A Point in the Mathematical Theory of Elasticity.

I DO not recollect that in Prof. Karl Pearson's recent memoirs embodying the results of tests on jelly models of dams he asserted that the distribution of stresses due to the water pressure on and the weight of a dam is *entirely* different in a thin slab cut from the dam from the distribution in the actual dam. In fact, Prof. Pearson used many such model slabs in an endeavour to ascertain experimentally certain stress distributions in actual dams. Prof. Pearson will doubtless be able to reply to criticisms from engineers or others regarding any statements he has made in this connection, either in his published memoirs or elsewhere; it is difficult to follow Mr. Martin's arguments (p. 198) at all points, more particularly with respect to the effects of the cancellation forces $\widehat{yy} = F(xz)$.

It seems to me, however, that the stresses in a thin slab, due to its weight and water pressure, *must* be different from those in an actual dam. A dam is fixed as

rigidly as possible along its base and at its ends, and if the plan of the upper edge is originally straight there must be some horizontal displacement at the centre of the length from the line joining the abutments, quite apart from such displacement as may be due to the overturning effect of the pressure on a vertical slab. The dam resembles *in some measure* a built-in beam, and, recognising this fact, some large dams have been built slightly convex on the water face.

If a balcony consisting of a plate of variable depth is rigidly supported at its ends and along one side, I imagine that the vertical displacement caused by a load at the centre and front of the free edge of the balcony could not be estimated without some regard for its end and side supports, nor could the stresses due to it be easily determined. There *would* be *some* stress along the horizontal fibres joining its ends, and the elevation of the front edge of the balcony must show contraflexure, since its ends are horizontal and the centre portion is concave upwards.

Can we deny the existence of such effects, whatever their magnitude may be, if a masonry dam is regarded as an elastic body? An engineer should be conscious of all the forces at work on a structure which he is designing, and if these forces and their effects can be correctly estimated, a design may be prepared having due regard to the physical properties of the materials employed and their liability to variation, owing to natural causes and errors of workmanship.

When the forces and their effects are in any measure uncertain, the exercise of due caution, accompanied by mature judgment based on experience, will usually lead to a successful design. It does not seem probable that a mathematical solution can be obtained for the stresses in a homogeneous isotropic dam, rigidly fixed at its ends and base, which can take account of the conditions existing in practice. The solution of the theoretical case would be of interest, but it is questionable to what extent it would be applicable to practical conditions, in which dams are not homogeneous and isotropic, and foundations and abutments are not absolutely rigid.

Engineers recognising these facts have used a simple but approximate method of estimating the stresses in a dam, based on the flexure of beams. The solution based on the theory of elasticity, as presented by Prof. Pearson, may be nearer the truth, but it may be questioned whether this can be known to be the case in an actual dam.

E. BROWN.

Echelon Spectroscope.

FURTHER observations on the secondary bands referred to in my letter in NATURE of January 2 (p. 198) seem to indicate that they are faint spectra of a much higher order than the primary spectra.

Faint spectra of a very high order must be formed by a series of beams that have suffered two reflections at the external surfaces of the echelon. Each of these secondary beams has traversed the echelon three times, and the retardations of the beams form a series the common difference of which is seven times that for the series of beams giving the primary spectra, taking the index of refraction to be 1·5. These secondary beams would only have about one six-hundredth of the intensity of the primary beams, and I thought that the resulting spectra would be too faint to be observed until I found that the reflections that take place at the interfaces of the echelon assist in forming the same secondary spectra.

Assume that each interface reflects the same very small proportion of the light incident upon it, and neglect beams that have been reflected more than twice. Imagine the echelon being built up one plate at a time, commencing with the largest. Each plate that is put on starts a series of secondary beams and adds another term to each of the series started by the earlier plates. The retardations in each of these series have the same seven-fold common difference as the first series, and so they all help in forming the secondary spectra.

Each member of the series started by the nth plate has n times the intensity of the unit secondary beam produced from the primary beam by two interface reflections, consequently the last few steps of the echelon are much more effective in producing the secondary spectra than the steps formed by the first few plates, and the clearness of the secondary spectra given by the echelon may be much improved by covering over, say, the first half of the whole number of steps built up.

In this way better photographs of the secondary bands have been obtained, and I hope to be able to test this explanation of their formation quantitatively.

H. STANSFIELD.

The University, Manchester, January 6.

The Photoelectric Property of Selenium.

I HAVE to thank Mr. R. J. Moss (January 2, p. 198) for the true explanation of the extraordinary increase of conductivity of a selenium bridge enclosed in an exhausted tube. The air pump employed, in the first instance, to produce the exhaustions was the mercury pump of Töpler, and it occurred to me that the mercury vapour might be objectionable. The enormous magnitude of the effect, however, induced me to ignore this vapour. The drop in resistance was finally from 61 megohms to 9·7 ohms. After seeing Mr. Moss's letter I made another bridge, enclosed it in a glass tube, and exhausted this tube with a Fleuss. The result was now an *increase* of resistance in the bridge from 57 megohms to 110 megohms—an increase which can be easily explained. Whether or not the exhaustion produces increased sensitiveness to light and other benefits I cannot yet say. Dr. Shelford Bidwell's conjecture that there was a short circuit in the bridge is the first explanation that naturally occurs, but from the nature of the bridge no short circuit is possible. The metallic parts are absolutely fixed, and separated by thicknesses of glass or mica sometimes amounting to 1 mm.

The result proves the undesirability of exhausting by mercury pumps in certain cases.

Oxford, January 5. GEORGE M. MINCHIN.

Musical Sands.

IN NATURE of December 26, 1907 (p. 188), Mr. S. Skinner's recent exhibition of "singing" sand at the Physical Society is referred to. These particular sands were said to consist chiefly of angular grains. In all my investigations, which have extended over a period of many years, I have never been able to produce musical notes from any sands composed of purely angular grains; indeed, as I have frequently stated, a certain proportion of angular grains mixed with a musical sand will effectually silence it! I dealt fully with this point in my paper on musical sand published in 1888. Again, I have never yet met with purely angular grains possessing smooth and rounded surfaces—conditions which, with others, are essential in the production of music from sands. Perhaps Mr. Skinner meant subangular grains?

I do not think the explanation of the cause of the phenomenon suggested by Profs. Poynting and Thomson in "Sound" ("Text-book of Physics") meets the case. It is based on the erroneous assumption that the sand-grains are arranged as a number of equal spheres in contact. If this supposition were correct, and the condition an essential one in the production of notes, then my experiments with many sands composed of highly spherical grains (like the "millet seed," for instance) should have yielded notes of the highest quality, instead of being, as they all were, mute under the most favourable conditions.

The late Prof. Tyndall, who took a great interest in my work, and personally confirmed the results of my experiments, agreed with my conclusions, and thought *hardness* of grain an important consideration, believing that the loudest notes might be emitted from ruby and diamond sands—if I could get them! I am under the impression that if the theory proposed by Profs. Poynting and Thomson is tenable, it should be possible to obtain notes from comparatively soft spherical seeds (like fig, &c.), but though I have experimented with many kinds, I have not been successful in this direction. I still think my friction theory the simplest, and as many leading men of science have supported it, and no one has as yet disproved it, why may it not be retained?

CECIL CARUS-WILSON.

SPORT AND NATURAL HISTORY.[1]

(1) IN works of the present nature, Mr. Millais is at his best; and his best, alike with pen and with pencil, is, it is almost unnecessary to say, very good indeed. Caribou-hunting was the main object of his expedition, and in this work the author has given us an account of the local race of the reindeer which has never before been equalled, a feature of special value being a coloured plate of the animal from a sketch by himself. Some magnificent and perhaps unrivalled photographs of heads of this handsome animal are also reproduced.

Mr. Millais is never content with following in the beaten track; and during his expedition he succeeded in making his way into previously unknown tracts in the interior, where he succeeded, from a clue given by Mr. F. C. Selous, in locating a large non-migratory southern herd. It will probably come as a surprise to many of his readers that a large area of the interior of the country is still unknown, even to the Government surveyors. Here reindeer abound, these swampy tracts of the interior being, in fact, fit for nothing else than reindeer. A most satisfactory feature is that, despite an organised annual slaughter during migration, the caribou continue to increase in the island, and, in the author's opinion, are likely to do so for centuries.

Mr. Millais estimates the number of caribou in the island at 200,000. The rate of destruction is estimated as follows:—"Putting the death-rate at the highest estimate of three animals each to 4000 shooters, 12,000 would be killed out of 200,000, that is, a depreciation of 6 per cent. Now this is a much smaller rate of killing than takes place among the stags of Scotland, and they are undoubtedly on the increase."

FIG. 1.—Caribou swimming a lake: Mount Cormack in the background. From "Newfoundland and its Untrodden Ways."

The book is, however, by no means restricted to Newfoundland and caribou, for we have, near the middle, an interesting chapter on the author's experiences in whaling, in which the game were the blue finner and the humpback. In the course of this chapter we notice (pp. 162, 178) two different dates assigned to Svend Foyn's invention of the bomb-harpoon, the one last mentioned being correct; and at least one slip in proof-reading is observable.

The coloured plates of scenery and animals are exquisite, and ought by themselves to ensure a large sale for this charming volume; while the reproductions from photographs and pen sketches are no less admirable and interesting. As an example, we reproduce the illustration of a party of caribou swimming a lake, with Mount Cormack in the distance.

(2) In place of stirring jungle adventures and hair-breadth escapes from tigers and wild boars, we have in this attractive and beautifully illustrated volume a series of chapters on the insect and other invertebrate (we really want a word equivalent to the Spanish *becho*, which will serve for all these creatures) life of the plains of India, followed by others on Indian trees, plants, and gardening. From preface to index the work is written in a style and with a charm which cannot fail to interest a large circle of readers; while the numerous references to details connected with the habits and environment of the various species cited serve to proclaim the author (already well known to the reading public by an earlier work on the same lines) as an accurate and painstaking observer. So graphic, indeed, are his descriptions that we can almost imagine ourselves in the veranda of a bungalow on a hot night at the beginning of the rains, surrounded by pests of many sizes and sorts, or wandering in spring through the incomparably beautiful glades of the Botanical Gardens at Calcutta.

Among the larger pests to which the author pays much attention are centipedes and scorpions; and in connection with the latter he relates how a *yogi* from Mirzapur, who had the reputation of being immune to the scorpion's sting, submitted himself to a trial in Calcutta. To make sure that there should be no "bogus" in the matter, a good supply of freshly-caught scorpions of the most venomous type was provided. After some hesitation, he allowed several of the creatures to affix themselves to his fingers, when he appeared to suffer no special inconvenience or pain, and thus demonstrated the truth of his assertions. The immunity was, in Col. Cunningham's opinion, probably due to frequent inoculation with the venom, aided possibly by an innate tendency in that direction, and the consequent development of an antitoxin, the case being, in fact, analogous to that comparative immunity to mosquito-poison which results in most persons after lengthened preliminary suffering.

Among other trials to which the resident in India is subjected, the author waxes eloquent on the difficulty of preserving books from the ravages of "silver-fish" and white ants; while he also refers to the voracity of the huge land-snails (achatinas) introduced into Cal-

[1] (1) "Newfoundland and its Untrodden Ways." By J. G. Millais. Pp. xvi+340; illustrated. (London: Longmans, Green, and Co., 1907.) Price 21s. net.

(2) "Plagues and Pleasures of Life in Bengal." By Lieut.-Colonel D. D. Cunningham. Pp. xi+385; illustrated. (London: John Murray, 1907.) Price 12s. net.

cutta gardens from Mauritius, and the unpleasant results which ensue if their destruction is not conducted on special lines.

Let no one, however, imagine that an Indian life has not its lighter side. What, for instance, can equal the glory of its sunsets, so graphically described by the author, or the luxuriance and beauty of its gardens, which he brings to our notice with the aid of both camera and pen? As an example of what can be done in the way of effect with foliage alone, we reproduce

FIG. 2.—Palms in an Indian Garden. From "Plagues and Pleasures of Life in Bengal."

the accompanying illustration, with which we must, reluctantly, take leave of a charming, thoughtful, and instructive work. R. L.

"KIMBERLITE" AND THE SOURCE OF THE DIAMOND IN SOUTH AFRICA.

THE origin of the volcanic pipes of South Africa and the genesis of the diamonds contained in their "blue-ground" filling are as productive of controversy as that other geological puzzle—the source of the gold in the Witwatersrand conglomerates—the discussion of which was revived by Prof. J. W. Gregory at a recent meeting of the Institute of Mining and Metallurgy; and agreement among the disputants is as little likely to be arrived at in the one case as in the other. Quite a crop of papers on the diamond-pipes has recently appeared,[1] and a perusal of these reveals so remarkable a variation of opinion that it may perhaps serve a useful purpose to give in these columns a brief summary of the different views as to the nature of the original matrix of the diamond and the place in which it was produced, that have been put forward from time to time since the discovery of the "dry diggings" at Kimberley in 1870.

Prof. E. Cohen, who visited the diamond field in 1872, gave the first scientific explanation of the origin of the volcanic pipes in a letter addressed to Prof. Leonhard, and published in the "Neues Jahrbuch für Mineralogie" (1872, p. 859). According to Cohen the diamond occurrences represent the centres of tuff-eruptions, whereby the greater part of the erupted material was provided by older crystalline rocks underlying the present known formations. These furnished not only the diamonds, but probably most of the accompanying minerals. Forced violently upward by volcanic explosions, the shattered rocks became pulverised, and the diamonds either survived as complete crystals or were broken into fragments (the "splints" of the dealers). This view explains the fragmentary character of the minerals that accompany the diamond; it also accounts for the presence of so many fragments of crystalline rocks in the pipe-material ("blue-ground"), and for the strongly brecciated character of the latter. Cohen's view was subsequently somewhat modified by Chaper (Bull. Soc. Minér. de France, ii., 1879, p. 195), who found it necessary to assume a repetition of explosive eruptions in order to account for the variation in one and the same pipe of large masses of the blue ground in colour, mineral composition, richness in diamonds, &c.

