THURSDAY, JANUARY 15, 1903.

THE HOLY SHROUD OF TURIN.

Le Linceul du Christ; Étude scientifique. By Paul Vignon, Dr. è Sci. Nat. Pp. 207 and 9 photogravures. (Paris : Masson et Cie, 1902.)

The Shroud of Christ. By Paul Vignon, D.Sc. (Fr.). Translated from the French. Pp. 170; 9 photogravures and collotype plates and 38 illustrations. (Westminster : Archibald Constable and Co., Ltd., 1902). Price 12*s.* 6*d.* net.

WHETHER the relic described, figured and discussed in this handsomely got up volume is the veritable shroud which enwrapped the body of Christ is a question which need not be seriously considered in the columns of a scientific publication. Dr. Vignon seems to have convinced himself that the relic is genuine, and his object in publishing this work is (presumably) to convince his readers, or at any rate to place before them the evidence on which his conclusions are based. So far as the antiquarian evidence goes, it will suffice to remind readers of NATURE that during the recent controversy—which appears to have been the last of a series of controversies concerning the authenticity of the relic in question—Father Herbert Thurston, S.J., communicated a letter to the *Times* of April 28, from which we make a few extracts :—

"The Abbé Ulysse Chevalier claims to have proved to demonstration that the linen winding-sheet exhibited at Turin is a spurious relic manufactured in the fourteenth century, and, as the writer believes, with fraudulent intent."

"We are not, of course, in any way bound to believe that those responsible for the subsequent veneration of this alleged relic have been guilty of conscious fraud. It may even in the first instance have been fabricated without intent to deceive. . . . Just as in the case of so many facsimiles of the Holy Vails, what was in the first instance a mere copy for devotional purposes has come in time to figure as an original, the wish, no doubt, being father to the thought, but probably without any deliberate insincerity."

Thus, out of the seven chapters composing this work, there are but two which come within our province, viz., chapter vi., in which the author deals with the scientific evidence, and chapter vii. more particularly, in which he puts forward an explanation of the image which is to be seen on the shroud. The antiquarian lore of the preceding chapters has no particular interest for us, and we may add, further, that the question whether the shroud is the real article or whether it was "faked" in the fourteenth century is a point which in no way affects the discussion of Dr. Vignon's scientific evidence, because the explanation with which we have to deal is equally miraculous whether the image is some twenty centuries old or whether it is only six hundred years old.

It will be necessary, in order that our readers may judge the issue raised by Dr. Vignon's *étude scientifique*, to give a brief description of the relic, facsimile reproductions of which are given in photogravure plates showing respectively the full-length image and the head only on an enlarged scale. The impression, according to the description and figure, is that of a human body undraped, with hands crossed, with a long face terminating in a beard, with hair over the lips and long hair lying along each side of the face ; in brief, the face of Christ as made familiar by the great masters of the old Italian school. This description, of course, applies only to the front aspect. The back view is such as would be presented by the same body if seen from behind or if it produced an impression on the linen while lying on its back, the front aspect being produced (on the assumption that it is an impression) by drawing the same shroud lengthways over the face of the prostrate body. The shroud would evidently in these circumstances (again assuming that the body impressed its image) show the two figures, front and back view, on being opened out, the figures being joined head to head, and this is declared to be the state of affairs visible on the holy shroud. The image is said to be formed of reddish-brown shades and—what is of fundamental importance to the author's theory—the lights and shades are reversed, *i.e.* the impression corresponds to a photographic negative. In consequence, the true aspect of the features only appears when the image is reversed by being photographed, and this is well shown in the plates referred to, from which the reader will be enabled to compare the image with its photographic reverse. There are many other marks on the shroud which are caused by rents, stains, burns, pieces clipped out, &c., all of which naturally appear in the photographs. We fail to see the importance of the over-elaborated details of description with which the author treats of these marks, unless it be to establish his claim for the authenticity of the relic from the antiquarian point of view. With this we have nothing to do here ; scientifically, these marks appear to us to have no value whatever.

It remains to be pointed out that the author, so far as can be gathered from his writings, has never seen this relic himself, but has relied upon the descriptions of others, upon a water-colour copy made in 1898 and upon photographs taken by M. Pia, by M. Fino and others in the same year when the shroud was allowed to be on view for eight days. We suppose that Dr. Vignon is satisfied that the image, as it appears on the shroud, is really a negative impression and that the photographic plates have not been tampered with, although we confess that for an *étude scientifique* we should have expected some more substantial and first-hand verification of these fundamental statements. We will, however, let all this pass and meet the author half-way, and admit that there is a negative image of a human figure on the linen, and this brings us to the core of the subject, which is embodied in the query :—Apart from the question of age, how was this image produced ?

Now according to the author's descriptions, which, we may repeat, are given in ridiculously minute detail, there are visible on the head and on the body itself certain marks which we are asked to believe to represent blood stains, lacerations and wounds, and we are even given an illustration of the particular kind of "flagrum" with metal buttons which the Romans used. In fact, the description as given by the New Testament writers is, if we are to accept the author's statements, so faithfully and so minutely verified by the figure on the shroud that the ordinary reader who is not thirsting for

new "evidences," but who is simply anxious to know the actual facts of the case, will probably come to the conclusion that Dr. Vignon is either the victim of credulity or that he has overdone his evidence to such an extent as to have damaged his own reputation as an expert scientific witness. The plates certainly do not tally with the details of the markings as described in the text; but here again it may be that there is much lost by the heliographic reproduction and that the author is describing the original photographic plate, which he is careful to inform us was taken by M. Pia on an Edward 50 × 60 isochromatic film sensitive to yellow, with a yellow screen, a Voigtländer lens, a diaphragm of 7 mm. diameter and an exposure of 18 minutes, the shroud being illuminated from the front by two powerful arc lights at 10 yards' distance from the surface. We will therefore again waive an objection which might be raised against the author's special pleading on behalf of the shroud, and we will admit that there are marks on the face, body and limbs in the original plate which we cannot see in the heliogravures reproduced from it—certainly no such marks are distinctly recognisable in the front view, whatever interpretation may be put on the blotched appearance on the body in the back view.

The simplest, the most obvious and the only straightforward answer to the question how the image was produced is that it is a time-worn painting—how, when or why executed being beyond our province of inquiry in these columns. Dr. Vignon, however, is so emphatic in his repudiation of this idea that he fires off a whole battery of arguments in the sixth chapter in order to demolish the sceptics who from the fourteenth century downwards have taken this not altogether unreasonable view of the relic. One or two of these arguments may be dealt with on their own merits as appealing to scientific principles. He lays very much stress, for example, upon the circumstance that the impression is a negative one, arguing therefrom that no forger could possibly have painted a figure intentionally with lights and shades reversed. May we ask why not? As an artistic feat it does not seem altogether impossible, and distinguished artists whom the reviewer has consulted inform him that, not only is such a style easy of execution, but that a forger who wished deliberately to convey the impression that the image was produced by contact of the body with the shroud would, if skilful, intentionally adopt such an artifice. Then again, it is stated (p. 123, English ed.) that the image cannot be a painting (*i.e.* in pigment) because it would have faded with the lapse of time instead of becoming darker. Again we ask why? In the first place, where is the evidence that the image has become darker? In the next place, accepting Dr. Vignon's own explanation, which shall be considered subsequently, why should a "vaporographic print" (to use the author's term) be more permanent than a painting? An organic colouring-matter developed on the linen by the hypothetical process advocated in this work is not more likely to withstand the influence of time than a painting. The argument appears to be:—It has not faded, therefore it is not a painting. It is not a painting, therefore it is a chemical (vaporographic) impression. Readers of this review will see that little value can be attached to such inferences.