On the other hand, Dunn, who wrote in 1874 (Quart. Journ. Geol. Soc., xxx., p. 54), described the blue ground as a "decomposed gabbro or euphotide"; while Maskelyne and Flight, who gave the first description of the microscopic character of the diamantiferous rock (Quart. Journ. Geol. Soc., xxx., 1874, p. 406), considered that it "was probably the original home of the diamond, possibly at the places of its contact with carbonaceous shales." These ideas were further developed by Carvill Lewis in papers read before the British Association in 1886 and 1887, and subsequently published by Prof. T. G. Bonney under the title "Papers and Notes on the Genesis and Matrix of the Diamond." After an elaborate microscopic investigation made in Prof. Rosenbusch's laboratory in Heidelberg, Lewis pronounced the rock to be a true eruptive lava—"a porphyritic

[1] A. W. Rogers and A. L. du Toit: The Sutherland Volcanic Pipes and their Relationship to other Vents in S. Africa (Trans. S.A. Phil. Soc., vol. xv., p. 61, 1904).
H. S. Harger: The Diamond Pipes and Fissures of South Africa (Trans. Geol. Soc. S.A., vol. viii., p. 110, 1905).
G. S. Corstorphine: The Occurrence in Kimberlite of Garnet-pyroxene Nodules carrying Diamonds (Trans. Geol. Soc. S.A., vol. x., p. 65, 1907).
F. W. Voit: Kimberlite Dykes and Pipes (Trans. Geol. Soc. S.A., vol. x., p. 69, 1907).
F. W. Voit: The Origin of Diamonds (Trans. Geol. Soc., S.A., vol. x., p. 75, 1907).
A. L. du Toit: Geological Survey of the Eastern Portion of Griqualand West (Eleventh Ann. Rep. Geol. Com. Cape of Good Hope, p. 135, 1906).
A. Macco: Ueber die südafrikanischen Diamantlagerstätten (Zeitsch. der deutsch. geol. Gesellsch., vol. lix., p. 76, 1907).
R. Beck: Untersuchungen über einige südafrikanische Diamantenlagerstätten (Zeitsch. der deutsch. geol. Gesellsch., p. 276, 1907).

volcanic peridotite of basaltic structure, or, according to Rosenbusch's nomenclature, the palæo-volcanic representative of a biotite-bronzite-dunite, being an olivine-bronzite-picrite rich in biotite." To this rock he gave the name of kimberlite, distinguishing between *kimberlite proper*, a typical porphyritic lava; *kimberlite breccia*, the same lava broken and crushed by volcanic movements within the pipe, and crowded with included fragments of foreign rock; and *kimberlite tuff*, the fragmental and tufaceous portion of the same volcanic rock, all these varieties passing into one another and occurring together in the same neck or crater. The kimberlite breccia constitutes, according to Carvill Lewis, the greater portion of the pipe material, but it is traversed by dykes of kimberlite proper, and contains streaks and patches of a soft, "soapy" material which appears to be kimberlite tuff. As to the diamond, it is as much a constituent of kimberlite as the more commonly occurring biotite, garnet, titanic and chromic iron and perovskite, and consequently must have been produced *in situ*.

From this view Bonney was led to dissent by a microscopic examination, made in 1899, of specimens from the Newlands mines in West Griqualand ("The Parent Rock of the Diamond in South Africa," Proc. Roy. Soc., vol. lxv., 1899, p 620). Among these specimens was a rounded boulder of a rock which was described by him as a "holocrystalline mixture of chrome-diopside and garnet, with a few small enclosures of olivine, in other words, a variety of ecklogite and of igneous origin." The interest of the specimen lay in the fact that it contained diamonds, and from this Bonney drew the momentous conclusion that the birth-place of the diamond and of the garnet, pyroxenes, olivine, &c., was not the "blue ground" itself, but the ecklogite which occurred in the latter as foreign boulders. He further concluded, from the smooth exterior of the specimen examined, that the boulders were water-worn, and were derived from a conglomerate bed "at the base of the sedimentary series in proximity to a crystalline floor." The blue ground then, according to Bonney, is a true breccia produced by the destruction of both crystalline and sedimentary rocks, the "result of shattering explosions followed by solfataric action."

R. Beck (*Zeits. für prakt. Geol.*, 1879, p. 417), to whom similar specimens from the Newlands mines had been sent, differed from Bonney as to the origin of the so-called boulders of ecklogite, which he considered to be concretions formed at great depth in the kimberlite magma—like the well-known olivine nodules in the basalt of Finkenberg, near Bonn, described by Rosenbusch and others as early segregations from the basalt magma. The serpentine breccia which represents the present condition of the kimberlite magma contains all the constituents of the nodules. The rounding of the boulders is to be ascribed to attrition during the upward course of the pyroclastic material in the pipe. Beck agreed with Bonney that the diamonds were formed at great depth, but for a different reason, namely, that only at great depths could such coarse-grained granular segregations from the magma have been produced. In a more recent paper (*Zeits. der deutsch. geol. Gesellsch.*, 1907, p. 226), Beck gives results of a further examination of the Newlands ecklogite, which, by the way, he proposes to call "Griquaïte." In addition to the constituents already named, he finds biotite, perovskite, zircon, rutile, and graphite. He repeats his conclusion that the "boulders" are deep-seated (intra-telluric) segregations from the same magma from which the pipe material is derived, and ascribes the genesis of the diamond to the presence in the original magma of metallic carbides, it being his opinion that not only the diamonds contained in the ecklogite, but also the isolated individuals in the blue ground, must have been formed at great depth.

The views of the earlier writers can be grouped into two distinct theories:—(1) The pipe material is a breccia or tuff produced with its contained diamonds, by violent volcanic agencies, from pre-existing rocks (Cohen, Chaper, Bonney, Beck). (2) It is a true eruptive lava which has solidified *in situ*, the diamonds having been separated out during this consolidation (Dunn, Maskelyne, Flight, Carvill Lewis).

Among the recent writers on the subject, H. S. Harger and G. S. Corstorphine support the view that the diamonds have been derived from a deep-seated source, the former mentioning that out of a parcel of 372 stones examined by him, 119 were found to be broken fragments of original crystals. F. W. Voit, on the other hand, regards the "splints" as either imperfectly formed crystals or as having been broken during the processes of mining and washing. (He would find it difficult, however, to explain the fractured character of the Cullinan diamond[1] by either of these hypotheses.) Voit regards the pipes as embryonic volcanoes. According to him, the igneous magma which rose in the pipes, being unable to reach the surface, was forced to solidify under the pressure of the superincumbent strata in circular or elongated moulds, thus giving rise to what he terms "conical batholites." While the extruding magma was still in the semi-plastic state, it was agitated by further gaseous eruptions, to the action of which the brecciated character of the blue ground is largely to be ascribed. He regards the ecklogite "boulders" as concretions of the kimberlite magma, formed *in situ*. He admits, however, the presence in the blue ground of boulders of granite, gneiss and crystalline schists of exotic origin.

A. L. du Toit, of the Cape Geological Commission, who during 1906 was working in the Kimberley district, has formulated a theory which combines parts of both the earlier views, and is more in accord with modern ideas of petrogenesis. According to him, kimberlite is a hybrid rock derived from a deep-seated magma (having the composition of a limburgite) which incorporated the shattered fragments of the various holocrystalline basic and ultra-basic components of the floor through which it broke. During its further ascent the eruptive mass caught up and included in its body fragments of the sedimentary beds through which it passed. A portion of its brecciated character, however, is to be attributed to movements during consolidation. Of the minerals found in the blue ground, du Toit considers the tremolite, smaragdite, epidote, orthite, tourmaline, muscovite, biotite, apatite and zircon to be xenocrysts derived from deep-seated rocks of acid composition (granite, gneiss, pegmatite, &c.); while he regards the olivine, pyroxenes, garnet, ilmenite, magnetite, chromite, spinel, sphene, kyanite, and the diamond as xenocrysts derived from basic and ultra-basic holocrystalline rocks. In addition, the original eruptive magma gave rise on consolidation to authigenic crystals of olivine, diopside, brown mica, magnetite, ilmenite, chromite, apatite, perovskite, nepheline and melilite.

In support of his view, du Toit gives instances of strong contact metamorphism effected by the pipe material during its intrusion. Few cases of contact-metamorphism, however, have hitherto been observed. Corstorphine (*loc. cit.*, p. 65), for instance,

[1] *Vide* F. H. Hatch and G. S. Corstorphine, "A Description of the Big Diamond recently found in the Premier Mine, Transvaal (*Geol. Mag.*, p. 170, 1905).

states that the fragments of sandstone, shale, &c., that he has found enclosed in the blue ground are conspicuously unaltered.

Much of the recent controversy has centred round the relation of the kimberlite dykes to the pipes. The fact that material of practically identical character to the pipe rock, and similarly brecciated, occurs in the form of dykes has long been known; but the latter have hitherto attracted but little attention, owing to the fact that the dyke material either carries no diamonds or so few as to be unworkable at a profit.

There can be no doubt that the dykes are genetically connected with the pipes, but were they formed contemporaneously, or did the dykes precede the pipes or *vice versâ*? Dr. Voit states that the pipes are younger than the dykes, which in all cases terminate, according to him, at the pipe-walls. Besides, fragments of dyke rock occur in the pipes, but pipe rock is never found in the dykes. Although chemically identical magmas, there are slight mineralogical distinctions, due, probably, to the different rate of cooling, which enable the rocks to be easily identified. Du Toit advocates the contrary view, namely, that the pipes and fissures have been formed contemporaneously. Between the extremes of occurrence in pipes or dykes he traces every gradation, and mentions "fissure-swellings," which, though dyke-like, expand at one or more points. Almost every pipe will be found to have one or more dyke-like offshoots, if not at the surface, at some greater depth. In the Newlands group, the pipes are connected below ground by a narrow dyke of kimberlite; on Secretaris, west of Kimberley, there are fissures with one or more little swellings on them, and there are numerous dykes and veins varying in width from mere stringers to belts of many feet. The strike of the fissures corresponds in some instances to that of the enclosing rocks (Newlands, Smith, and Peiser mines), indicating that the intrusion followed planes of physical weakness.

Instances might be multiplied to show the differences of opinion that obtain among South African geologists with regard to these interesting occurrences. They only emphasise the difficulties of the problems awaiting solution.

One word as to the date of intrusion. The pipes and fissures are later than the Karroo dolerites, which, in their turn, cut the Stormberg lavas. They are therefore at least of post-Rhætic age. If the melilite-basalt pipes of Sutherland are connected in origin with an intrusion of melilite-basalt in the Uitenhage beds at Spiegel River (Heidelberg, Cape Colony), then the occurrences of kimberlite are of post-Neocomian age (*vide* Rogers and du Toit, *loc. cit.*).

F. H. HATCH.

THE INDUCTION OF ANÆSTHESIA BY CHLOROFORM.

THE inquiry which was initiated seven years ago by the Council of the British Medical Association into the many-sided problem of chloroform-anæsthesia has added greatly to our knowledge, and directed particular attention to the fact that the administration of an amount of chloroform vapour above 2 per cent. in the inspired air is fraught with danger to the patient. The scope of this inquiry has been further supplemented and extended by independent researches carried out in this country and in France.

The view has been held, and to some extent verified by experiments, that during the progress of anæsthesia the drug was absorbed by the corpuscles rather than by the plasma of blood. The experiments of Benjamin Moore and H. E. Roaf first definitely proved that *in vitro*, with an adequate concentration or solution tension of chloroform in the blood, easily dissociable compounds or aggregations were formed between the drug and the proteins, including hæmoglobin, of the blood. It was a natural inference from these experiments that the production of anæsthesia, either in isolated cells or in unicellular or multicellular organisms, was due to the formation of such compounds between cell-protoplasm and chloroform. With a very small constant quantity of chloroform, 1 per 100,000, in blood it has been found that the anæsthetic effect is in no sense a cumulative one; the degree to which a living tissue is affected depends entirely upon the concentration of the chloroform in the blood, and therefore in the living cell, for the degree of anæsthesia remains constant, and persists for only so long as a definite solution pressure is maintained. Any given grade of anæsthesia is therefore entirely independent of the total amount of chloroform which is supplied at an adequate concentration. In the induction of anæsthesia in man the various stages from slight to profound must therefore essentially depend upon the gradually rising pressure of chloroform in the blood. When the amount of chloroform in inspired air is very low, the induction of anæsthesia is impossible; while that too high a percentage is lethal, the unfortunate accidents which occur from time to time bear abundant witness.

The rate of absorption of chloroform during the induction of anæsthesia has been studied by many observers, most of whom have attempted a solution of this problem by ascertaining the degree to which the lungs are ventilated during narcosis, and the extent to which chloroform is apparently retained by the body. This is determined by estimating the difference between the chloroform-content of inspired and expired air. In the case of inspired air this can easily be done with accuracy, but, especially with a low percentage of chloroform, the corrections which are necessary for temperature, amount of carbon-dioxide and aqueous vapour are so great as to render an accurate determination of the amount of chloroform in expired air a matter of much difficulty.

The rate at which chloroform is taken up by the blood can, however, be directly measured. In three papers just published in the Proceedings of the Royal Society, Dr. G. A. Buckmaster and Mr. J. A. Gardner have described the exact procedure of their experiments, which were undertaken with the view of ascertaining the function of the red corpuscles in anæsthesia produced by chloroform. Two of the papers fully describe experimental studies on "The rate of the assumption of chloroform by the blood during anæsthesia," and "The rate of elimination of chloroform from the blood after anæsthesia."

Hitherto an exact determination of chloroform in blood has been found to be difficult. It is not possible to use Neumann's method for chlorides. French observers, Tissot, Mansion, and Nicloux, have employed a method which is based on Dumas's reaction, which, as carried out by Nicloux, is rapid, convenient, and capable of giving satisfactory results, though it does not possess such a high degree of precision as an exact chemical method as does the one which was introduced by Carius for the determination of chlorine in organic compounds. This method was first used by Buckmaster and Gardner in their experiments on the anæsthetic and lethal quantity of chloroform in blood. The maximum error of this method never exceeds five per cent., and is generally much less. The amount of chloroform in the blood at any stage of anæsthesia is calculated from the difference between the chlorine-content of the blood of each individual animal before and after the induction of anæsthesia.

Buckmaster and Gardner had shown that when a mixture of chloroform and air is inhaled, almost all the drug is held by the red corpuscles; in one case no less than 98·5 per cent. of the total chlorine in the blood was found associated with the red corpuscles after 2 per cent. of chloroform vapour had been inhaled for three-quarters of an hour. It would appear, therefore, highly probable that in chloroform narcosis the transport of chloroform from and to the lungs is a function of the red corpuscles, which are the chief vehicle for the drug. If this is the case, it is obvious that although the absolute quantity of chloroform in the blood of any individual would vary with the mass of blood, the percentage amount in a sample of blood would not vary, other conditions being constant, whether the total amount of blood in the body was augmented or diminished. A large number of experiments were therefore performed, in order to elucidate this point. The general aim of these was to vary the mass of blood either by bleeding or by introducing the greater part of the blood of one animal into another of the same species. The blood was directly transfused. In experiments where the asphyxial state was reached rapidly, the average percentage of chloroform in the blood was found to be practically identical before (0·043 gram) and after bleeding (0·045 gram). In cases where the asphyxial state occurred half an hour to an hour and a half after the commencement of chloroform-inhalation, the figures were 0·048 before and 0·051 after bleeding. The paper gives full details of fourteen experiments which have been made as to the percentage amounts of chloroform in blood before and after hæmorrhage, and these, together with other experiments in which comparisons were made with a normal, with an augmented, and with a diminished mass of blood in the same animal, show conclusively that the percentage of chloroform in the blood does not vary with differences in the mass of the circulating blood. The results of the experiments are therefore in complete accord with what would be the case if, as Buckmaster and Gardner suspected, the red corpuscles were the essential agents for the transport of chloroform.

The curves which illustrate the chloroform-content of the blood during the induction of anæsthesia with 2 per cent. or 3 per cent. of inhaled chloroform vapour are of much interest. At the present time these curves, constructed from data fully given in tabular form, possess great interest. Not only are they the only curves which exist that show clearly the rate at which the percentage of chloroform rises in the blood from the commencement of the administration of the anæsthetic, but the fact which is so well known, that deaths during anæsthesia not infrequently occur within two or three minutes after the patient commences to inhale, is easily understood, for the chloroform-content of the blood mounts up so rapidly at first as to constitute a veritable danger-point. The amount or tension of the drug in the blood rises in the initial stage of anæsthesia with great rapidity to a value which approaches a maximum. If the individual passes this stage naturally, then after a distinct fall in the chloroform-content of the blood, the amount of the drug quickly rises again towards a maximum value, and an equilibrium between the factors which determine the amount of chloroform in the blood is subsequently obtained, the processes of intake and output at the surface of the lung going on side by side. This period corresponds to the second stage of anæsthesia. It may last for one or more hours, and represents the state of surgical anæsthesia. But the condition of the individual is far from one of safety, for although this stage can be maintained with an amount of chloroform in the inspired air which could not have induced anæsthesia, throughout the whole of this time the difference between the amount of chloroform which is present in the blood and what is found at the lethal point is very minute. The authors have laid special stress on this point, and from a careful examination of their curves it would appear that their contention is a sound one.

In their third paper Buckmaster and Gardner have studied the rate of elimination of chloroform after anæsthesia. Five typical experiments, accompanied with full data and curves, are given. During recovery from chloroform small quantities of blood were in some cases taken at intervals from an artery; in other cases the blood was taken by a long canula from the venous system close to the right auricle of the heart, and one curve is constructed from data obtained by analysis of samples, taken simultaneously, of arterial and venous blood from the carotid artery and the neighbourhood of the right auricle. The authors find that the rate at which chloroform is eliminated at the surface of the lungs is at first comparatively rapid, though subsequently this becomes much slower. But the initial rates of elimination are much less rapid than the initial rates for absorption, and therefore, on the whole, elimination of the drug is a much slower process than the assumption. From Tissot's observations it would appear that during recovery from chloroform anæsthesia the amount of the drug in venous blood constantly exceeds the amount in arterial, and he suggests that a study of the chloroform-content of arterial blood should be made during the induction of anæsthesia, and of venous blood during the disappearance of this state. Buckmaster and Gardner do not confirm all the results obtained by Tissot, though they are in entire agreement with him on the important fact that at the moment when the inhalation of chloroform is stopped, arterial blood always contains an excess of the drug when compared with the amount in venous blood.

The salient points of these researches have now been indicated. The application of an exact method, and the performance of a large number of experiments which were carried out under precisely similar conditions in the physiological laboratory of the University of London, have enabled Dr. Buckmaster and Mr. J. A. Gardner to complete this portion of their work, and their results will probably afford a sure basis on which a full knowledge of the physiology of the anæsthetic process during the inhalation of chloroform may in the future be built up.

ARCHÆOLOGICAL REMAINS IN WALES AND THE MARCHES.

IN the sphere of archæology the University of Liverpool bids fair to surpass all other British homes of learning, ancient or modern. Backed by a number of wealthy citizens, more cultivated than the corresponding class in any other town of the Empire, it has lent generous aid to the excavator, and is able to boast, at the present time, of a vigorous archæological school directed by men whose names are pledges of efficiency in their several departments. So far, however, it has interested itself mainly in the elucidation of classical history, in the study of Greek art, and in exploration in Asia Minor and Egypt. Now for the first time its attention is being directed to regions nearer home; at the instance of many Celtic scholars, and numbers of influential Welshmen both in the city and the Principality, it is undertaking the supervision of no less a work than the survey and

systematic excavation of historic remains in Wales and the Marches. As a result of the meeting convened by the Lord Mayor of Liverpool (Dr. R. Caton) —an event already chronicled in these columns—a fund has been started and committees appointed—general, advisory, and financial—for the furthering of the scheme. The actual operations, needless to say, will be watched by the heads of the archæological school, Profs. Bosanquet, Garstang, Myres, and Newberry. Assistance has also been promised by Prof. Haverfield, of Oxford. The work will be carried out in cooperation with the University of Wales, with the Cambrian Archæological Association, with the district or county societies, and with such local committees as it may be found advisable to form from time to time. All these bodies are to be represented on the general committee, which is to include the names, not only of well-known scholars, such as Prof. Haverfield, Sir John Rhys, and Dr. Arthur J. Evans, but of patriotic Welshmen representing every interest and every shade of opinion.

The magnitude of the undertaking and its importance for the study of Welsh ethnology and history can hardly be exaggerated. Owing, it is suggested, to the absence of a capital where their records could be brought together and examined, the Welsh have unduly neglected the investigation of their past, so that the questions which beset the historian are unusually numerous and difficult. It has been the fashion hitherto to search for their solution in the national literature, the memoirs, so to speak, of the people themselves, taking them, in fact, at their own valuation. It cannot be denied that this method has its advantages, the facts which it supplies, when they can be shown to be facts indeed, stamping themselves on the mind with peculiar vividness. In this case, however, they have only too often ended as they began, mere autobiography, with little or no objective value, good material for history, it may be, but still not history. It can no longer be doubted that the study of the Welsh texts, if it is not to end in mere guess-work, must be supplemented for the early period, at any rate, by the study of evidence of another kind, the evidence, that is to say, of historic sites and monuments. That such is to be obtained has been shown by the sporadic excavations of recent years, but until last November it seemed useless to hope for a systematic archæological inquiry; now at last, under the direction of men who will not suffer a penny or the stroke of a pick to be spent in vain, the secrets of cromlech, camp and battlefield will be brought to light, and the story of the past reconstructed step by step.

There are several directions in which research seems particularly needed. It is important in the first place, through the exploring of Roman sites, to determine the relation of the mountaineers to the Roman army in possession, a subject which so far has remained shrouded in mystery. How excavation can help to increase our knowledge of the later Roman Empire may be seen from the work carried out in Germany and Austria, in North Africa and Asia Minor, where the Roman frontier defences have in each case been marked out and made available for comparison, or, looking nearer home, from the operations of the Society of Scottish Antiquaries and other learned bodies, during the past ten years, in Scotland. Though only nine or ten of the Scottish forts have been investigated, definite conclusions have already been formed. The scanty statements of civilians writing at a distance, which used to be our sole authorities for Roman Scotland, it has now been found possible to verify and amplify by means of the handiwork and personal belongings of the frontier guards themselves. At the present time there are ten Roman sites, most of them military posts, awaiting excavation in Wales and the Marches, and there is no reason to doubt that it will be as fruitful in their case as in any of those we have mentioned. We shall be disappointed indeed if it does not enable us to judge of the length of the Roman occupation of Wales, of their frontier policy, and the character and methods of their government. We need hardly point out that light shed on these subjects will be light, not only on the Silures, but on Roman Britain as a whole.

From the Roman remains the committee may proceed with advantage to the examination of the sites and monuments of early Christianity in Wales. Here also valuable data may be had for comparison from other countries, much having been done, both in Ireland and France, to preserve and record the memorials of the primitive church. Among Welsh ecclesiastical sites Bangor is y Coed in Flintshire, and Whitland (Ty Gwyn Ar Dav) in Carmarthenshire seem to promise the richest results. Again, the monasteries of Norman times might be explored with a view to the production of a Welsh Monasticon, the place and personal names in the charters to be corrected with such accuracy as to make these a help, not, as now, a stumbling-block to the student.

Other subjects for investigation will suggest themselves without doubt to all those interested in the early history of this island. The reader will have noticed that the researches specified above are mainly in the nature of digging out or clearing of the ground. We need scarcely remind him that valuable evidence may also be obtained through the observation of things on its surface. The materials for the early history of Wales, like that of other countries, must be sought with the theodolite no less than with the pick or shovel. That it will help us to fuller knowledge of the pre-Celtic inhabitants of the country has been made clear by Sir Norman Lockyer during his expeditions to South Wales. He has indicated the lines to be followed in this kind of inquiry, and the committee cannot do better than follow in his steps. It is occupied as yet with preliminary arrangements. Among the subjects which may be expected to engage its attention in the first instance are the following :—

(*a*) The preparation of an archæological map of Wales and the Marches, on which all known sites and individual finds shall be marked, together with a bibliography and index of all known information regarding them.

(*b*) The execution of an archæological survey of the whole area, to supplement the recorded material, and complete the archæological map, so far as surface evidence is required.

(*c*) The consideration of a scheme of successive excavations for the sites, which may be selected as of most crucial importance, for the solution of the questions of distribution and historical sequence, certain to be raised by the preliminary survey and mapping.

We will only remark, in conclusion, that great schemes cost money, and that those which we have been discussing are not likely to disprove the rule. The expense of surveying a county has been estimated at 150*l*., that of excavating each of the Roman forts, together with the exploration of the adjacent roads and the subsequent publication of results, at not less than 1000*l*. Liverpool is proverbially generous, but even so there will be ample room for the liberality of sympathisers outside, both Welshmen and others. We sincerely hope that the appeal of the committee will not be made in vain; it would be regrettable indeed if its work were retarded or hampered through lack of the necessary funds.

We are given to understand that an illustrated

report of the work will be presented every year to subscribers of 2*l.* 2*s.* and upwards, and for five years to all donors of 10*l.* 10*s.* Cheques should be sent to the treasurer, Mr. T. Rowland Hughes (North and South Wales Bank, Liverpool), and requests for information addressed to the organising secretary, Captain A. O. Vaughan (38 Bedford Street, North Liverpool).

DR. P. J. C. JANSSEN.

FRANCE is again called upon to mourn the loss of a veteran astronomer whose services have rendered him conspicuous among the many eminent men of science his country has given to the world. Jules Janssen, born in 1824, was first a painter, but for more than fifty years contributed to the scientific literature of his country and enriched many departments of physics by his untiring energy, his accurate observations, and his fertility of resource. He was a great traveller; his first scientific expedition was in 1857 to Peru, to study the magnetic equator. Ten years after he was studying the eruption of Santorin with Fouqué. It is not possible to do justice to his work within a small compass, but fortunately its salient features will long remain fresh in our memories.

Janssen's reputation will rest mainly upon his numerous and important researches on light spectra, and the methods he employed for pursuing his investigations. He early recognised the power of the spectroscope as an engine for research, and in its application to many problems connected with solar activity he was without rival among his own countrymen. In 1862, he published the first results of his celebrated researches on the origin of the telluric lines in the solar spectrum, and it is only necessary to recall the history of spectroscopy in the last half-century to make us appreciate the value of his pioneering services in this direction. The perseverance and ardour with which he pursued this subject was shown, first at La Villette, where he so arranged his experiments that the light the spectrum of which was to be examined passed through a tube, 37 metres long, containing steam under a pressure of seven atmospheres, and later, at Geneva, where in another series of experiments the light traversed several miles of atmosphere immediately overlying the lake. For many years the same problem in different aspects occupied his attention.

Long after the part played by water vapour in modifying the spectrum had been settled, Dr. Janssen had recourse to experiments of the same nature in order to decide the precise character of the spectrum effects due to oxygen. The pursuit of this question and his anxiety to vary as much as possible the conditions under which his observations were made, carried him to the top of Mont Blanc, where his experiments warranted him in asserting that there was no evidence of the presence of oxygen in the exterior and cooler parts of the solar atmosphere. To speak with equal confidence of the lower, and, consequently, hotter layers, it was necessary to examine the spectrum of oxygen when submitted to high temperatures and great pressure. By ingenious devices, Dr. Janssen succeeded in raising oxygen to a temperature of 800° or 900°, and in placing the gas under a pressure of 1000 atmospheres. As before, his observations pointed to the absence of oxygen in the sun's atmosphere. His researches on the effect of planetary atmospheres in modifying the spectrum of solar light were equally thorough and satisfactory.

The observations made on Mont Blanc firmly convinced Dr. Janssen of the advantages offered by high mountains for the conduct of certain inquiries, in which it was of importance to reduce as far as possible the thickness of the atmosphere, through which observations had to be made. In spite of increasing age and the inconvenience of lameness, he interested himself energetically in the construction of the Mont Blanc Observatory, and on more than one occasion personally made the ascent of the mountain to assure himself of the success of the enterprise. Under his auspices various physical inquiries have been successfully pursued in this elevated observatory.

As an observer of the sun at the time of total solar eclipse, Dr. Janssen was indefatigable. In 1868, he began that long series of observations which have so much enriched our knowledge of the sun's surroundings. For it was while observing this eclipse at Guntoor that he was impressed with the possibility of observing the prominence lines on the limb of an uneclipsed sun. How, without delay, he put his plan into operation and enjoyed the advantage of a prolonged eclipse is well known, as also the fact that the announcement of his discovery reached the Paris Academy of Sciences at the same time as a similar contribution from Mr. (afterwards Sir Norman) Lockyer informed that body of the successful results of his more prolonged researches. The claims of each have been fully admitted, and just as the names of Adams and Le Verrier are connected with a famous problem in gravitational astronomy, so those of Lockyer and Janssen are joined in the solution of a fundamental problem of physical astronomy. A medal containing effigies of the heads of the two astronomers side by side was struck by the French Government to commemorate this "Janssen-Lockyer Discovery." This is an oft-tale tale, and it would not be necessary to repeat it here but for one circumstance which is not so well known, and which it is desirable to emphasise. This is the generous recognition which Dr. Janssen ever expressed towards his English *confrère*, and his ready acknowledgment of the value of English work. Fortunately, the days of international jealousy in science have passed, but the loyal and hearty appreciation which Dr. Janssen exhibited stands out as a conspicuous example of unselfish and kindly interest, in which no unworthy considerations found a place. Needless to say that his warm-hearted sympathy and encouragement was highly valued and cordially reciprocated.