Having dismissed the theory of artistic forgery—at any rate to his own satisfaction—the author proceeds to demolish the view that the image is a contact impression. With this conclusion we quite agree. The only way that such an image could be produced by contact would be for the body to be uniformly coated with pigment and then for the supple shroud to have been pressed over and into every elevation and depression in the body. We are all familiar with the appearance of images produced by such means, and a glance at the figure on the shroud with all the details of the features and the hair will suffice to show that such an impression on linen, however supple, could never have been obtained by mechanical contact—even supposing the preliminary preparation of the body with pigment were conceded. Nothing short of a plaster cast could reproduce features such as appear in the plates. The martyrdom which Dr. Vignon must have suffered in allowing his face (with a false beard) to be smeared with red chalk in order to see what kind of impression could be obtained from it by such means will be credited to his zeal, although the publication of the blurred results in the form of a heliogravure plate seems quite superfluous.

Having thus shown how the image could not have been produced, the author proceeds to the development of his own hypothesis. The impression is not a photographic negative in the ordinary sense, but it is a genuine chemical impression produced by emanations from the body acting on the shroud, "sensitised" by the materials used for its impregnation. The emanations were not of the same kind as those proceeding from radio-active substances, but were more of the nature of vapours. Appeal is made to Dr. W. J. Russell's experiments in order to show the analogy between the images produced by the emanations from zinc, resinous substances, &c., and that on the shroud. Prof. Colson has cooperated with the author, and between them they have produced what by courtesy the writer of this notice proposes to call Russell-types of coins and busts (prepared by coating with zinc powder) on photographic plates.[1] Photographic reproductions of these are given in the volume under notice. From these figures, it will be seen that the impressions produced are really very poor as compared with the originals. The head on the coin, for example, is full of detail; its Russelltype, after photographic reversal, shows but a blurred and hazy image. Of course, the emanations from the body did not consist of zinc vapour, nor was the shroud coated with gelatino-bromide emulsion, so there may be no real analogy between the images—even on the "vaporographic" theory of Dr. Vignon. The emanations of the body, according to the author, proceeded from "febrile sweat" which bathed every portion of the body, hair included, and the sensitive material which enabled the shroud to receive the impression was, or may have been, a mixture of oil and aloes. There is nothing antecedently improbable in the supposition that emanations from a dead body, especially if ammoniacal as supposed by the author, may produce a coloured impression on a sensitive vegetable colouring-matter. So far there is just enough *vraisemblance* in the hypothesis to lead the

1 Prof. Colson, by the way, has come to the conclusion that the emanations from zinc really consist of zinc particles, and it is these which penetrate the sensitive surface and produce the photographic effect. This explanation is at variance with the hydrogen peroxide theory of Russell.

unwary to think that Dr. Vignon has established his case. As his work professes, however, to be an *étude scientifique*, and as he unhesitatingly lays down the conclusion that the shroud is the real article (Popes, Bishops and Jesuits notwithstanding) and that the image is a "vaporograph" produced in the manner described, it is of considerable importance that his evidence should be critically considered.

In order to clear the ground, we will make a most liberal advance in Dr. Vignon's favour and concede for the sake of argument that such ammoniacal vapours may be emitted as required by hypothesis, and further, that the shroud may have been impregnated with some sensitive colouring-matter or colour generator capable of receiving an impression in three days. What kind of impression could be expected in these circumstances? Stretching the hypothesis to its utmost limit, certainly only a blurred human figure in outline. Now look at the image on the shroud; features with a recognisable expression, hair in detail and (as per description) blood stains, wounds and stripes. Surely, as the author himself says (p. 43), "There is no limit to hypothetical ingenuity."

A scientific witness must, however—whether his hypothesis be reasonable or otherwise—be expected to give some substantial evidence for a hypothetical belief, and the more unlikely the hypothesis, *a priori*, the stronger must that evidence be. Here is what Dr. Vignon has to offer:—

"We took the plaster cast of a hand and covered it with a glove of suède kid. We then poured some of the ammoniacal solution (ammonium carbonate in water) along the wrist so that it penetrated the plaster without completely saturating the glove. The vapours were given off very regularly through the pores of the kid without staining the linen by too much water or letting the oil penetrate the damp glove.

"Working in this way we got an excellent impression of the back of the hand (on linen impregnated with olive oil and aloes). The tips of the fingers have the square aspect due to the glove having been too long. On the inside of the thumb the seams of the glove are plainly to be seen, while on the outside the image fades away rapidly and regularly. *The print is sufficiently definite to show the likeness of a finger, but too diffuse to mark the actual outlines, and this may be said of all the fingers.* (Italics ours. Compare with the hands on the figure on the shroud where the fingers are distinct.) . . .

"The print which we have obtained of this hand justifies us in asserting that under special conditions ammoniacal vapours may produce as distinct impressions of an object as those shown on the Holy Shroud" (p. 167).

Dr. Vignon's scientific conscience must really be very easily satisfied. This is the only scrap of experimental support that he furnishes. No illustration of the "vaporographed" hand is given. It is confessed that the experiment is so delicate that an attempt to repeat it gave a worse result than the first. A plaster bust of Michael Angelo refused to furnish any recognisable impression. Yet with these inconclusive results, the author virtually claims to have settled the whole history and origin of the relic. Just when he comes to the very point where scientific evidence becomes possible, he meets with what appears to the reviewer to be a failure, and then naïvely remarks:—'We shall continue these experiments if desirable, though they only present a limited interest" (p. 167). The magnitude of the conclusions based on such lame experimental evidence justifies the condemnation of the whole work as an *étude scientifique*. To the reviewer, it reads like an antiquarian dissertation ending in a pseudo-scientific anti-climax. The conditions required by the hypothesis are not difficult to realise experimentally. There are many organic colouring-matters sensitive to ammonia gas. The fever hospitals would surely furnish the author with subjects for experiment if inanimate models of the human figure are considered unsatisfactory. If by ammoniacal or any other vaporous emanation Dr. Vignon can succeed in producing an impression as distinctly recognisable as a likeness as the image on the shroud in all its details, we will waive the question of twenty centuries' permanence and go so far as to admit that there is at any rate some justification for "vaporographic" portraiture. As the "explanation" stands now, it is purely in the region of hypothesis, and pending that rigorous verification required by science, we consider that the author's case is "not proven." If there are any scientific readers who are convinced that the conclusions in this work are satisfactorily established, we shall be disposed to credit the shroud with having wrought a greater miracle than was ever ascribed to it by the Chapter of Lirey in the fourteenth century.

R. MELDOLA.

IRISH FOLKLORE.

Traces of the Elder Faiths of Ireland. A Folklore Sketch. By W. G. Woods-Martin, M.R.I.A. Vol. i., pp. xix + 405; vol. ii., pp. xv + 438. (London: Longmans and Co., 1902.) Price 30*s.* net.

"MANY readers may have read works treating of some one or more epochs included in the past of which Ireland has been the scene, but up to the present," says the author, "this lengthened period has not been treated as a whole." Such a complaint can no longer be made after the publication of this able and comprehensive work, which is, as its second title indicates, "A Handbook of Irish Pre-Christian Traditions."

The consideration of the main subject of the book, the faiths of Ireland, is preceded by about 120 pages of introductory matter concerning the geographical shape of the island, the Great Ice Age and the nature of the earliest inhabitants. Excellent illustrations are given of the effects of the Great Ice Age in moulding the sides of the hills, &c. In the enumeration of the various theories as to the causes of the Ice Age, a suggestion is made as to the significance of the sun being a variable star. This fact may possibly explain the whole mystery. Though not often mentioned by the theorists, namely by those who are in favour of Sir C. Lyell's geographical explanations or of Croll's astronomical arguments based on the variability in the shape of the earth's orbit, it cannot have been outside their views. If, for instance, it be true that, in the time of Ptolemy, α Geminorum (*Castor*) was the brighter, and, therefore, presumably the hotter, star than β (Pollux), we may suppose that the inhabitants of the planetary dependents of the former are now experiencing a glacial or those of the latter a torrid epoch.