At Sir Norman Lockyer's suggestion, Janssen was invited to join the English Eclipse Expedition of 1870, and as he was then in besieged Paris, thanks to the exertions of the English Foreign Office the invitation reached him there by the hands of Bismarck, who accompanied it with a safe conduct. This he declined, and left the beleaguered city in a balloon. On that occasion he carried with him the essential parts of a reflector especially constructed to collect evidence about the solar corona. He repaired to Oran, and deserved better fortune than to find the sky completely obscured by clouds at the time of the eclipse. In 1871 and 1875 he was again in Asia, taking part in the observation of solar eclipses, while in 1883 he was one of that remarkable party of enthusiasts who repaired to the lonely coral reef in the Pacific known as Caroline Island. For this eclipse Dr. Janssen used telescopes of six and eight inches aperture, and on his photographs obtained an extension of the corona further than it could be traced in the field of the telescope, revealing a remarkable complexity of structure. Here, too, he confirmed his previous suspicions of the presence of reflected Fraunhofer lines in the spectrum of the corona. His passionate interest in solar phenomena never deserted him, and on the occasion of the eclipse in 1905, notwithstanding his advanced age, he was

found among the observers stationed on the line of totality as it crossed the Spanish peninsula. At a still later period, when the International Union for Cooperation in Solar Research met at Meudon, last May, Dr. Janssen, as president of the congress, exhibited an unflagging interest in all that could promote the object of the meeting.

On the occasion of the transit of Venus in 1874, Janssen not only took part in the observations—going for this purpose to Japan—but devised an apparatus to take a number of pictures of the sun in a short space of time. In many ways the late astronomer distinguished himself by his photographic researches. Not only was he one of the first to direct his attention to the possibility of photographing comets and nebulæ, securing satisfactory pictures of Tebbutt's comet of 1881 and of the Orion Nebula, but his photographs of the solar surface, taken at the Meudon Observatory, have acquired a world-wide renown, both for the beauty of the results obtained, and the ingenuity of the devices employed to secure short and uniform exposures. These photographs were not left as mere pictures to please the eye by the infinite variety they revealed. They were studied and compared until the photospheric network of varied granulation was made to disclose its tale, and put us in possession of the beginning of a solar meteorology. In the course of his photographic experiments he was led to suggest the use of a camera with double slits, so as to allow only a narrow portion of the spectrum to reach the photographic plate, a method of observation which in the hands of Prof. Hale and Deslandres has proved so effective.

He served his country in many capacities, but perhaps rendered no service greater than that of establishing and organising the observatory at Meudon. By this act a permanent home for the furtherance of physical astronomy and solar research has been ensured, and here the work which he began and pursued with such eagerness will be carried on with more powerful instruments than were at his command; but however successful its future career may prove, it will owe its origin in no small measure to the insistence, perseverance, and reputation of Dr. Janssen.

In many ways his colleagues acknowledged the value and extent of his services. He was Commander of the Legion of Honour, Membre de l'Institut; he was the oldest member of the Academy of Sciences, having succeeded Langier in 1873. He was also a member of the Bureau des Longitudes, and had been decorated with the Lalande medal. The learned societies of many countries enrolled his name on their list of fellows. In this country he was a foreign member of the Royal Society, from which he received the Rumford medal for his researches; Edinburgh made him an LL.D. of that university, and in 1872 he was elected an Associate of the Royal Astronomical Society.

NOTES.

THE annual meeting of the British Science Guild will be held at the Mansion House at 4.15 p.m. on Wednesday next, January 15, by invitation of the Lord Mayor. Mr. Haldane, president of the Guild, will address the meeting; and among other speakers will be Dr. T. H. Warren (Vice-Chancellor of the University of Oxford), Sir Archibald Geikie, K.C.B. (secretary of the Royal Society), Sir John Rhys, Sir Wm. Bousfield, Sir John Wolfe-Barry, K.C.B., F.R.S., and Mr. A. Siemens.

THE death is announced of Prof. Albert Lévy, professor of mathematics at the Paris Municipal School of Industrial Physics and Chemistry, and director of the chemical department of the Municipal Observatory of Montsouris. Prof. Lévy was well known for his analyses of the air and water supply of Paris.

A TELEGRAM from Brownstown, Jamaica, announces that a severe earthquake occurred at 8.5 a.m. on January 3. Considerable damage is reported from Kingston and other places on the south shore.—Reuter reports on January 4 that Vesuvius is again active. The volcano is emitting clouds of vapour from large fissures near the summit of the crater, and also towards Atrio Cavallo.

A REUTER message from Rome states that Signor Rava, Minister of Public Instruction, has appointed a special commission to direct and supervise the excavations at Herculaneum, composed of Commendatore Gattini, administrative director of the Museum of Naples; Signor De Petra, professor of archæology of the University of Naples; Prof. Gabrici and Prof. Dall'Osso, both of the Naples Museum; Prof. Sogliano, director of the excavations at Pompeii; Commendatore Avena, director of the technical office of the monuments of Naples; and two civil engineers of the province of Naples.

ON Tuesday next, January 14, Dr. A. A. Gray will deliver the first of two lectures at the Royal Institution on the internal ear of different animals, and on Thursday, January 16, Prof. W. W. Watts will deliver the first of two lectures on (1) the building of Britain. On Saturday, January 18, Prof. Gisbert Kapp will commence a course of two lectures on the electrification of railways. The Friday evening discourse on January 17 will be delivered by Prof. T. E. Thorpe, on the centenary of Davy's discovery of the metals of the alkalis, and on January 24 by Colonel David Bruce, on the extinction of Malta fever.

THE discovery of a large group of dene-holes in the woods between Woolwich and Erith, close to the ruins of Lessness Abbey, was announced in the *Times* of January 3. Two of these holes have already been explored, the position having been marked in each case by a shallow cup-like depression on the surface overgrown with verdure. Excavation in the centre of the hollow exposed the shaft, which is rather more than 3 feet in diameter, and circular in transverse section. After descending for about 50 feet through loam, the shaft enters chalk, and having penetrated this for 4 feet or 5 feet expands into chambers about 18 feet in height. In the sides of the shafts are holes, evidently for supporting a rude kind of ladder for descent. A conical mound of earth, about 10 feet high, occupies the floor at the bottom of the shaft. Each cave has six chambers grouped radially around the central shaft, so as to form in plan a rough double trefoil, recalling the pattern familiar to explorers of dene-holes elsewhere.

ACCORDING to a paper by Mr. H. Beeston published in the December (1907) number of the *Zoologist*, the breeding-range of the marsh-warbler in the south of England is gradually spreading east, a nest having been observed during the past summer in Hampshire. The nest was attached to four or five reeds at an elevation of about 4 feet, like that of a reed-warbler.

TO *Naturen* for November and December, 1907, Prof. A. W. Brögger contributes an illustrated article on "eoliths," in which a number of types from various parts of Europe are described and figured. The author appears to be convinced that these stones were shaped by human agency for special purposes, describing some as knives, others as scrapers, &c.

AMONG the articles in *Schriften naturfor. Ges.*, Danzig, vol. xii., part i., attention may be directed to one by Dr. A. Wallenberg on the anatomy and physiology of the central nervous system of man. The paper, of which only the first portion is now published, is based on an address delivered before the society so long ago as 1888, and has been presented to the public by request. It deals specially with modern methods of brain-research and their result, and is illustrated by several diagrams, coloured or otherwise, displaying in a remarkably clear manner the complicated system of "telegraphy" by which coordinated movements of the body are brought about.

IN his presidential address to the Indiana Academy of Science, as reported in the Proceedings of that body for 1906, Dr. Robert Hessler states that both malaria and tuberculosis seem to have made their appearance in the country since its colonisation by the white man. The advent of malaria is attributed to the felling of the forests, and the consequent periodical drying-up of the smaller rivers, and the destruction of fish, accompanied by an enormous increase in the numbers of mosquitoes. This disease rapidly attained its maximum, but, under preventive measures, as speedily declined, and has now been eliminated from large cities, and to a great extent from their suburbs. Tuberculosis, on the other hand, which is essentially a disease of civilisation, has been steadily on the increase ever since its introduction, and shows no signs of having yet attained its maximum.

THE report on agriculture in the Virgin Islands for 1906–7 refers mainly to the work done at the experiment station at Tortola under Mr. C. W. Fishlock. Although formerly cotton provided a valuable crop, the cultivation had to be re-introduced by the Imperial Department of Agriculture in 1903; since that time the industry has advanced, and is now remunerative; about one-third of the quantity grown is Sea Island cotton. It has also been demonstrated that many parts of the island are suitable for cacao cultivation. A series of illustrations of the experiment station add to the interest of the report.

IN the *Geological Magazine* (June and November, 1907) Prof. A. C. Seward publishes descriptions of fossil plants from Egypt and South Africa. Of three Egyptian specimens, only one, a new species of Clathropteris, is sufficiently well preserved to be named; it furnishes some evidence that the beds from which it was collected were of Rhætic or Lower Jurassic age. The material from South Africa yielded a Phyllotheca and an Osmundites, both made types of new species, a Lepidodendron impression, and a Bucklandia stem. The Osmundites stem and the Lepidodendron both show interesting morphological features, while the Bucklandia is the first record of a Cycadean stem from plant beds of the Uitenhage series.

OWING to the character of the leaves and the intervals that elapse between the flowering periods, the classification of the genus Agave is a difficult matter; also the existing nomenclature is so uncertain that it becomes necessary to study the species in their native habitats. Two papers on Agave and the allied genus Furcræa are published in the eighteenth annual report of the Missouri Botanical Garden. In the former, Prof. W. Trelease discusses the three species *macroacantha*, *pugioniformis*, and *Karwinskii*, belonging to the group of Euagaves. The second species is merged in *macroacantha*, for which the author gives a diagnosis and illustrations showing the plant in its natural environment. Similarly the species *Karwinskii*, that produces a trunk about 10 feet high closely set with leaves, is described. The article on Furcræa, contributed by Mr. J. R. Drummond, furnishes an epitome of the literature of the genus, with a synopsis of known species.

IN connection with the bicentenary of the birth of Euler, the great Swiss mathematician, *Engineering* of December 27, 1907, gives an account of his life, work, and character.

WITH the object of helping prospectors, the Geological Survey of Western Australia has compiled a Bulletin (No. 30) giving particulars of the distribution and occurrence of the ores of metals other than gold. The Bulletin, which covers 129 pages, has been written by Mr. E. S. Simpson and Mr. C. G. Gibson, and contains details of the occurrence in Western Australia of ores of copper, tin, lead, zinc, antimony, bismuth, iron, nickel, cobalt, manganese, aluminium, tantalum, tungsten, and molybdenum.

IN the *Engineering Magazine* (vol. xxxiv., No. 3) Dr. A. Gradenwitz gives an illustrated description of the Royal Bavarian Workmen's Museum at Munich. It is one of the most important museums devoted to industrial hygiene in Germany, where the cause of industrial betterment has been largely furthered by such institutions. The museum is intended to further any efforts made in the field of workmen's protection, while affording a comprehensive view of present achievements in the prevention of accidents, in industrial hygiene, sanitary habitation, and alimentation.

AT a meeting of the Association of Water Engineers on December 14, 1907, an interesting paper was presented by Mr. W. R. Baldwin-Wiseman on the influence of the thickness of the pipe wall on the rate of discharge of water from minute orifices piercing the pipe. The results of the experiments described show that, although the diameters of the orifice may vary considerably, yet for a similar ratio of the thickness of the wall to the diameter of the orifice, the coefficients of discharge are approximately the same at the pressures recorded of 60 lb., 40 lb., and 20 lb. per square inch, and that the coefficients of discharge are in general higher for large values of the ratio of thickness to diameter than for small values of that ratio.

AN elaborate memoir of considerable economic interest, by Mr. Mauric Alfassa, is published in the *Bulletin de la Société d'Encouragement* (vol. cix., No. 9). It deals with the reduction of the working day to eight hours, and records the experience of the French Government establishments and of works in other countries. The author considers that the eight hours' day is practically realisable in all cases. In the cases where the reduction has not been made, it is possible, as is shown by English experience, particularly at the works of Messrs. Mather and Platt, sensibly to abridge the working hours, maintaining at the same time the production and the cost of production, the increase in certain departments being compensated by savings effected in others.

TO the worker in pure science who finds difficulty in following the progress of applied science, the annual retrospects published in the technical journals are of special value. The most complete record of engineering progress is contained in the *Engineer* of January 3. The achievements in 1907 in the various branches of engineering practice are ably summarised, and illustrations are given of the most noteworthy works. A report on shipbuilding in

1907, published in *Engineering* of January 3, shows that in the United Kingdom 1499 ships, aggregating 1,795,400 tons (excluding three dockyard-built warships), and propelling machinery totalling 1,712,000 indicated horse-power, were turned out in 1907. A very complete record of progress in mining and metallurgy in 1907 is contained in the *Mining Journal* of December 28.

BULLETIN No. 14, on "Tests of Reinforced Concrete Beams," by Mr. A. N. Talbot, has just been issued by the University of Illinois Engineering Experiment Station. The tests described are a continuation of the tests discussed in Bulletin No. 4. The topics investigated include the effect of quality of concrete upon the strength of beams, the effect of repetitive loading upon the action of beams, and the resistance of beams to diagonal tension failures. The results of the investigation of diagonal tension failures throw light upon the amount of the vertical shearing stress which may be allowed in reinforced concrete beams not having metallic web reinforcement. The resistance of beams to diagonal tension may be the controlling feature of relatively short beams, and as such failures occur suddenly and without much warning, a knowledge of the resistance of the concrete is essential. Some beams gave surprisingly low values, and it seems evident that the values allowed by many city building ordinances are higher than should be recommended. The tests of concrete columns and reinforced concrete columns and of reinforced concrete T-beams for 1906 have already been published.

THE spell of frost which set in immediately after Christmas over the entire country was for the time severe, and the thermometer touched a lower reading than for several years past. The region of cold spread westwards from the continent of Europe. The Weather Report issued by the Meteorological Office for the week ending Saturday, January 4, covers nearly the whole period of the frost. It shows that the deficiency of temperature for the week amounted to more than 7° in the south and north-west of England, to nearly 8° in the south of Ireland, and to nearly 10° in the south-west of England. In many places the maximum temperature did not once reach 40°. The sheltered thermometer fell below 20° in all districts except the south of England, and in many parts of Scotland, Wales, and the north-west of England it fell below 15°, the lowest temperature reported being 10°, at Balmoral and West Linton. On the grass, the exposed thermometer fell to 2° at Balmoral. In the south-east of England, as well as at some places in the Midlands, the weather was still colder on Sunday, January 5, and the succeeding night. At Greenwich, the minimum shade temperature was 18°, and on the grass 10°. At Birr Castle, in central Ireland, the shade temperature was 12°, and at both Nottingham and Liverpool 16°. An exceptional rise of temperature occurred over the whole country on Monday, January 6, when the thermometer touched 50° in many places. There was a sharp fall of snow in London and the suburbs on the morning of yesterday.

IN the *Annuaire Météorologique* for 1907, published by the Royal Observatory of Belgium, there is an interesting article by M. J. Vincent describing the upper-air investigations carried out by the Belgian observers by means of *ballons-sondes*. The instruments and methods employed are described in detail and illustrated, and the article will be found full of interest by all workers in this important branch of meteorology. Another article in the same publication deals with the humidity of the air in Belgium, the subject being dealt with exhaustively and in a lucid manner. These special articles, and the large number of tables, &c., which the *Annuaire* contains, make the publication a very valuable reference work for meteorologists in general.

A SUMMARY of the results obtained from the meteorological observations made at the Catania Observatory during 1906 is given by Profs. Riccò and Cavasino in an extract from the *Atti dell' Accademia Gioenia di scienze naturali in Catania* (series 4*a*, vol. xx.). The actual readings and reduced values are given for each element, and in a series of notes they are compared with the analogous values for 1905.

PROF. RICCO has completed his gravitational survey of Sicily and Calabria, and published the results in the *Annale* of the Central Meteorological and Geodynamical Office of Italy (vol. xix., part i.). The distribution of gravitational anomalies in Sicily is somewhat peculiar; in the centre there is a defect which reaches the greatest observed value of −67 at Caltanisetta, the unit being 0·001 mm. in the length of the seconds pendulum. Over the greater part of Sicily, however, the anomaly is positive, the lines of equal anomaly forming elongated ellipses with the longer axis running about N.E. and S.W., and cut off by the sea coast on the south. The anomaly reaches a positive value of 160 at Stromboli, and on the east coast off Syracuse, but there are some interruptions of the regularity of increase, the most important of which is on Mt. Etna. Round the foot of the mountain the anomaly has a positive value of about 70, which decreases on its slopes and sinks to −11 at the observatory near its summit. The magnetic survey of Sicily shows anomalies in the distribution of terrestrial magnetism, but as it is impossible to eliminate the magnetic effect of the superficial volcanic rocks, they cannot be correlated with those of gravitational attraction.

THE first part, just received, of the annual report for 1905 of the director of the Weather Bureau of the Philippines gives the results of hourly meteorological observations at the Manila Central Observatory during 1905. The hours of observations are given in insular standard time, that is, in the time of 120° E. longitude, adopted by order of the U.S. Government in 1899. The observations of atmospheric pressure, temperature, relative humidity, vapour tension, and the direction and force of the wind are hourly, read directly between 6 a.m. and 7 p.m., and from self-registering apparatus from 8 p.m. to 5 a.m. Each of the tables of hourly observations shows also the respective hourly, daily, and monthly means. The extreme daily values of the various elements, together with the times of their occurrence, are united in a separate table.

THOSE who in making measurements in which a spark gap has formed part of the apparatus have been troubled by the inconstancy of the results obtained, will welcome a simple device described by Dr. W. Eickhoff in the *Physikalische Zeitschrift* for December 15, 1907, which appears to increase the regularity of action of the gap to a very marked degree. It consists of a short piece of pointed wire, attached to the conductor carrying the negative sphere of the gap at a point close to the sphere, and bent over towards the positive sphere so that its pointed end is a little further away from the surface of that sphere than the two spheres are apart.

COMMUNICATION No. 99 from the physical laboratory of the University of Leyden contains two papers on the

variation of the electrical resistance of pure metals down to very low temperatures, by Prof. H. Kamerlingh Onnes and Mr. J. Clay. They find that the influence of very small amounts of impurities, although insignificant down to a temperature of −200° C., at lower temperatures becomes very marked. They express the effect by writing the resistance found equal to that of the pure metal *plus* a constant, depending on the amount and nature of the impurity. Platinum, gold, silver, lead, bismuth, and mercury have been tested between 16° C. and −260° C. and the results agree fairly well with those obtained fourteen years ago by Sir James Dewar and Prof. Fleming down to the temperature of liquid air. They differ considerably at low temperatures from the results recently published by Mr. G. Niccolai, of Pisa, and it seems probable that the differences are due to the latter not having expressed his temperatures in terms of the international constant-volume hydrogen scale.

MESSRS. N. ZANICHELLI, of Bologna, have published as No. 10 of their series of "Attualità Scientifiche" a recent address delivered by Prof. A. Righi before the Italian Society for the Advancement of Science; the lecture is entitled "New Views on the Ultimate Nature of Matter," and covers a wide field, dealing with the nature of atoms and electrons, and embracing the question of ordinary and colloidal solution.

THE Iron and Steel Institute has published in No. 3 of its journal a detailed account of the visits and excursions during the meeting of the institute held at Vienna in September last. The report contains a large number of interesting particulars of works and mines visited by the members, together with a great deal of information regarding the development of the iron and steel industry within the Austrian Empire; the account is illustrated by several photographs.

FROM Mr. A. B. Porter ("The Scientific Shop"), 324 Dearborn Street, Chicago, U.S.A., we have received a number of circulars containing descriptions and prices of a large number of pieces of physical apparatus, many of which are novel in character and for use in special experiments. The different sets cannot be mentioned here, but the catalogue is an interesting item for anyone engaged in science teaching or research; many of the sets of apparatus are well illustrated and described. Mr. Porter has also favoured us with his "Catalogue D," giving descriptions, illustrations, and prices of numerous optical parts. Telescope objectives and mirrors, prisms, echelon and diffraction gratings, photographic lenses, &c., are included in this list. As showing the enterprise of this firm, we would note that Mr. Porter quotes a price of 38,000 dollars for a paraboidal mirror, grade A, of 84 inches diameter and 40 feet focal length; "prices of other sizes up to 10 feet in diameter will be quoted on request."

THE virtues of celluloid as a material suitable for the sharp and clean divisions of scales or slide rules, or in its transparent form as an edge for T-squares or for set-squares, are well known. Messrs. Casella and Co. have availed themselves of these properties, and of another, viz. that fine sharp lines may be ruled upon it with some opaque black dye, in the convenient area scale, White and Bean's patent, which they have put upon the market. This is nothing more than a group of parallel lines alternately full and dotted one-quarter of an inch apart. The set of parallel lines is laid over the figure the area of which is required, *e.g.* a steam-engine diagram, taking care that it is so placed that the extremities of the area lie half-way between a pair of lines on each side. Then the sum of the included lengths of all the parallel lines is found by marking them off on the edge of a strip of paper. The total length in inches divided by four gives the area in square inches. In order to avoid the necessity of dividing by four, a scale is attached in which the unit distance is 4 inches, and this is divided into one hundred parts, and so by direct application of the strip of paper to this scale the area may be read directly. Alongside of the inch scale is another scale of equal parts such that the length of 4 inches read on this scale appears as 6·45. From this, therefore, square centimetres may be read. When less accuracy is required, alternate lines only need be used, and the result multiplied by two. In the example submitted the linear dimensions are all short by 1 in 150, which would make the areas come out too much by 1 in 75.

THE current issue of Mr. Charles Baker's quarterly catalogue of second-hand optical and other instruments is now available. The list contains particulars of about 1250 pieces of apparatus on sale in this particular department of Mr. Baker's establishment.

THE list of electrical novelties just published by Messrs. F. Darton and Co., of St. John Street, London, E.C., contains numerous illustrated descriptions of pieces of electrical apparatus likely to prove acceptable presents to boys with interest in science. The catalogue also includes various applications of electricity to domestic purposes, in addition to many different patterns of widely used electrical instruments.

MESSRS. JAMES WOOLLEY, SONS AND CO., LTD., publish a compact and useful "Reference Book and Diary for 1908," intended for science teachers and students. The pocket-book contains many convenient tables of constants, brief hints as to the use of instruments, "first-aid" notes, and some advertisements, in addition to the usual form of diary. The price of the book is one shilling bound in cloth and two shillings in leather covers.

THE "Science Year-book and Diary for 1908," edited by Major B. F. S. Baden-Powell, and published by Messrs. King, Sell and Olding, Ltd., contains 152 pages of useful scientific information, a full-page diary for the year—each page being provided with useful astronomical and meteorological data for the day—and numerous blank pages for notes, cash accounts, and other memoranda. The frontispiece is a portrait of Sir Norman Lockyer, K.C.B., F.R.S. New names have been added to the biographical section, but it is difficult to understand what plan has been adopted in selecting names for inclusion in this list. The price of the volume is 5*s.* net.

MESSRS. NEWTON AND CO., 3 Fleet Street, E.C., have submitted to us a specimen of an instrument termed the "Vitascope," devised for the examination of small living creatures under natural conditions. The instrument is in the form of a telescope, about 1½ inches in diameter and a foot in length when closed, and by a novel combination of lenses it enables a magnification of about twelve diameters to be obtained at a distance of 20 inches from the object under observation, and sixty diameters at a distance of about 5 inches. With these magnifications, the observation of insects in flowers or of other small living objects, at a suitable distance from them, becomes a pleasurable and instructive pastime. The instrument has a pillar, which can be screwed upon the top of an ordinary camera stand for use in the garden to observe the struc-

ture or movements of living creatures conveniently. It should be of real assistance in the study of numerous small forms of animal life under natural conditions.

MESSRS. CHARLES GRIFFIN AND CO., LTD., have published the twenty-fourth annual issue of the "Year-book of the Scientific and Learned Societies of Great Britain and Ireland." The work is, as usual, compiled from official sources, and according to the title-page provides a record of the work done in science, literature, and art during the session 1906–7 by numerous societies and Government institutions. It is surprising to find, however, that in connection with the British Association, the only information in the book is confined to the proceedings of the York meeting in 1906, and no mention is made of the Leicester meeting in August last. Under societies concerned with geography, the Geographical Association is not included, though its membership is now nearly 650, and it has branches in various parts of this country and in South Africa. But notwithstanding such defects, which can be remedied easily in the next issue, the compilation should continue to be of real assistance as an index to British scientific associations and their work.

A LIST of publications of the Carnegie Institution of Washington, already issued or in the press, has just been received; and it reminds us of the very useful work the institution is doing by the publication of monographs on many scientific subjects of wide and deep interest. About ninety of these memoirs have been published, and most of those containing contributions to natural knowledge have been described in the columns of NATURE. Among the works now in the press, we notice an atlas of the Milky Way, E. E. Barnard; dynamic meteorology and hydrography, V. Bjerknes and J. W. Sandström; the rotation period of the sun, as determined by the motion of the calcium flocculi, G. E. Hale; inheritance in canaries, C. B. Davenport; supplementary investigations of infra-red spectra, W. W. Coblentz; and botanical features of North American deserts, D. T. MacDougall. The publications are sold at a nominal price, and a list can be obtained upon application to the Carnegie Institution of Washington, Washington, D.C., U.S.A.

OUR ASTRONOMICAL COLUMN.

RETURN OF ENCKE'S COMET (1908*a*).—A telegram from the Kiel Centralstelle announces that Encke's comet was found by Prof. Wolf on January 2.

Its position at 6h. 14·5m. on that date (Königstuhl M.T.) was R.A.=23h. 3m. 16s., dec.=1° 19′ N., and its magnitude was 13·0.

The following is an abstract from the ephemeris given in No. 4222 of the *Astronomische Nachrichten*:—

Ephemeris 0h. (M.T. Berlin.)

1908	α (app.) h. m.	δ (app.) ° ′	log *r*	log Δ
Jan. 11 ...	23 8·8 ...	+2 21·9 ...	0·2829 ...	0·3461
,, 19 ...	23 17·4 ...	+3 7·8 ...	0·2617 ...	0·3477
,, 27 ...	23 27·1 ...	+4 3·1 ...	0·2385 ...	0·3469
Feb. 4 ...	23 38 1 ...	+5 7·5 ...	0·2130 ...	0·3435

At present the comet is apparently passing through the constellation Pisces towards Aries, and sets nearly due west at about 10 p.m. The calculated time of perihelion passage is April 30, not February 22, as stated in our last issue.

SATURN'S RINGS.—No. 4222 of the *Astronomische Nachrichten* (p. 361, December 18, 1907) contains further notes on the recent appearance of Saturn's rings.

The Rev. T. E. R. Phillips states that on many occasions since the middle of October he has seen the ring clearly, as an extremely fine line of light on each side of the planet, with his 12¾-inch Calver equatorial. This line was not always uniformly luminous, but appeared continuous except on November 8, when an interruption on the following side was suspected. He believes the present visibility of the ring to be due to the sunlight passing through the Cassini division and illuminating the edge of the second ring, which is the brightest part of the system.

Dr. Lau gives the results of a number of micrometer observations of the minor axis of the rings, for position-angle, from September 3 to 28, 1907, and shows the differences between the observed and the Nautical Almanac values. The rings were seen on October 2 at 0·2h., but were invisible on October 3 at 23·1h.

THE SPECTRA OF TWO METEORS.—Using a prismatic camera made up of a Voigtländer euryscope, of 50 mm. aperture and 300 mm. focal length, with a 45° crown-glass prism placed before it, M. Blakjo, of the Moscow Observatory, obtained the spectrum of a meteor on May 11, 1904; with another camera an ordinary trail photograph was obtained at the same time. Encouraged by this chance fortune, M. Blakjo directed his cameras towards the Perseid radiant on August 12 of the same year, and was fortunate enough to secure a second meteor spectrum.