Ireland seems to have been the home of the gigantic

deer, their increase being explained by the total absence of lions from the island.

The earliest inhabitants of the country migrated, it would seem, from the south-west of Scotland into Ulster. According to the author, the fact that the skulls of these early inhabitants are often rather larger than those of the average of the masses inhabiting the great cities of the present day is explained by the intelligence needed for defence and for the procuring of food.

"Indeed, on the principle of the survival of the fittest, it could only be the robust who lived through the hardships and climatic exposure incidental to a savage life."

The author, in his summary, admits the theory of evolution, though under the direction of the Great First Cause.

Even as late as the time of the Spanish Armada, the inhabitants of Ireland were described as follows by Captain Cuella, who escaped from one of the wrecks off the Irish coast:—

"They live in huts made of straw. The men have big bodies, their features and limbs are well made and they are as agile as deer. They eat but one meal a day, and their ordinary food is oaten bread and butter. They drink sour milk, as they have no other beverage, but no water, although it is the best in the world. They dress in tight breeches and goatskin jackets, cut short, but very big, and wear their hair down to their eyes."

It is not surprising that such a race should entertain the curious ideas so abundantly described in the author's pages.

Nowhere in Ireland has discovery as yet been made of any Palæolithic art like the extraordinary and life-like incised sketches of men and animals made by the cave-men of Gaul. No representations of human or animal forms seem to have been made prior to the introduction of Christianity. Even then, they were of an arabesque character and subsidiary to the scroll work in which they were entwined. Nor does iron appear to have been introduced into Ireland until the fourth century, A.D.

It is difficult to fix the point where real Irish history commences. An interesting map of Ireland according to Ptolemaic geography is reproduced on p. 230. There is said to have been no Roman colonisation, though Roman objects were, of course, imported. An illustration is given (p. 237) of a Roman medicine stamp of smooth grey slate found in the county Tipperary. It was probably used to stamp a "patent medicine" made and sold by the Romano-Hibernian dealer whose name it bears.

In the chapter which deals with stone worship, there seems to be so little, so far as Megalithic remains are concerned, which can be illustrated from Ireland that the chief example has to be drawn from Carnac, in Brittany. One circle of stones, indeed, is introduced, named the Druids' circle, near Killiney, which consists of seven small stones and two uprights large enough to be called *giants*. There are no data, however, given from which the age of the work, as in some of the Megalithic circles in Great Britain, could be investigated, and there is only one instance, and that a doubtful one, of anything of the nature of the alignments in Brittany which can also to some extent be interpreted astronomically; but there are numerous and very curious examples of perforated stones which have been employed even in comparatively recent times for passing children through in hopes of curing them from various disorders. These holes, in some instances, are large enough to allow grown-up people to creep through them, though generally with difficulty. Sometimes the holes were only large enough to admit the arm, or even the thumb and fingers, to be passed through them. Marriage contracts, it is said, are still ratified in this way, country couples signifying betrothal by clasping hands through the hole. Such practices, it is shown, were not confined to Ireland, but the evidences seem to be very greatly multiplied in that country. The history is given of the *Stone of Destiny*, as it was called, which is now placed under the Coronation Chair in Westminster Abbey. This supposed magic stone, which roared like a lion when a legitimate king stood upon it, was, it is alleged, sent to Scotland in the ninth century in order to secure the then dynasty on the throne. It was preserved with great care at Scone, in Perthshire, until 1296, when it was carried off by Edward I. of England.

Lovers of folklore will find in this book abundant illustrations of that subject, and among them many examples of prehistoric practices surviving into recent and even modern times.

MIGRATORY LOCUSTS.

Die Wanderheuschrecken und ihre Bekämpfung in unseren afrikanischen Kolonieen. Von Dr. L. Sander. Pp. 544. (Berlin: Reimer, 1902.) Price 9 marks.

AFRICA has always been exposed to the ravages of migratory locusts, the fringe of cultivation on the borders of extensive deserts or wildernesses being peculiarly favourable to their attacks; and this applies more especially to the north and south of the continent. Dr. Sander's volume is a carefully compiled account of their ravages in the German colonies of Africa during the last ten or twelve years, for though travellers and missionaries have left us accounts of earlier invasions, yet the first disastrous appearance of locusts in East Africa since the German occupation was in the years 1894 and 1895, when a serious famine was the result. A graphic account is given by a native of Pangani, from which we may extract and condense a few sentences:—

"In December there came vast swarms, so that the heavens were covered by them, as if with black clouds. The locusts have devoured everything in the country, especially lentils, peas and bananas. We are in a sad state here, for they have devoured the whole harvest, and it will take years to repair the damage. First we must dig over the whole country, for the locusts have devoured everything, root and branch. Second, we must buy fresh seed, and that will cost much money. Third, we must buy our food from the traders for the present, for we have nothing left to live upon. The locusts have been here in vast swarms since November and December, and have not yet retired. We have the black and yellow ones here, and red ones too. Our largest landowners and sugar manufacturers have removed to Pangani because their plantations lie wasted. Each of these gentlemen has hundreds of workmen to provide for. For the present, there is no thought of the retreat of the creatures. I tell you that when a swarm comes, we can often scarcely see the sun. The locusts

are greedy beyond expression. A European laid out some cotton and coffee to dry in the sun, and when he looked for it after a time the locusts had devoured it all —cotton, coffee, and even the blankets on which the raw material had been spread out." Since then, the locusts have never left the district, and were again very destructive in 1898 (pp. 7, 8).

In South-west Africa, various locust invasions are noticed, from 1831 to the present time; and it is recorded that at Barmen (in the present Orange Colony) in 1866, the

"Fussgänger" (immature locusts) "not only devour all the plants, green or dry, before them, but everything that they can find, including linen and clothes left unprotected; for they creep into the houses even to the bedrooms, and eat up everything" (p. 20).

A pitiful story comes from Little Namaqualand in 1873:—

"On the morning of May 5 I held a prayer-meeting to implore the Lord to send us a little rain, and to put an end to the great drought and distress. In the afternoon clouds actually rose, and we heard a rushing in the air as if it was about to rain; but, alas! the noise was caused by swarms of locusts, which covered the whole place, and completely devoured the little dry grass that was left" (pp. 21, 22).

One is forcibly reminded of the old story of the Adites, who sent a deputation to Mecca to pray for rain, and were answered by a black cloud which sent forth a desolating wind which exterminated the whole tribe.

After discussing the ravages of locusts in the various territories of German Africa, Dr. Sander proceeds to give a full account of the habits, transformations, biology, &c., of the most destructive species of African locusts, and also discusses the best means of contending with their ravages; and the natural enemies of locusts (birds, &c.) are also noticed. Without being overloaded with illustrations, there is a sufficiently good series in the text to render the subject intelligible to the general reader. An appendix contains an interesting edict of Frederick the Great, ordering the destruction of locusts in Prussia in 1753. Dr. Sander's maps illustrate the prevalence of the pest in German East Africa from 1897 to 1899, and in Cape Colony and South-western Africa from 1891 to 1900. His book, though written, of course, for the benefit of the German colonies in Africa, deserves the most serious attention from all who are interested in the welfare and prosperity of our own African possessions.

W. F. K.

OUR BOOK SHELF.

Applied Mechanics for Beginners. By J. Duncan, Wh.Ex., A.M.Inst.C.E., &c. Pp. x+324. (London: Macmillan and Co., Ltd., 1902.) Price 2*s.* 6*d.*

WITH the development of the mechanical laboratory in technical schools and colleges, the teaching of mechanics has in recent years undergone a quiet revolution. Experiments are no longer confined to the few made by the teacher, but the students now all take a share in this kind of work, which has become an important part of the school or college course, being of great value, as affording the training in inductive methods which in former times was often neglected.