In the first case the meteor was of about the first magnitude, and of a yellow colour, and the spectrum consists of fine lines, of which, by an ingenious method of comparison with the hydrogen lines shown in the adjacent stellar spectra, M. Blakjo determined the approximate wave-lengths to the number of thirteen.

The second meteor was equally bright and of a pure green colour; during the second half of its flight it was considerably brighter than at first, and this increase of brightness increased the number of lines shown in the spectrum; the wave-lengths of ten certain and three doubtful lines were determined, and on comparison it was found that the emission spectra of the two meteors are entirely different from each other.

In the spectrum of the first meteor, the calcium lines H and K are the brightest, and are accompanied by the line at λ 4227; magnesium and potassium are also apparently represented. Helium is apparently the outstanding feature of the spectrum of the second meteor, the lines at λλ 3819·8, 3888·8, 3964·9, 4026·3, and 4121·0 being represented. M. Blakjo accounts for the pure green colour of this object by the presence of the thallium line at λ 3775·9 in its spectrum (*Astrophysical Journal*, vol. xxvi., No. 5, p. 341, December, 1907).

THE CONSTANCY OF WAVE-LENGTHS OF SPECTRAL LINES.—The importance of the constancy of wave-length of spectral lines in astronomical, as in terrestrial, spectroscopy leads Prof. Kayser to discuss the question in No. 3, vol. xxvi., of the *Astrophysical Journal*. He points out that Exner and Haschek based some of their recent evidence for variation on differences obtained by students in his laboratory, and states that, in his opinion, these differences were probably due to errors of the standards employed rather than to any real variability of wave-length. Prof. Kayser also adduces evidence, based on the recent work of Dr. Pfund and of Prof. Fabry, in support of his view that "the question of the constancy of the wave-lengths is finally settled."

NEW CHEMICAL LABORATORIES AT ABERYSTWYTH.

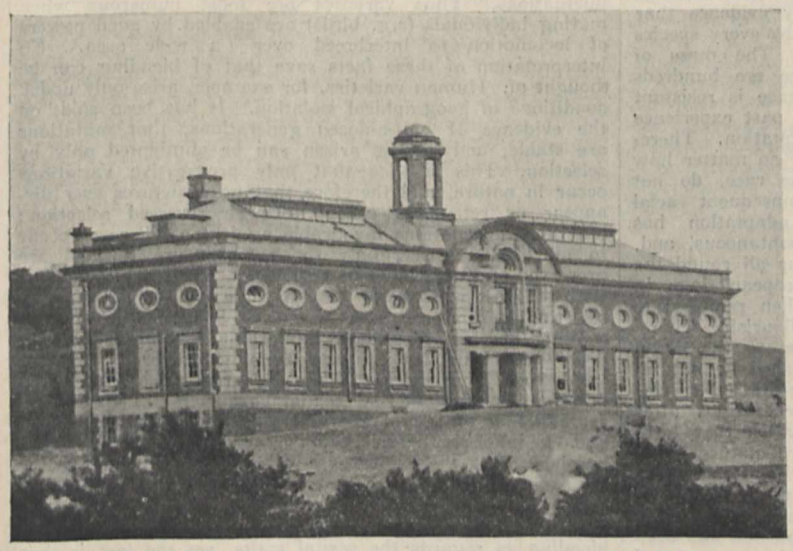
THE Edward Davies chemical laboratories at the University College of Wales, Aberystwyth, which were formally opened on November 1 by Mr. Asquith (see this vol., p. 22), have been erected at a cost of 23,000*l.* by Mr. David Davies, M.P., his mother and sisters, to the memory of the late Mr. Edward Davies, J.P., and have been handed over to the governing body of the University College of Wales. The laboratories are under the direction of Prof. J. J. Sudborough, and have been in use since the opening of the present session on October 2.

The laboratories form a separate block of buildings about half a mile distant from the college, and are erected in local stone with Grinshill dressings. On the first floor are two large laboratories (50 feet by 40 feet), each con-

taining eight double benches (11 feet by 5 feet), so that sixty-four students can work simultaneously; adjoining are balance rooms and a combustion room. The laboratories are well provided with fume cupboards, placed in the window recesses, and ventilated by two main electric "blowers" placed in dormers at the ends of the building. On the same floor is the departmental library (26 feet by 15 feet), which contains complete sets of all the more important English and foreign chemical periodicals, in addition to important general works of reference. The main lecture theatre is situated at the back of the building on the first floor; it is provided with lift-up seats for 130 students, and adjoining it are the preparation room and museum.

On the ground floor are the following rooms:—the physical chemical laboratory, the director's private room and private laboratory, distillation room, two dark rooms, general stores, special stores, porter's room, demonstrator's private laboratory, lecture room with accommodation for fifty students, and two small research rooms. In the basement are a small metallurgical laboratory, extra stores, a fire-proof room, a small dynamo room, and a mechanic's room.

The physical chemical laboratory has a central table 12 feet by 5 feet, with no reagent shelves. Around the walls are slate slabs and wooden tables. The slate tables



The "Edward Davies" Chemical Laboratories, University College of Wales, Aberystwyth.

are provided with several thermostats regulated for different temperatures. The room also contains a fume cupboard for electrolytic work, and a main accumulator board. This board carries the terminals of twenty Tudor cells placed in the adjacent room. The cells are charged from a small motor generator in the basement, and are in groups of one, two, and four. The accumulator board also carries the terminals of eight working positions, four in the physical chemical laboratory and four in one of the large laboratories, and, in addition, three main terminals for the lecture theatre and the motor generator terminals. The terminals are so arranged that any position in the theatre, large laboratory, or physical chemical laboratory can be connected to any group or combination of groups of cells, and also, if necessary, to the motor generator terminals.

The distillation room has no gas connections, but has a long slate slab provided with water, steam, current (220 volts), and waste. It is used for the distillation of large quantities of inflammable liquids, and the source of heat is either steam or electric current. The fire-proof room is furnished with slate slabs and an iron fume cupboard. Experiments necessitating the use of gas during the night are conducted in this room. The gas connections for this room and for the chemical physical laboratory are so arranged that flames may be left burning in these rooms when the main gas supply is shut off for the night. The general heating is by means of hot-water pipes, and the lighting by means of tantalum lamps.

The laboratories are especially arranged to give students a sound training in the various branches of chemical study, and are also admirably suited for the carrying out of original investigations. At present about eighty students are working in the laboratories, and of these five are engaged in research work, mainly on the relationship between constitution and the velocity of reaction of carboxylic acids.

SCIENTIFIC WORK OF THE LOCAL GOVERNMENT BOARD.

THE supplement to the thirty-fifth annual report of the Local Government Board, 1905–6, contains the report of the medical officer for 1905–6. The contents of this valuable volume are briefly summarised in the excellent introduction contributed by the principal medical officer, Mr. Power.

An account of the general administrative business of the medical department is given in Appendix A, which includes reports on the outbreaks of enteric fever at Basingstoke and at Lincoln.

Appendix B contains an account of the auxiliary scientific investigations carried out for the Board, of which three are contributed by Dr. Klein, and deal with plague. The first and second of these form a further contribution on the value of a new plague prophylactic prepared from the dried organs of plague-infected animals, as previously detailed by the author, who concludes that it would appear that the injection of rats with efficient material—the raw or the heated filtrate of emulsions of dried plague organs—in appropriate doses has proved protective in as short a period as seven days against subsequent cutaneous inoculation of virulent *B. pestis*, that is, against plague infection administered in the most effective manner. Further, it appears that the protection thus afforded, though inducible so speedily, may be trusted to persist many days, and even weeks. The prophylactic having been proved to protect rats was also tested on monkeys in order to ascertain whether or not there was promise of its application to the human subject proving salutary and justifiable, and 25 milligrams of dry material sufficed to protect against a supra-lethal dose of virulent plague bacilli. As regards the rat, Dr. Klein finds that various species of rat are differently susceptible to the *B. pestis*, the Norway rat apparently being less susceptible than certain other races.

Dr. Gordon reports on the micrococcus of epidemic cerebro-spinal meningitis ("spotted fever"), with special reference to its identification in the upper respiratory passages. The morphological and other characters of the meningococcus are fully described, and its differentiation from other somewhat similar cocci by means of fermentation reactions on various sugars is detailed.

Dr. Sidney Martin has continued his studies on the chemical products of micro-organisms, and reports on the products of the *Bacillus enteritidis sporogenes*. The experiments show that the poisonous products of this organism do not consist of an endo-toxin, but of a soluble chemical and non-protein substance which is formed by the bacillus by its action on proteins. Dr. Wade contributes an exhaustive experimental inquiry on sulphur dioxide as applied in the destruction of rats and in disinfection on shipboard. The conclusion is formulated that a modification of the Clayton apparatus (described in the report) to supply dilute sulphur dioxide will prove the best adapted to practical requirements.

The last paper, by Drs. Andrewes and Gordon, discusses

the biological characters of the staphylococci pathogenic for man, and tests that will be useful for their differentiation are described.

It will thus be seen that the report contains matter of considerable scientific and practical interest, and it would be a great pity if this work were to be discontinued in the future, as has been rumoured it may be.

R. T. HEWLETT.

MENDELISM AND SEX.[1]

ALL science is founded on observed facts. All authenticated facts, no matter how observed, are valuable to science. Many invaluable facts cannot be observed without the aid of some special method, for example, experiment; but, of the total mass of facts garnered by science, data furnished by experiment form a very small part. Therefore to rely solely on experiment is to put on blinkers.

Since species are able to exist in their environments, they are adaptational forms. The more minute our knowledge of a species, the more certainly are we able to assign past or present utility to nearly all its structures and faculties. Adaptation extends deeper than structures and functions. Variability itself is adaptive. A greater or lesser degree of variability is a variation and material for natural selection. There is satisfactory evidence that the average degree of variability displayed by every species and structure is controlled by selection. The mass of variations are "spontaneous." Thus there are hundreds of human races and diseases, and every race is resistant to every lethal disease in proportion to its past experience of it. Therefore in this case there is adaptation. Therefore it is clear that the poisons of disease, no matter how virulent or universally experienced by the race, do not cause alteration in the germ-plasm, and consequent racial degeneration. On the contrary, since adaptation has occurred, it is plain that variations are spontaneous, and, since diseases are so many, that they occur all round the specific mean. But some races (*e.g.* European dogs in India) have been known to degenerate when removed to new environments, where the native races flourish. Therefore the insusceptibility of the germ-plasm to the direct action of the environment has been established by natural selection, and this, combined with the facts that (1) species tend to become more variable a few generations after removal from ancestral environments to which they have become closely adapted, and where, therefore, nature limits variability; (2) the degree of variability in functionally correlated structures (*e.g.* pairs of limbs) tends to be correlated; and (3) the greater the need for adaptation the less is the degree of variability when once adaptation has been attained (*e.g.* head and fore-foot of squirrels as compared to tail), affords plain evidence that variability is under the control of natural selection.

When cessation of selection as regards any character occurs, that character tends to retrogress. Therefore retrogressive variations tend to predominate over progressive variations, whereby, without an increase of mortality, species are rid of redundancies, both useless variations and old-established parts which have become useless. Since this tendency to retrogression is highly adaptive, the presumption is that it is an adaptation. That the retrogression which follows panmixia is not due to reversed selection is shown by the fact that, though variations favourable against all diseases occur in every human race, yet they retrogress unless preserved by selection, for races become resistant only to those diseases to which they are exposed.

The two central doctrines of Mendelism are:—(1) segregation of units, and (2) independent inheritance of characters. Taken by itself, the doctrine of segregation assigns no function to conjugation. It merely controverts the doctrine of blending. Taken with the doctrine of independent inheritance, it assigns to conjugation the function of effecting an exchange of germinal units between the two sets of parental units. That much Mendelism implies—that much and no more. Mendelians believe, apparently, that they have found the key to all the problems of heredity; but obviously Mendelism is concerned with nothing more than the function of conjugation. No other problem of biology with which it is concerned can be thought of. However grandiose the language used by its adherents, they are quite unable, when challenged, to indicate any other.

Mendelian inheritance is common when varieties which have arisen under artificial selection are crossed. It is comparatively rare when natural varieties (*e.g.* human) are crossed. Blending is then the rule. Latent traits, also, are commonly revealed by the crossing of artificial varieties. In the whole range of biological literature, no instance is recorded of a latent trait being revealed by the crossing of natural varieties. Even when artificial varieties are crossed, they never revert beyond the wild variety; that is, they never reveal traits that were latent in the wild variety. Presumably, therefore, characters become latent only under artificial selection, and consequently Mendelism is concerned, not with the main problem of conjugation, but only with certain anomalies which occur under conditions of artificial selection.

It is admitted on all hands that artificial selection is founded mainly on mutations, and that the inheritance of mutations tends to be alternative. It is admitted that the inheritance of fluctuations tends to be blended, and the evidence is conclusive that natural selection builds on fluctuations. Thus varieties are most numerous when mating individuals (*e.g.* birds) are enabled by good powers of locomotion to interbreed over a wide area. No interpretation of these facts save that of blending can be thought of. Human varieties, for example, arise only under conditions of geographical isolation. It has been said, on the evidence of half-a-dozen generations, that mutations are stable, and having arisen can be eliminated only by selection. This implies that only progressive variations occur in nature, and therefore that no structures ever disappear or retrogress except through reversed selection; but though variations favourable against all diseases occur in all human races, only those which are selected are preserved and contribute to evolution. Therefore it is clear that the rest retrogress, though there can be no reversed selection in this case.

When species are sexually dimorphic, mating individuals differ, as a rule, little in non-sexual characters, but much in sexual characters. Offspring reproduce *either* the paternal *or* the maternal sexual characters. That is, the *reproduction* of sexual characters is alternative, the male and female characters being "allelomorphic" to one another. But the *inheritance* of them is not alternative, for each sex inherits the characters of the other in a latent state, as is proved by a mass of evidence. Therefore, though in bi-parental reproduction there is apparently no blending as regards the sexual traits, yet the fact is that the patent characters of the one sex blend with the latent characters of the other. Sometimes the male characters are latent for a long series of generations, as in aphides, or apparently permanently, as in *Cypris reptans*. A mutation, like a sexual difference, is a large difference, and when an individual mutates and mates with the parent type, the *reproduction* of the mutation tends to be alternative. But the evidence is massive that the *inheritance* is not alternative, but, on the contrary, that the mutation is latent in those lines of descent which follow the parent type, whereas the ancestral trait is latent in those lines which follow the type of the mutant. Like the sexual traits in bi-parental reproduction, the recessive is temporarily latent in the impure dominant. Like the male characters in aphides and *Cypris reptans*, it is more or less permanently latent in "pure" dominants, as is the dominant character in the recessive. This is proved by the occasional occurrence of recessives in lines of "pure" dominants, and *vice versa*. It is even more decisively proved by the reproduction of latent ancestral characters, especially when (artificial) varieties are crossed. Cuénot's theory of colour factors attempts to interpret in Mendelian terms this fact of the reproduction of latent ancestral traits, but his hypothesis totally fails to account for the reappearance of latent ancestral traits in pure lines of descent, as, for example, when an aged female bantam reproduces, not the secondary male characters of her own variety, but those of an ancestral type. Here there can

[1] Abstract of a paper read before the Linnean Society on December 19, 1907, by G. Archdall Reid.

have been no antecedent separation of factors. Therefore the evidence is that mutations tend to be inherited in the mode of sexual characters. There are, however, differences. Sexual characters tend to alternate more perfectly, to cohere together in their respective sets more closely, and to have a lesser tendency to blend with their opposite numbers than Mendelian characters; but this is only what might be expected, for the mode of inheritance for sexual characters has been established by stringent selection. Some sexual characters, however, sometimes blend or change places with their opposite numbers, as in so-called human hermaphrodites; the dominance of some Mendelian characters is very imperfect; reciprocal Mendelian crosses sometimes produce unlike results; and the inheritance of some Mendelian characters (*e.g.* colour-blindness) is sexual. Were their occurrence the rule, not the exception, we would speak of them as sexual characters. Properly speaking, Mendelian characters are non-sexual traits which are reproduced in the sexual mode. If, however, we examine any list of so-called Mendelian characters, we find that the majority may fairly be described as secondary sexual characters, though not necessarily as sexual differences, for example, colour and form of plumage. It seems clear, then, that there is no real segregation, no real alternative *inheritance*, but only alternative *reproduction*, alternative patency and latency. Therefore blending is universal. Unless the reappearance of ancestral traits can be explained, the bottom falls out of the Mendelian hypothesis. Nevertheless, Mendelian facts are very valuable, inasmuch as they indicate the difference between natural and artificial selection. The experimental observer is able to note only large differences between mating individuals. In practice, he has almost limited his materials for study to domesticated varieties. He has altogether ignored fluctuations. Hence the mutation and Mendelian theories.

It is possible that mutations are more common amongst artificial than amongst natural varieties, in which the range of variability is more stringently limited. But amongst the entirely natural varieties of the species we know most intimately (man) mutations are common enough, and their reproduction tends to be Mendelian. But all are so injurious in the struggle for existence or for mates that when possible they are treated surgically. Never yet has a useful human mutation been recorded. Man has a written history of thousands of years, and human varieties differentiate whenever geographical isolation is sufficiently complete and prolonged. Men are fond of noting wonders. But, notwithstanding the immense range of material, never yet has the origin of a human variety by mutation been recorded. It is easy to conceive of evolution as resulting from mutations when we limit our materials of thought to the colours and shapes of flowers and leaves of plants which are preserved under human care. It is not so easy to think of it as founded on mutations when we take into account the exquisitely co-adapted internal parts of a complex animal, amongst which a mutation would have the same effect as one occurring in one of the parts of a watch.

The extreme instability of fluctuations has been noted and has furnished a main argument to the supporters of the mutation theory. There is abundant reason for believing that in a blend the retrogressive character tends to predominate. Thus racehorses degenerate unless carefully selected. Suppose a country in which malaria is prevalent and another from which it is absent. In the former, variations favourable against malaria are selected; like mates with like; therefore blending causes little or no retrogression, and the mean of the race is raised in each generation. In the latter, though favourable variations occur, unlike individuals mate; therefore blending causes retrogression, and the race is rid of a useless redundancy. Apply this reasoning to all variations and all characters, and the function of conjugation becomes apparent. It is, in effect, a selective agent of retrogression. Selection rough-hews the type; retrogression chisels out the finer lines. Reproduction is bi-parental in all the higher and more complex forms in which nature's task of closely adjusting the numerous co-adapted parts is most difficult.

If we accept the theory of blended inheritance, we are able to assign a useful function to conjugation. But to both the Mendelian and the mutationist, sex is a phenomenon to be explained away. According to the former, conjugation merely jumbles together elements which may be incongruous. According to the latter, conjugation is nothing other than an obstacle to the survival of mutations, which have the best chance of surviving when reproduction is parthenogenetic. It has been said by some Mendelians and mutationists that fluctuations are due merely to temporary effects of nutriment, temperature, and the like; mutations alone are permanent. How, then, is it possible to explain the fact that when reproduction is parthenogenetic "thousands of forms may be cultivated side by side in the Botanical Gardens, and exhibit slight but undoubted differentiating features, and reproduce themselves truly by seed" (de Vries)? This does not happen when reproduction is bi-parental. It can hardly be contended that mutations are a thousand-fold more numerous when reproduction is parthenogenetic than when it is bi-parental. We are driven to the conclusion that the fluctuating nature of fluctuations when reproduction is bi-parental is due to the retrogression caused by blending. The seeming permanency of mutations is due to their mode of reproduction. They take longer to retrogress than fluctuations only because they are bigger. All latent characters, since they are not selected, tend to retrogress.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. ADOLPHE CARNOT, latterly director, and for many years professor, of chemistry at the Paris School of Mines, has retired with the title of honorary director of the school.

IT is announced, says *Science*, that Mr. Emile Berliner, of Washington, the inventor of the gramophone, has given 2500*l.* as endowment of a research fellowship for women who have demonstrated their ability to carry on research work in physics, chemistry, or biology.

A RESEARCH scholarship or scholarships, founded by Mr. Andrew Carnegie, will be awarded shortly, irrespective of sex or nationality, on the recommendation of the council of the Iron and Steel Institute. Candidates, who must be under thirty-five years of age, must apply on a special form before the end of February to the secretary of the institute, 28 Victoria Street, London, S.W. The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry.

THE sixth annual meeting of the North of England Education Conference was opened at the University of Sheffield on January 3, under the presidency of Prof. M. E. Sadler. After the presidential address, Prof. Hicks read a paper on the function of a modern university, and Dr. R. H. Crowley (Bradford) and Dr. Clement Dukes (Rugby) dealt with medical inspection of school children. Other subjects discussed were holiday and open-air schools, compulsory attendance at evening schools, and the teaching of history. On the following day Sir William Clegg presided, and the morning sitting was devoted to consideration of the work of training colleges. The afternoon topics were:—(1) the treatment of defective children; (2) house-craft in girls' schools; (3) artistic perception in children.

THE London County Council Conference of Teachers was held on January 2, 3, and 4, when more than 1200 visitors signed the attendance book, and as this was the tenth of these annual meetings, it is clear that their utility is appreciated. With a wise liberality, the County Council promises to send a verbatim report of the proceedings to those who attended the conference, of which a noteworthy feature was the frank cordiality with which the Council inspectors and teachers interchanged views. The principal topics discussed were the place of nature-study in the curriculum, the study of botany by girls, the commercial education of boys, manual instruction for young children, practical suggestions for school library management, and recent pedagogic experiments in the study of literature and of open-air geography.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 7, 1907.—"Further Results of the Experimental Treatment of Trypanosomiasis in Rats: being a Progress Report of a Committee of the Royal Society." By H. G. **Plimmer** and J. D. **Thomson.** Communicated by Sir Ray Lankester, K.C.B., F.R.S.

The following results carry the work, part of which has been already described, on to October 24, 1907.

Rats treated with atoxyl and mercury are still living and well at 229, 222, 208, 178, 164, and 63 days after inoculation; and a rat treated with atoxyl and iodipin is alive at 218 days.

The principal pathological lesion in rats which have been treated with atoxyl and some compound of mercury and have lived for a very long time after inoculation, apparently cured of the disease, is a degeneration of the kidneys; and in most of these rats this was the only lesion found *post mortem*.

Considering both the experiments already recorded which have since ended fatally, and the more recent and —as regards dosage—bolder experiments, the authors are bound to conclude that, in small animals at any rate, mercury has not given altogether satisfactory results. Perhaps it may be a question of dosage; they have, however, tried to enlarge the range of dosage as far as possible, from homœopathic to large ones, without attaining a large percentage of cures. If the dose of mercury be sufficient to aid the atoxyl, they have found, in those cases which have died, chronic kidney, and in a less degree liver, lesions, which seem to be the late result of those more acute changes which have been found in those animals that have died earlier, either from disproportionate dosage, or from some want of resistance to the drug.

Potassium antimonyl tartrate has been tried, and this was found to be fatal to rats in doses of 1 centigram. The trypanosomes were observed to be greatly diminished in numbers, but it was also noticed that soon after the injection the rats appeared to be very ill. This was attributed at the time to the potassium in the compound; probably erroneously, as a similar effect has been noticed in rats treated with the compound described below, when the number of trypanosomes in the blood was very great. The symptoms may have been due to the dissolution of so large a mass of trypanosomes. But they suggested the use of the sodium compound—sodium antimonyl tartrate—with which many experiments have been made.

This substance in 1 per cent. solution is that which, of all the various bodies tried, including atoxyl, has the most marked influence upon trypanosomes in the living body. Although the experiments with it are not many, or of long duration, the results so far seemed sufficient to induce the authors to direct the attention of other workers in this field to it.

The question of dosage is still under observation. The authors have tried many ways, and at present are inclined to think that a full dose (*e.g.* 0·5 c.c. of a 1 per cent. solution for a rat of 200 grams or over) should be given when the trypanosomes are fairly plentiful in the blood, and then repeated at intervals of one, two, and three days, up to about four doses, and thereafter in weekly doses for a month. But they have good results in cases in which a dose has been given on four successive days, also when given every other day, and so on up to once every five days, without any recurrence up to as many as 52 days; but of two cases dosed at five-day intervals, one has recurred and one has not.

The quickness of the action of sodium antimonyl tartrate is remarkable. In one rat, the blood of which was swarming with trypanosomes, a dose of 0·35 c.c. of a 1 per cent. solution caused their entire disappearance from the blood within half an hour; and in two other cases, in which the blood contained very large numbers of trypanosomes, after injection of 0·33 c.c., only a few could be found at the end of half an hour, and in one after an hour none could be found, and in the other only one in an ordinary blood preparation. A few trypanosomes can sometimes be found in the liver, and these are extremely active, and in no way inconvenienced by the drug; whether these are the forms which can persist, and need to be tired out by successive doses, cannot be said at present, but their extreme activity, when all the others have disappeared, is suggestive. The authors have not detected any morphological differences in them.

A guinea-pig, moribund with sleeping-sickness, with œdema of eyelids and genitals, entirely unable to stand, and with a large number of trypanosomes in the blood, was given, on September 16, 0·5 c.c. of a 1 per cent. solution; on September 17 the trypanosomes had entirely disappeared, and 0·75 c.c. was given; on September 19 the animal to all appearances was quite well, and on this day and on September 21 and 26, 1 c.c. was given. The œdema disappeared and it continued to look well, and showed no more trypanosomes. It lived until October 14, when it died; *post mortem* the organs were congested and the kidneys were inflamed, and the urine in the bladder contained albumen. The fact that the guinea-pig was moribund when the treatment was commenced may reasonably account for the pathological conditions.

Of 36 rats treated with sodium antimonyl tartrate, 11 have died, 6 not of the disease, and there remain alive and well: 3 of 52 days, 1 of 49, 7 of 44, 8 of 43, 4 of 31, and 2 of 21; and of these 25, 23 have had no recurrence.

With the view of ascertaining what amount of immunity, if any, had been conferred on an animal which was considered to be cured, a nagana rat was taken which was inoculated on May 13, and had been afterwards successfully treated with atoxyl and succinimide of mercury, and in which no trypanosomes had been found since it had its first dose on May 16, when the trypanosomes were very plentiful in the blood. On October 7, the 147th day, the rat was re-inoculated from another nagana rat, and on October 11 trypanosomes were present in numbers in the blood; a dose of sodium antimonyl tartrate was given, and no trypanosomes have been seen since October 12. This seems to point to the fact that no immunity is conferred.

December 12, 1907.—"Magnetic Declination at Kew Observatory, 1890–1900." By Dr. C. **Chree,** F.R.S.

The paper deals with the phenomena exhibited by the magnetic declination at Kew from 1890–1900. The magnetograph curves have been measured on every day of this period, whether disturbed or undisturbed, and the data from days of the different species are contrasted. Diurnal inequalities are got out for ordinary days, excluding those of large disturbance, and separately for the highly disturbed days, and the differences between these, and the points wherein they differ from the corresponding inequalities from *quiet* days, are investigated.

The disturbed days show a well-marked regular diurnal variation, which differs in many notable respects from that observed on ordinary days.

When the inequalities are analysed in Fourier series, it is found that the difference mainly centres in the twenty-four-hour term, the amplitude and phase of which seem both largely influenced by disturbance. The variations in the phenomena presented by disturbances throughout the year are investigated from several points of view.

The *absolute range* of the declination (absolute maximum less absolute minimum) was determined for every day of the eleven years, and special attention is given to the variation of this quantity throughout the year, and from year to year. With the view of throwing light on the theories of Arrhenius, Maunder and others, on the origin of magnetic storms, a minute comparison is made of the relationship between the absolute ranges and (Greenwich) sun-spot areas throughout the eleven years. Whilst the results do not preclude the possibility that Arrhenius's theory may be true of a certain number of magnetic storms, they seem to indicate that it cannot be a complete explanation of the facts.