The volume under review shows the influence of these prevailing conditions. A considerable portion of the book is devoted to the description of laboratory appliances, the methods of making tests and the kind of information to be got therefrom. Some of the apparatus is of quite a simple character, such as a student may readily make and use at home, and yet from which fundamental mechanical principles can be verified and illustrated in a satisfactory manner. In other cases, the experiments are more elaborate; those dealing with hydraulics strike us as being particularly good.

Another important part of a course in applied mechanics is the working of many numerical examples; here also the requirements are well met, and the student is amply provided with material in great variety. The answers to the examples are given at the end of the volume.

There are a few defects which may probably be remedied in great measure in a future edition. The diagrams are well drawn and clearly printed, but in some cases the letters of reference are unfortunately too small. The author is not very happy in his definitions of the engineer's units of mass and force, and occasionally his enunciations of fundamental principles of mechanics could be improved by revision. The treatment of vectors is rather weak. We should like to have seen more use made of the *radian* measure of angles and angular velocities in the many problems involving rotation.

These faults do not detract materially from the general merits of the book, which is one that can be confidently recommended for the use of students who are beginning the subject of applied mechanics and wish for guidance in obtaining an experimental knowledge of the foundations on which the science is built, and for an account of many of its applications in the arts.

Compte rendu du deuxième Congres international des Mathématiciens tenu à Paris, 6 au 12 Aout, 1900. Pp. 450. (Paris: Gauthier-Villars, 1902.)

AMONG the innumerable congresses held at the Paris Exhibition, this one dropped completely out of sight. On arrival at the advertised place of meeting in the Hall of Congress, it was found occupied already by some 1500 deaf-mutes, assembled in conclave; naturally they could give us no information. The Mathematical Congress was discovered at last, on the top floor of the Sorbonne, where it was left severely alone by the French professors, too dignified to meet the herd of visitors on equal terms.

The Physical Congress, held simultaneously, carried off all but the mere pure mathematicians, who enjoyed themselves by reading papers to each other on arithmetic and algebra, analysis and geometry, bibliography and teaching methods.

An eloquent address by M. Poincaré, the president, who put in an appearance at the closing ceremony, on the *rôle* of intuition and logic in mathematics, an extract from a lecture by Mittag-Leffler on a page of the life of Weierstrass, Hilbert's discourse on the mathematical problems of the future, and communications by M. Cantor on mathematical historiography and by Vito Volterra on Betti, Brioschi and Casorati, these form the most important part of the volume.

Wood: a Manual of the Natural History and Industrial Applications of the Timbers of Commerce. By G. S. Boulger. Pp. viii + 369. (London: Edward Arnold, 1902.) Price 7*s.* 6*d.* net.

THE contents of this ugly volume, of heavy paper and with narrow margins, are more worthy of attention than its exterior suggests, and comprise an immense amount of information about the timbers of commerce from many points of view. That it is a compilation which would probably never have seen the light had not the works of

Hartig, Nördlinger, Laslett and Marshall Ward preceded it may be a safe surmise, but the author has done his work much in his own way, and, on the whole, has done it well, and acknowledges his indebtedness to the above and to other writers. The longest section, that on the sources, characters and uses of the woods of commerce, which occupies more than two hundred pages of the three hundred and fifty composing the book, abounds in interesting facts about the foreign and colonial timbers now so largely imported into this country, though why the word "Acacia," on p. 141, is limited to "Robinia" and "Eucryphia" is the more puzzling since the author shows, on p. 341, that the wattles of Australia are the true plants of that genus.

The sections on the recognition and classification of woods, on seasoning, on the supplies of wood and on testing are also good; those on the origin, structure and development and on the defects of wood are less so. Indeed, the whole subject of the microscopic structural characters is very poorly treated, and the appendix on the microscopic examination of wood might as well have been omitted. This is a pity, since it is just in this direction that so much interesting and important work has been done of late, and the author's meagre treatment of this theme and his omission of any mention of the publications of Müller, Mer, Strasburger and other investigators suggest that he is here on unfamiliar ground. Moreover, certain slips, such as the confusion of the schlerenchyma of a peach stone with wood (p. 2), the denial of wood to the so-called herbaceous plants and the retention of the term "exogenous" (p. 3), the inadequate treatment of cellulose (p. 6), the denial of tracheæ to the protoxylem of Conifers (p. 19) and the explanation of the term "desmogen," are signs pointing to the same conclusion.

On the other hand, there are some capital photographic reproductions of the appearances of various woods in transverse sections, and the material is well arranged and rendered accessible by what appears to be a very complete index.

L'Eau dans l'Alimentation. By F. Malméjac. Pp. 312. (Paris: Felix Alcan, 1902.) Price 6 francs.

IT is quite true, as the author of this work states, that the great problems connected with the purification of water and its safety or danger when used for drinking purposes are not yet solved, but although he claims—and not without reason—that his work is something more than a compilation, inasmuch as it contains results of special study on the points which have appeared to him the least clear or the more controversial, the reader who has studied, say, the works by Thresh or Mason on the subject will find little to learn from the present volume.

The work is certainly a useful and interesting one, but it scarcely justifies the eulogistic preface written by M. F. Schlagdenhauffen, honorary director of the Higher School of Pharmacy of Nancy, from which the reader would conclude that the present volume was almost an epoch-making contribution to an important subject.

The book is divided into five parts, which are subdivided into chapters. The first part deals with water in general, including the microscopic, the chemical and the bacteriological examinations, and the other four parts deal with the organic matter of water, the germs of water, the filtering value of different earths and the purification of water.

Our Dogs' Birthday Book. Arranged by Mrs. F. H. Barnett. With Twelve Pictures of Champion Dogs. Pp. 144. (London: George Allen, 1902.)

A BIRTHDAY book of the familiar kind, except that the quotation under each day of the year is concerned with dogs.

LETTERS TO THE EDITOR.

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

The Hydrographical Work of the North Sea Investigation Committee (Scotland).

IN weather of exceptional severity, Lieutenant and Commander Sharp, of H.M.S. *Jackal*, has just brought his second hydrographical cruise to a successful issue. The *Jackal* left Aberdeen on December 4, and followed approximately the same course (on lines laid down by Mr. H. N. Dickson) as on her autumn cruise in August-September (*cf.* NATURE, October 30, 1902), that is to say, northwards to Lerwick, thence in a north-easterly course to near the Norwegian coast, then westward to Faeroe and back along a somewhat more southerly track, passing between Shetland and Orkney and out into the North Sea as far as the meridian of 0°. The last observations were made on December 15. About 125 water-samples were obtained at various depths, in full series, at twenty stations, and surface samples were collected in addition hour by hour. Captain Sharp bore, on this occasion, the whole responsibility of collecting the samples and observing the temperatures, and I venture to think that, in spite of the worst possible weather, he has achieved remarkable success. The water-samples are being estimated in the laboratory of my colleague, Prof. Walker, and when this work is done, the whole of the data will be handed over to the hydrographers; but the temperature records are in themselves interesting, so much so that I think it right to publish them in the following brief abstract.

The stations were as follows (numbered according to those of the August cruise with which they approximately correspond:—ii., 58° 36′ N., 1° 46′ W.; iv., 59° 17′ N., 1° 30′ W.; vi., 60° 37′ N., 0° 30′ E.; vii., 61° 12′ N., 1° 52′ E.; viii., 61° 40′ N., 3° 4′ E.; ix., 61° 39′ N., 2° 0′ E.; x., 61° 38′ N., 0° 33′ E.; xi., 61° 50′ N., 1° 0′ W.; xii., 61° 0′ N., 1° 18′ W.; xiii., 61° 10′ N., 2° 9′ W.; xiv., 61° 23′ N., 3° 25′ W.; xv., 61° 38′ N., 4° 39′ W.; xvi., 61° 44′ N., 6° 3′ W.; xvii., 61° 13′ N., 6° 34′ W.; xviii., 60° 53′ N., 5° 30′ W.; xix., 60° 35′ N., 4° 26′ W.; xx., 60° 13′ N., 3° 9′ W.; xxi., 59° 40′ N., 1° 15′ W.; xxii., 59° 32′ N., 0° 2′ E.; xxiv., 58° 53′ N., 0° 25′ W.

To take first the surface-temperatures. These fluctuated much in the first part of the course from the entrance of the Moray Firth to Lerwick. Starting at 7°·5, the temperature rose opposite the Pentland Firth to 8°·8, fell off the Orkneys to 6°·6, rose again in the neighbourhood of Fair Isle to 9°·3, and after falling as low as 5°·4, rose to 8°·4 at Lerwick. Similar temperatures (8°·3–8°·5) were then met with as far as Station vii., after which point there was a rapid rise to 9°·6, followed by an exceedingly sudden drop to 6°·6 (the salinity dropping from about 35°·3 to 32°·6) near Station viii., off the Norwegian coast. Running westward, temperatures ranged in the neighbourhood of 9°·5 all the way to the middle of the Faeroe Channel, and then dropped between Stations xiv. and xv. to 7° at the latter point. They rose again as Faeroe was approached, to 8° or a little less; and on the homeward and more southerly course, a colder current was again crossed, this time in a broader and apparently double belt, between 4° and 5° W. longitude, with temperatures of 6°·6 to 6°·8. Eastward of 4° W., a rapid rise took place to 8°·9, rising further to 9°·4 a little to the east of 3°, and thereafter the curve fell, with considerable fluctuations, to about 8° at the limit of Station xxii. (0° 2″ E.).

Passing to the deep-water temperatures, we have, on the line from the Moray Firth to Lerwick (Stations ii., iv. and xxi.), everywhere warmer underlying colder water, the readings at 0 and 100 metres being respectively 8°·2–8°·8, 8°·8–9° and 8°–8°·6.

Between Lerwick and the coast of Norway, we have firstly at Station vi. slightly irregular readings, falling from 8°·5 at the surface to 8°·2 at 130 m.; at Station vii., the surface-water of 8°·3 has underneath it warmer water to 8°·85 at 60 m., cooling to 8°·65 at 140 m.; while at Station viii, a broad zone of similarly warm water underlies the very cold (6°·7) surface-layer (6°·05 at 20 m.), giving us readings of 8°·3 at 100 m., 8°·7 at 200 m., below which level the temperature falls again to 6°·0, at 380 m., near the bottom. Turning westward, we have at Station ix.

practically the warmer waters of Station viii., released from the superincumbent colder layer; that is to say, we have at 20 m. 8°·6, at 100 m. 8°·4, at 200 m. 7°·85 and at 300 m. 6°·91. At Stations x. and xi., the water cools very slowly downwards, from 9°·6 to 8°·8 at 170 m. and from 9°·3 to 7°·8 at 360 m., respectively. At Station xii., in shallower water, we have readings to 100 m., practically identical with those to the same depth at Station xi., further to the north.

The records along the next two lines, those crossing the Faeroe Channel, deserve to be given in detail.

Faeroe to Shetland (xvi.–xii.)

Depth in Metres.	xvi.	xv.	xiv.	xiii.	xii.
	°	°	°	°	°
Surface.	7·9	7·5	9·5	9·5	9.2
100	7·6	7·45	8·8	8·9	8·9
200		7·51	7·72	8·9	
300		6·81	7·6	8·9	
400		3 2	5·56	8·7	
500		1·38	2·12	7·9	
600		0·4	0·34	(at 460	
700		−0·2	−0·25	metres.)	
800		−0·48	−0·45		
900		−0·65	−0·65		
1000			−0·7		
1100			−0 8		

Ditto (*Southerly Course*) *and on by Fair Isle to* 0° 2″ *E.*

Depth.	xvii.	xviii.	xix.	xx.	xxi.	xxii.
	°	°	°	°	°	°
Surface.	8·0	7·6	6·9	9·3	8·0	8·2
100	7·9	7·53	7·69	9 9	8·6	7·54
200	(80 m.)	7·55	6·8	9·0 (at		
300		7·59	4·28	150 m.)		
400		6·9	0·5			
500		1·62	−0·25			
600		1·72				

The first of these two tables corresponds as closely as possible with that given by Mr. Helland-Hansen for the August cruise in the note to NATURE already quoted. The most striking differences will be found to be that below 300 metres the temperature is now much higher at Station xiv., and at 400 m. it is now much lower at the more westerly Station xv. This means that the cold wedge is now considerably further to the westward and probably also of less vertical extent. In the more southerly section (Table II.), the cold wedge is seen, of great intensity, at Station xix. It is to be regretted that the next station (xx.) to the eastward of xix. is a shallow-water one, and still more to be regretted that we have no deep-water station to the westward of Station xv.

I have hastened to publish these few preliminary notes in the belief that many are interested in the progress of the work, and because we shall have long to wait until the full data are available and the final deductions are drawn by competent hands.

D'ARCY W. THOMPSON.

Dundee, December 29, 1902.

The Quadrantids of 1903.

OBSERVATIONS were made at Hampstead Heath on January 1, 3 and 4 for the Quadrantid meteors. During a combined watch of six hours, 57 meteors were seen, distributed thus:—

		h. m.		h.		
Jan. 1	...	11 55	to	14	...	18 meteors
3	...	14 0	to	16	...	29 ,,
4	...	15 0	to	17	...	10 ,,
Total	...	...		...	...	57

The paths of 10 only were registered, which I append as follows:—

Date.	Time.	From R.A.	From Decl.	To R.A.	To Decl.	Mag.	Remarks.
	h. m.	°	°	°	°		
Jan. 1	12 5	210	+50	130	+40	2	Sl. stk.
,,	12 21	240	+45	247	+35	1	,, ,,
,,	12 39	217·5	+43	185	+30	2	Sw. stk.
,,	1 10	211	+29	195	+10	2	Sl. stk.
,, 3	14 5	197	+33	182	+23	1	,, ,,
,,	14 16	195	+40	165	+30	1	,, ,,
,,	14 33	225	+50	226	+51[1]	3	Sl. streakless.
,, 4	15 59	215	+49	170	+43	1	Sl. stk.
,,	16 7	220	+27	213	+15	2	,, ,,
,,	16 14	196	+30	150	+ 9	1	Sw. stk.

Sl. = slow, Stk. = streak, Sw. = swift.

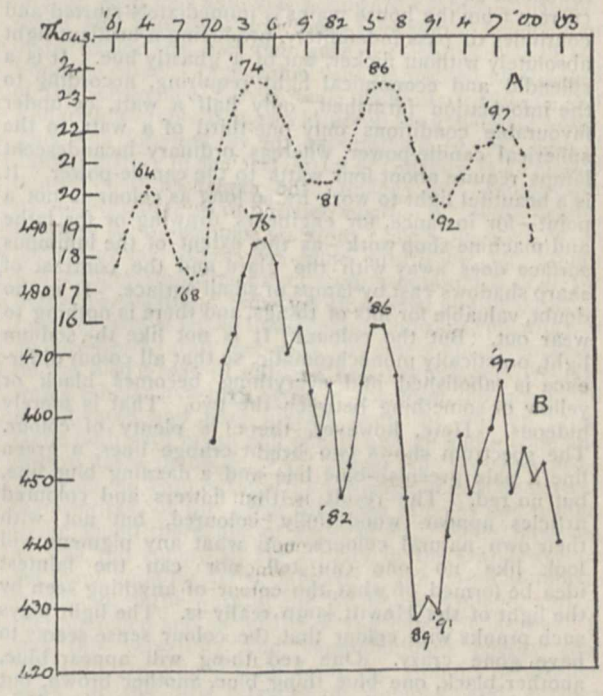
25 Holford Square, Percy Circus, W.C., January 11.