Chemical Society. December 19, 1907.—Sir William Ramsay, K.C.B., F.R.S., president, in the chair.—Attempted synthesis of $\begin{matrix}\beta\text{—N—}\beta\\ |\\ \beta\text{—CH—}\beta\end{matrix}$-dinaphthacridine; condensation of methylene dichloride and 1-substituted-2-naphthylamines: A. **Senier** and P. C. **Austin.** By condensing methylene dichloride with derivatives of β-naphthyl-

amine in which the hydrogen of the α-position adjacent to the amino-group had been substituted by a halogen, either Reed's dinaphthacridine or a meso-derivative thereof was formed, thus completing the proof that this base has the constitution assigned to it.—Cobaltamine compounds (preliminary note): C. E. **Groves.** Carycino-cobaltamine carbonate is produced when freshly precipitated cobalt carbonate suspended in dilute ammonia is agitated with air and then exposed to the air for three or four days, in the form of bright crimson crystals. When the crimson carbonate is treated with excess of nitro-hydrochloric acid it is ultimately converted into "bluish-black" crystals. A bronze-green nitrate is prepared by gradually adding a solution of cobalt nitrate in dilute nitric acid to a mixture of dilute ammonia with a solution of ammonium persulphate, and, after it is thoroughly oxidised by shaking it with air, acidifying the mixture with dilute nitric acid. The bronze-green hydrochloride is easily obtained from the nitrate by heating the latter with dilute hydrochloric acid. A grass-green compound obtained from purpureo-cobaltic chloride is also described.—The direct interaction of aryl halides and magnesium: J. F. **Spencer** and Miss E. M. **Stokes.** The authors find that the Grignard reaction between cyclic halogen compounds and magnesium powder takes place without the use of ether when the two substances are heated together. In the case of aliphatic compounds, methyl iodide, methylene iodide, and *iso*-propyl iodide were indifferent, but bromosuccinic acid gave succinic acid.—Derivatives of tetramethyl glucose: J. C. **Irvine** and Miss A. M. **Moodie.** The constitution of tetramethyl glucoseoxime, deduced from its behaviour on alkylation and the hydrolysis of the product, shows that it is produced by the reaction of the sugar in its γ-oxidic forms, and this also seems to be the case with tetramethyl glucoseanilide. It was found that the silver oxide method of alkylation can be applied to the methylation of oximes, thus furnishing a convenient method of determining the hydroxyl content of such compounds.—The characterisation of mercerised cotton. Preliminary note: J. **Hubner.** After treatment with iodine in potassium iodide, mercerised cotton becomes brownish-black, whilst cotton remains white. Similarly, non-mercerised cotton remains practically white, whilst the mercerised material becomes dark navy-blue on treatment with iodine in zinc chloride solution.—Note on the action of metallic calcium on alcohols: F. M. **Perkin** and L. **Pratt.** The statement that metallic calcium has no action on alcohol is inaccurate. With ethyl or methyl alcohol, after from thirty to sixty minutes, reaction ensues, and may become very vigorous, a calcium alkyloxide being formed.—Note on the iodates and periodates of the alkalis and the ammonium radicle: T. V. **Barker.** Specific gravity and solubility determinations of the iodates of rubidium and cæsium, and the periodates of sodium, potassium, rubidium, cæsium, and ammonium, are given.—The colour of cupric salts in aqueous solution: N. V. **Sidgwick** and H. T. **Tizard.** From the results obtained, it seems probable that ionisation affects the intensity of the colour but not the tint.—Derivatives of S-phenylphenazothionium, part i.: S. **Smiles** and T. P. **Hilditch.**—A colorimetric method for the determination of small percentages of iron in copper alloys: A. W. **Gregory.** The method is based upon the colour reaction given by salicylic acid and ferric chloride. The interfering action of the blue copper salts is overcome by the addition of a weak solution of potassium cyanide. Zinc and antimony do not interfere with the reaction, but lead must be removed as sulphate.—The effect of heat on the alkyl iodides: Z. **Kahan.**—The influence of acids and alkalis on the velocity of formation of acetoxime: E. **Barrett** and A. **Lapworth.**—Action of metallic calcium on ketones: H. D. **Law** and F. M. **Perkin.**—The so-called "tetrabromodiphenoquinone" and the constitution of cœrulignone: J. **Moir.**—A note on certain pyrogenic reactions: N. T. M. **Wilsmore** and A. W. **Stewart.**

DUBLIN.

Royal Dublin Society, December 17, 1907.—Prof. G. H. Carpenter in the chair.—The separation and quantitative spectra of cerium, lanthanum, and yttrium: Dr. J. H. **Pollok** and A. G. G. **Leonard.**—The quantitative spectra of molybdenum, tungsten, thorium, and zirconium: A. G. G. **Leonard.** These two papers are in continuation of the authors' joint work on the quantitative spectra of the elements, undertaken to facilitate the use of the spectroscope in its application to ordinary chemical analysis. A reproduction of the spectrum of each element was given, together with a table of the wave-lengths of the most persistent lines, Greek letters being added to indicate the order of disappearance of the lines as the quantity of the element present diminished. In the first paper an account was given of the method of separating the rare metals of the cerite group.

Royal Irish Academy, November 30, 1907.—Dr. F. A. Tarleton, president, in the chair.—The dynamics of a rigid electron: Prof. A. W. **Conway.** A rigid electrified system of any shape is in general motion. A direct calculation is made in a series of approximations of the resultant force and couple due to the internal electric forces. To the first approximation the motion is formally the same as that of a general body moving in a liquid, to the second the motion is found to be aided by a force proportional to the rate of change of the acceleration and independent of the shape. This leads to the ordinary expression for the radiated energy. The third approximation introduces the "transverse" masses. It is shown that the usual expressions for electromagnetic mass become correct if we neglect powers and differential coefficients of the acceleration beyond the first.

December 9, 1907.—Dr. F. A. Tarleton, president, in the chair.—Presidential address on the relation of mathematics to physical science: Dr. **Tarleton.**

PARIS.

Academy of Sciences, December 30, 1907.—M. H. Becquerel in the chair.—Grafting in plants containing hydrocyanic acid: L. **Guignard.** The question as to whether chemical substances secreted by the plant can pass into the graft, or *vice versa,* has been much contested. The author has grafted a plant producing a hydrocyanic glucoside on to another plant totally free from this compound, and inversely; in neither case was there any transport of the glucoside from the graft or the plant. In the artificial symbiosis produced by grafting, each species preserves its chemical characteristics and its autonomy.—Some examples of a collective reasoning in bees: Gaston **Bonnier.** A description of some interesting experiments proving the discipline and division of labour among bees.—The recent determinations of the volume of the kilogram of water: René **Benoit.** A *résumé* of the work done at the Bureau international des Poids et Mesures by the method of contact, and methods based on the phenomena of interference. The mean of the whole of the experiments is that a kilogram of pure water, at its maximum density and under a pressure of 760 mm., measures 1·000028 cubic decimetres, with an uncertainty of about two units in the last figure.—Tables of Uranus and Neptune by Le Verrier. Rectification of the analytical theory: some new tables: A. **Gaillot.** The method followed in this re-calculation was that of Le Verrier, making use of the rectified values for the masses and elements of the orbits. A comparison of the calculated and observed positions furnishes no indication of the influence of any possible planet beyond the orbit of Neptune.—The theory of the moon: H. **Andoyer.**—Vectorial differential invariants and the theory of binary forms: E. **Waelsch.**—The decomposition of a number into a sum of eighth powers of integers: Edmond **Maillet.**—The equation $\frac{\partial^2 z}{\partial x^2} = \frac{\partial z}{\partial y}$: E. **Holmgren.**—The definition of the area of a portion of a curved surface: E. **Cartan.**—Inverse functions of integral functions: Pierre **Boutroux.**—The statics of the deformable line: Eugène and François **Cosserat.**—The variations of the absorption bands of didymium and erbium salts in a magnetic field: Jean **Becquerel.**—The spectrophotometry, viscosimetry, and electric signs of solutions: Charles **Henry.**—The specific heat and molecular field of ferromagnetic substances: Pierre **Weiss.** The hypothesis of the molecular field gives a quantitative explanation of the anomalies of the specific heats of ferromagnetic substances.—The electrolytic reduction of indigo: Henri **Chaumat.** The negative electrode

of an electrolytic cell divided by a diaphragm and containing sodium carbonate solution is formed of a mixture of indigo and graphite. The reduced indigo is dissolved by the caustic soda formed in the electrolysis, and 30 per cent. to 40 per cent. of the current is utilised.—Some thermochemical data relating to the chlorine compounds derived from Millon's base: H. **Gaudechon.**—A new method for the hydration of pinene: Ph. **Barbier** and V. **Grignard.** Pinene dissolved in acetic acid is treated with a 50 per cent. aqueous solution of benzenesulphonic acid at the ordinary temperature. Terpinol can be isolated from the products of the reaction with a yield of about one-third of the weight of the pinene taken.—The ketone derived from β-hexahydrocarvacrol: Léon **Brunel.**—Two modes of individualisation of albite in the microgranitic *massif* of Genis: Jacques **de Lapparent.**—A general method of microchemical research and its application to the study of the distribution of the saponines in plants: R. **Combes.** The method is based on the formation of an insoluble compound of the saponine with baryta, followed by treatment with potassium bichromate. Each cell in which saponine has been present is stained with barium chromate.—Tea from French colonies: J. **Dybowski.** Teas from Indo-China, compared with Ceylon teas, have a slightly higher proportion of caffeine, and about half the quantity of tannin.—The adaptation of *Orchitophrya stellarum*, a parasite of the testicles of the star-fish, to a marine medium: Casimir **Cépède.**—Ethyl chloride in the blood during anæsthesia: Lucien **Camus** and Maurice **Nicloux.** Ethyl chloride penetrates into the blood with great rapidity, and its proportion may, under certain conditions, be raised considerably without danger to the organism.—Discontinuous tetanisation: N. **Wedensky.**—Maps showing the distribution of oysters on the coasts of Vendée: M. **Guerin.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 9.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Cost of Electrical Power for Industrial Purposes: J. F. C. Snell.

MATHEMATICAL SOCIETY, at 5.30.—A Formula in Interpolation: C. S. Jackson.

FRIDAY, JANUARY 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Photographs of Comet *d* 1907 (Daniel): Max Wolf.—(1) Note on the Comparative Eccentricities of Visual and Spectroscopic Binary Stars; (2) On the Orbits of ξ Bootis (Σ 1888); β 80; β 513=48 Cassiopeiæ; β 552=11 Orionis; and β 524=20 Persei: T. J. J. See.—Note on the Simple Equation which comprises the Theory of the Fundamental Instruments of the Observatory: Sir R. S. Ball.—Ephemeris of Flora near the Time of Opposition in 1908: A. M. W. Downing.—(1) Occultations of Stars by the Moon, observed in the Year 1907; (2) Observations of Saturn's Ninth Satellite, Phœbe, from Photographs taken with the 30-inch Reflector in 1907: Royal Observatory, Greenwich.—On an Improved Illumination of the Field in a Transit Instrument, and its Effects on the Discordance in Reversed Positions of the Instrument: Sir W. H. M. Christie and H. A. H. Christie.—The Perturbations of Halley's Comet in the Past. Second Paper: The Apparation of 1222: P. H. Cowell and A. C. D. Crommelin.—*Probable Paper:* Proper Motions of Faint Stars in the Pleiades: F. J. M. Stratton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Principles of Engineering Geology: Dr. Herbert Lapworth.

MONDAY, JANUARY 13.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Among the Volcanoes of Guatemala and St. Vincent: Dr. Tempest Anderson.

TUESDAY, JANUARY 14.

ROYAL INSTITUTION, at 3.—The Internal Ear of Different Animals: Dr. Albert A. Gray.

ZOOLOGICAL SOCIETY, at 8.30.—Description of a Biological Expedition to Birket el Qurun: Dr. W. A. Cunnington.—The Duke of Bedford's Zoological Exploration in Eastern Asia. VI. List of Mammals from the Shantung Peninsula, N. China: O. Thomas, F.R.S.—On the Musculature and other Points in the Anatomy of the Engystomatid Frog, *Breviceps verrucosus*: F. E. Beddard, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Continued discussion:* Keyham Dockyard Extension: Sir Whately Eliot.—Keyham Dockyard Extension; Temporary Works, and Plant and Appliances used in Construction: G. H. Scott.

WEDNESDAY, JANUARY 15.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Ordinary Meeting.—At 7.45.—Annual General Meeting.—Presidential Address on "Map-Studies of Rainfall": Dr. H. R. Mill.

ENTOMOLOGICAL SOCIETY, at 8.—Annual General Meeting.

SOCIETY OF ARTS, at 8.—Screen-Plate Processes of Colour Photography: Dr. C. E. Kenneth Mees.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Microscope as an Aid to the Study of the Biology of Insects with special Reference to the Food: W. Wesché.—Improved Type of Mercury Vapour Lamp for use with the Microscope: J. E. Barnard.

THURSDAY, JANUARY 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Alternate Current Measurement: Dr. W. E. Sumpner.—Prominence and Coronal Structure: Dr. W. J. S. Lockyer.—The Conversion of Diamond into Coke in High Vacuum by Kathode Rays: Hon. C. A. Parsons, C.B., F.R.S., and A. A. Campbell Swinton.—And other Papers.

ROYAL INSTITUTION, at 3.—The Building of Britain: Prof. W. W. Watts, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.

SOCIETY OF ARTS, at 4.30.—Indian Agriculture: Henry S. Lawrence.

LINNEAN SOCIETY, at 8.—(1) Brassica Crosses, illustrated by lantern slides; (2) Notes on Wild Types of Tuber-bearing Solanums, illustrated by lantern slides: A. W. Sutton.—Revision of the genus Illigera, Blume: S. T. Dunn.—New Coniferæ of Formosa: Bunzō Hayata.

CHEMICAL SOCIETY, at 8.30.—Colour and Constitution of Azo-compounds. Part II. The Salts of *p*-Hydroxyazo-compounds with Mineral Acids: J. J. Fox and J. T. Hewitt.—The Oxidation of Aromatic Hydrazines by Metallic Oxides, Permanganates, and Chromates: F. D. Chattaway.—Studies in Fermentation. II. The Mechanism of Alcoholic Fermentation: A. Slator.—Organic Derivatives of Silicon. Part IV. The Sulphonation of Benzylethylpropylsilicyl Oxide and of Benzylethyldipropylsilicane: H. Marsden and F. S. Kipping.—The Formation and Reactions of Imino-compounds. Part VI. The Formation of Derivatives of Hydrindene from *o*-Xylylenedinitrile: C. W. Moore and J. F. Thorpe.

FRIDAY, JANUARY 17.

ROYAL INSTITUTION, at 9.—The Centenary of Davy's Discovery of the Metals of the Alkalis: Prof. T. E. Thorpe, C.B., F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Third Report to the Gas-Engine Research Committee: Prof. F. W. Burstall.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Principles of Engineering Geology: Dr. Herbert Lapworth.

SATURDAY, JANUARY 18.

ROYAL INSTITUTION, at 3.—The Electrification of Railways: Prof. Gisbert Kapp.

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