G. MCKENZIE KNIGHT.

Sun-spots and Summer Heat.

Is not a connection between these rather distinctly suggested by the enclosed curves?

A is obtained from sums of the sun-spot figures (mean daily area) in the thirty years ending 1861, '62, '63, &c.



B is from sums of the number of days with maximum temperature over 80° in the thirty years ending 1870, '71, '72, &c.

ALEX. B. MACDOWALL.

4 Bodfor Terrace, Aberdovey, Wales, January 5.

A Curious Projectile Force.

HAVE you or any of your readers had an experience similar to this? I placed a half bottle of champagne, *half full*, in a basin in a lavatory, with cold water tap dripping in same, corked. About twenty-four hours later we heard a crash, and found that the bottle had literally jumped out of the basin through the window and out into the garden, breaking itself on the stone work beneath window. Now I know there would be nothing remarkable in a bottle bursting, but in this case not a particle of glass was found in the room, and the hole in the window-pane being so clean cut shows enormous velocity. The wine was a good brand and of the year 1892. A scientific friend tells me the facts are so unaccountable that I thought I would venture to trespass on your space.

B. A. OXON.

[1] A short pathed meteor.

THE HEWITT MERCURY LAMP AND STATIC CONVERTER.

ONE of those happy discoveries which at once and unexpectedly supply the solution of a difficult or hopeless problem was brought to the notice of a limited number of railway and of scientific men last Friday evening by Mr. George Westinghouse. The company were invited to meet Mr. Westinghouse at the Westinghouse Company's office in Norfolk Street, Strand, to see two of the inventions of Mr. Peter Cooper Hewitt, of New York, and to meet again at Claridge's Hotel, after an hour, in circumstances that would enable them more easily to contemplate the full beauty of what they had seen.

The mercury vapour lamp consists of a long vacuum tube, perhaps a yard long and an inch in diameter, but of dimensions depending on the current and potential available and the light required, with an electrode at each end, but at the lower end, which is the negative pole, the tube is blown out into a bulb, which contains a quantity of mercury. When the ordinary voltage of a house supply is applied to the terminals, nothing happens at all, as it is not sufficient to break across the long, vacuous gap. If, however, a single spark from an induction coil is sent from one terminal to the other, the current from the house mains is immediately started and continues to pass indefinitely, producing a brilliant light absolutely without flicker, but of a ghastly hue. It is a splendid and economical light, requiring, according to the information furnished, only half a watt, or under favourable conditions only one-third of a watt, to the spherical candle-power, whereas ordinary incandescent lamps require about four watts to the candle-power. It is a beautiful light to work by so long as colour is not a point—for instance, for engineers' drawing or for lathe and machine-shop work—as the extent of the luminous surface does away with the glare and the contrast of sharp shadows cast by lamps of small surface. It is, no doubt, valuable for lots of things, and there is nothing to wear out. But the colour! It is not like the sodium light, practically monochromatic, so that all colour difference is abolished and everything becomes black or yellow or something between the two. That is merely hideous. Here, however, there is plenty of colour. The spectrum shows two bright orange lines, a green line, a pale greenish-blue line and a dazzling blue line, but no red. The result is that flowers and coloured articles appear wonderfully coloured, but not with their own natural colours, and what any pigment will look like no one can tell, nor can the faintest idea be formed of what the colour of anything seen by the light of the Hewitt lamp really is. The light plays such pranks with colour that the colour sense seems to have gone crazy. One red thing will appear blue, another black, one blue thing blue, another brown, but the skin becomes ghastly. If anyone sees himself in a glass, it is difficult for him not to form a sort of opinion that he is killed and drowned and dead as well. These effects the Westinghouse people believe may somewhat interfere with the success of the lamp as a domestic luminary. But even here there are possibilities. A wisp of silk dyed with a particular crimson dye appears to have its colour enhanced. It shines with a glorious luminosity among its surroundings, on which not a trace of a rosy tone can be discovered. This is a true fluorescence. If a spectroscope be turned on the lamp or any ordinary thing lighted by it, the red end of the spectrum is absent, but when this particular dye is brought up, the whole of the red end flashes out, and other things may be seen more as they are. A striking experiment is to look at the lamp through ruby glass, through which hardly any light can be detected, and then to bring up the dyed silk, which immediately appears to create its own light and shine brilliantly.

Enough has now been said to give an idea of the Hewitt lamp, which is found to have the remarkable property, one not unknown as a vacuum phenomenon, of only allowing a current to pass in one direction, that being with the mercury as a negative pole. If it is attempted to send a common alternating current through a Hewitt lamp, it may be started by a preliminary spark, but at the first reversal it goes out, and so it has to be started perhaps a hundred times a second to keep it going. If, however, the three ends of a star-wound triphase transformer or generator are connected with three electrodes near the top of a globe and the common centre is connected with the mercury pole at the bottom, then, as before, nothing will happen until a starting spark has been sent across the globe, for which purpose a fifth electrode is placed at the top; then at once the triphase current starts running round from electrode to electrode, and always going to the mercury below, and each current being still alive when the next is ready to start, they keep each other going and a single direct current leaves the mercury electrode. By this simple means, it is possible to rectify a current of even 1000 volts, subject, however, to a constant loss of 14 volts in the bulb, and this whatever the voltage. As the contrivance will work with anything between 100 and 1000 volts, and at present up to 100 amperes, it will be evident that if further experience bears out the information so far available, the present methods of conversion depending on the use of rotary converters and motor generators will be at an end, and the labours and ingenuity of Mr. Pollak and others with the aluminium cell largely superseded. With the higher voltage, the economy is unapproached by other methods, the loss being only 1·4 per cent., which appears as heat in the bulb.

C. V. B

THE VIBRATIONS OF GUN BARRELS.

A SERIES of experiments has been conducted by Messrs. C. Cranz and K. R. Koch for the purpose of obtaining information respecting the character of the vibrations set up in the barrel when a gun is fired. It is a matter of experience that when a cylindrical rod is struck by an approximately axial blow, the particles of the rod, instead of vibrating in straight lines, perform in general elliptic vibrations the axes of which vary in direction at different points, and it was one of the objects of the investigation to ascertain how far a gun barrel behaved in the same manner.

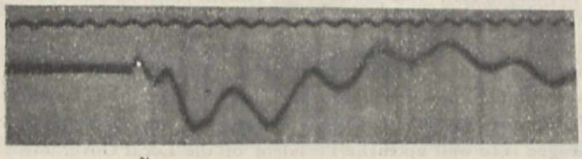
For this purpose, a number of military rifles supplied by the firm of Mauser were furnished with projecting wires the motions of the shadows of which, thrown on a screen by a powerful lens, were recorded by photography, a tuning-fork similarly projected affording a standard of comparison from which the period of vibration could be measured.

The rifles were either fixed in a support of cork or held in the position usually adopted by marksmen, under conditions closely resembling those existing in actual rifle practice. By means of an electric spark, a mark was recorded on the photographic plate indicating the exact instant at which the projectile left the barrel.

An example of the diagrams obtained is shown by Fig. 1 for a rifle fixed in cork and by Fig. 2 for free firing. It will be observed that under the latter conditions a dark shadow is in general produced by the recoil of the rifle, and it is only possible to study such parts of the vibration curves as are not blotted out by this shadow.

The experiments show that the vibrations are in general, as predicted, elliptic in character, each vibrating particle describing a small ellipse instead of a straight line. The vibrations are generally similar to those of an elastic rod fixed at one end, and consist of a fundamental tone and overtones, of which as many as three have been

observed. From the tabulated results, it appears that the periods of vibration for the fundamental and first two overtones, while varying considerably for different rifles, may be said to be roughly about 0·04, 0·008 and 0·002 of a second, and the first two overtones are those the periods of which have been the most completely determined. In the case of the other vibrations, most of the tabulated results contain the mere indication that they have been observed, from which it is a natural inference of the reader that they have been much less intense, a result

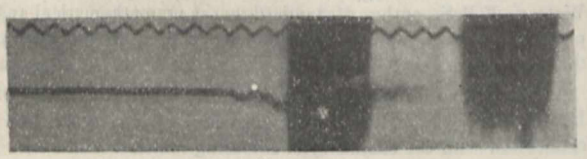


γ

FIG. 1.—10-Millimetre Servian rifle, right-handed breech, fixed in cork.

which appears on general grounds highly probable. The nodal points of the overtone appear to a certain extent to vary periodically in position. The vertex of the angle of vibration, instead of being at the screw of the breech pin, as commonly assumed, is at a nodal point near the muzzle, a result arising from the effect of one of the overtones at the instant when the bullet leaves the gun, and as the overtones predominate, the vertex approaches the muzzle.

Of practical interest is the conclusion that, since a certain time elapses before the vibrations are completely



γ

FIG. 2.—11-Millimetre Mauser held as in rifle practice. The white spot γ, indicates the instant of the bullet leaving the barrel.

formed, it is important that the bullet should leave the muzzle before the deflection of the barrel has become considerable, and hence that a small-bore gun is to be preferred to one of large calibre. In the six-millimetre Mauser gun, it would appear, from the position of the white dot in Fig. 3, that the limit in this direction has practically been attained, so far as horizontal vibrations are concerned.

Two further points are discussed. The effect of the breech has been observed by comparing guns with a right-handed and left-handed breech respectively. In

γ

FIG. 3.—6-Millimetre Mauser rifle, fixed in cork.

the former, a deviation to the right of 7mm. per 4·5 metres was observed, in the latter, a deviation to the left of 4 mm. in the same distance.

The other question arises in connection with the attachment of bayonets. In some observations of the horizontal vibrations, a rifle of 11 mm. calibre was experimented on, with the bayonet attached at one side, the lateral attachment being the best calculated to affect these particular vibrations. The effect was to increase the periods of the first overtone from 0·0095 to 0·0130 of a second and of the second from 0·0016 to 0·0036 of a second, to give rise to a third overtone of period 0·0011 of a second and also to alter the phase at the instant at which the bullet left the muzzle.

The paper of which this is a brief summary is published in the *Abhandlungen* of the Bavarian Academy (cl. 2, vol. xxi. part iii., pp. 559–574), and it will be seen that it has an important bearing on rifle shooting generally. A marksman who is fully aware of the nature of the vibrations occurring in his rifle ought to be able to allow for them, with a little practice, far better than one ignorant of the scientific aspect of the question.

G. H. BRYAN.

PROF. JOHN YOUNG.

JOHN YOUNG was born in Edinburgh in 1835. He was educated at the High School and at the University, and finally he graduated as doctor of medicine. Like many of his time, he came under the spell of the great teachers who then made the northern university famous, such men as Goodsir, Edward Forbes, Christison, Syme and Simpson, and there is reason to believe that in particular the first two gave a scientific bias to Dr. Young's career. For some time he worked on the staff of the Ordnance Survey and made a friend of Sir Roderick Murchison, then a leader in the geological world. This was followed by his appointment to the chair of natural history in the University of Glasgow in 1866, and in this chair he taught both zoology and geology for nearly thirty-five years. After a period of failing health, he died on December 13, 1902. Such, in brief, is an outline of his career, but those who knew Dr. Young will recognise how imperfect a representation it is of the man's personality. Gifted with a keen and penetrating intellect and a fertile imagination, showing versatility of acquirements rarely met with, absolutely unconventional, he was also a man of untiring and restless energy. He was a scholar in a high sense of the term, he possessed a cultivated and pure literary taste, he was an artist facile both with brush and pencil, and he had a wide and critical taste in music. As keeper of the Hunterian Museum, he acquired much knowledge of rare books and manuscripts, of the great collection of coins and medals to be found there, and of works of art. Wide, however, as was the sphere of his activity in the University, he yet found time for active labours in the cause of female education, in the work of the Technical College, and in the municipal and social life of the city of Glasgow. It was this versatility and superabundant energy that hindered Dr. Young from doing the amount of original work in the two sciences of zoology and geology which might have been expected from a man of his genius, and the work of his life must not be judged from this point of view. His chief labour, perhaps, was the systematic arrangement of the great legacy of William Hunter—books, pictures, medals, engravings, coins—and in this work he took a keen delight and over it he spent laborious hours, even far on into the night when silence reigned in the cloisters. But it was the man's individuality of character that made him a force in his time. Often a determined opponent, he could also be a true friend, while his mental moods, sometimes quiet and observant, ofttimes brilliant and radiant with flashes of wit and humour, constrained even those who knew him best to regard him as a man quite by himself. He has thus left little of an enduring character in the literature of science, but he will be long remembered by many generations of students in the University of Glasgow.

JOHN G. MCKENDRICK.

JAMES WIMSHURST, F.R.S.

WE regret to have to announce the death of Mr. James Wimshurst, F.R.S., which occurred at his residence on Saturday, January 3. Mr. Wimshurst was born in London in 1832 and was therefore in his seventy-first year. He was for a long time a surveyor with Lloyds', both in London and in Liverpool, finally becoming principal shipwright surveyor to the Board of Trade, which appointment he held until a few years ago, when he retired under the age rule.

Mr. Wimshurst was devoted to scientific pursuits, in which he spent the greater part of his spare time. At his private house at Clapham, he had a laboratory and workshop, which he had himself fitted up with the assistance of his two sons. It was here that he worked out the new designs in influence machines which have made his name familiar to every student of science. His attention was first turned to this subject about 1881, when he constructed a machine of the Holtz pattern, but embodying several important improvements. After about a year's work, he designed an influence machine with oppositely rotating glass discs bearing metal sectors on their outer faces, which he called a "duplex" machine, but which has been universally known since as "Wimshurst's machine." For many years, he continued perfecting this pattern of electrostatic generator, building larger and more efficient machines. These machines have displaced all other generators of static electricity on account of their possessing the property of being self-exciting under any atmospheric conditions; they are very largely used for experimental, X-ray and electromedical works.

In 1890, Mr. Wimshurst designed a machine capable of producing rapidly alternating charges of electricity. In the same year, he was elected a member of the council of the Physical Society. In 1898, he was elected a fellow of the Royal Society; he was in addition a member of many other scientific societies, including the Institution of Electrical Engineers and the Röntgen Society; he was also a member of the board of managers of the Royal Institution.

All Mr. Wimshurst's scientific research was done for pure love of the work, and he persistently refused to accept any pecuniary benefit from it. His advice and assistance were always at the service of those interested, and his long experience with influence machines made his advice invaluable and in frequent requisition.

NOTES.

WE are authorised by Prof. J. J. Thomson to contradict the announcement that he has accepted the chair of physics in Columbia University, U.S.A.

THE Geological Society of London will this year award its medals and prize funds as follows:—Wollaston medal to Prof. Heinrich Rosenbusch, of Heidelberg, Murchison medal to Dr. C. Calloway, Lyell medal to Mr. F. W. Rudler, Bigsby medal to Dr. H. M. Ami, of Ottawa, Prestwich medal to the Right Hon. Lord Avebury, Wollaston fund to Mr. L. L. Belinfante, Murchison fund to Mrs. Gray, and Lyell fund to Mr. George Edward Dibley and Mr. S. S. Buckman.

IN a letter to Wednesday's *Times*, Sir Norman Lockyer states that several months ago he discussed with Mr. Shaw, the secretary of the Meteorological Council, the desirability of obtaining information regarding barometric pressures from ships crossing the Atlantic, by utilising wireless telegraphy. It now seems probable that this idea will soon be practically realised, for in reply to an ethergram from Mr. Marconi, Sir Norman Lockyer asked for help in this matter, and on January 13 received the following message:—"By wireless telegraphy.—Thanks for suggestion, hope to be able to do so soon, big westerly gale here Monday.—MARCONI." Sir Norman remarks that all friends of Science will be grateful to Mr. Marconi for such generous and invaluable assistance which will undoubtedly be of enormous advantage to British meteorology.

THE article by Dr. J. C. McVail in another part of this issue (p. 254) directs attention to the present unsatisfactory position of the law relating to vaccination in England, and the need for educating and organising public opinion in support of a new Vaccination Act. At the end of the present year, the Vaccination Act of 1898 will have run its experimental course of five years, and the opportunity should then be taken to ensure the introduction of a new measure based upon scientific principles. It is to render assistance in this direction that the Imperial Vaccination League has been formed. A deputation of the League is to wait upon the President of the Local Government Board this week, and will place before him the principal points upon which legislation is needed in connection with vaccination, with particular reference to revaccination. Three sub-committees appointed recently by the League have reported upon the degree of immunity given by primary vaccination, the need for revaccination at the age of twelve years, the transfer of vaccination administration from Boards of Guardians to some authority charged with public health functions, and the preparation and supply of calf lymph. The deputation which will wait upon Mr. Long will doubtless refer to the conclusions of the sub-committees and will urge emphatically that legislation should tend in the direction suggested by them.

WE regret to announce the death of the Rev. Dr. H. W. Watson, F.R.S., author of standard works on mathematical and physical subjects, and of well-known treatises on the kinetic theory of gases.

WE notice with regret the announcement of the death of Dr. H. E. Schunck, F.R.S., distinguished by his researches i connection with the chemistry of colouring matters.

THE death is announced of M. Albert Hénocque, vice-president of the Paris Biological Society and assistant director of the laboratory of biological physics in the Collège de France. M. Hénocque was known for his work in connection with the spectroscopic examination of blood.

THE King of Sweden and Norway has, *La Nature* reports, conferred the Norwegian medal Til Beleenning (Pour le mérite) upon M. Berthelot in recognition of the work of the distinguished French chemist.

A REUTER telegram from Ashkabad states that a fresh earthquake occurred at Andijan at 11 a.m. on January 7. The shock was of a particularly violent character.

THE Royal Statistical Society has awarded a Guy medal in silver to Mr. R. H. Hooker, for his paper on the suspension of the Berlin Produce Exchange and its effect on corn prices, which was read before the Society on December 17, 1901.

LAFFAN'S AGENCY announces from New York that Mr. Henry Phipps has just given 250,000*l.* for the establishment of a hospital at Philadelphia for the study, treatment and prevention of tuberculosis. The Pasteur Institute in Paris will be the model for the new establishment, which, however, is to devote itself exclusively to tuberculosis.

AN International Fire Prevention Congress will be held in London on July 7–10 in connection with the International Fire Exhibition at Earl's Court.

THE *Times* correspondent at St. Johns reports that Lieutenant Peary has decided to make another attempt to reach the North Pole. He is looking for a suitable steamer for a voyage next summer.

A GENERAL exhibition, devoted to hygienic milk supply in all its branches, will be held at Hamburg on May 2–10, 1903. Applications by intending exhibitors should be made, not later than February 15, to the Geschaffstelle, 46, Kampstrasse, Hamburg.

THE Carnegie Institution has, says *Science*, granted 1600 dollars to Prof. E. W. Scripture, of Yale University, for the prosecution of researches on the voice; 5000 dollars to Prof. W. O. Atwater, for his work with the respiration calorimeter, and has also made grants, the amount of which is not reported, to the Peabody Museum of Yale University, and to send Dr. H. S. Conrad, of the University of Pennsylvania, to Europe to study varieties of the water-lily.

AN exhibition is being held in London of the results of what is described as a new process for the preservation of animal tissues, by the injection of a fluid, the composition of which is not made public. The process is said to afford a satisfactory method of embalming animal bodies and of preserving museum specimens in a condition closely resembling life. The period which has elapsed since the application of the process to the various preparations exhibited is said by the inventor to range from a few weeks to thirty years.

A WRITER in the *Times* of January 7 suggests that wireless telegraphy should be used for sending time-signals from Greenwich and other places at definite instants, so that they could provide a means of determining longitude on ships having instruments capable of detecting the signals, or for regulating clocks or chronometers. The same suggestion was made by Mr. John Munro in NATURE of August 28, 1902 (vol. lxvi. p. 416), and the idea has doubtless occurred to others. Another writer, in Saturday's *Times*, suggests that some steamers crossing the Atlantic should be equipped with instruments for sending wireless messages as to meteorological conditions in mid-ocean, so as to provide material for weather forecasts and warnings.

REUTER'S AGENCY announces that the British and German Governments have decided on the immediate dispatch to West Africa of a mixed commission to demarcate the boundaries laid down by the Anglo-German Agreement of 1893. The frontier which is now to be fixed is that from the southern shore of Lake Chad to Yola, a distance of some 300 miles. The commissioners will proceed up the Benue direct to Yola, where they hope to arrive by the end of March, and will then work their way along the frontier to Lake Chad and, after fixing the position of Kuka, will return by the same route. The work is expected to occupy about a year.

WE learn from the *Lancet* that Dr. Michael Grabham, of Jamaica, a zealous exponent of the West Indian Culicidæ, is at work upon the mosquitoes of the Atlantic islands and has already obtained interesting results. The Azores have yielded no specific forms of any interest, but from the Madeiras he has sent to the British Museum four or five new varieties of culex in addition to one or two already well known and described. Dr. Grabham has found at Teneriffe, on the south side, a small anopheles identical with, or allied to, the malarial insect of the west coast of Africa. He has found also the same mosquito as is concerned in the spread of yellow fever at Havana.

IN a letter from Dr. Logan Taylor, the leader of the Sierra Leone expedition of the Liverpool School of Tropical Medicine, reference is made to the progress of the expedition in Sierra Leone. A very decided absence of anopheles larvæ in places where it was formerly easy to get any number has been noticed, and is due to their not being able to breed owing to the pools being either swept out or oiled regularly. Compared with the corresponding time last year, in some of the notoriously bad streets, where in a single house as many as six, seven or a dozen anopheles mosquitoes could be found in the early morning, this year, after searching house after house with great difficulty, one, or perhaps two, adult insects alone were discovered. Since the members of the Liverpool School expedition stopped clearing up yards and emptying out the water containing culex larvæ, no one else has taken up the work, and these insects are getting bad again, and unless the Government or the school will keep on the work, the money the school has spent on it will be almost thrown away.

THE copy of Sowerby's "English Botany" Supplement in the library of the Royal Botanic Gardens, Kew, is incomplete, wanting plates 2912 to 2960, with letterpress and index, also plates, with letterpress, 2964, 2977, 2978, 2983, 2987, 2988 to 2999. The director appeals to the public to assist him in completing this classical work on British botany, either by presentation or sale.

A NEWLY issued part of the "Conspectus Faunæ Grönlandicæ," which is now being prepared by the naturalists of Copenhagen, relates to the mammals, and has been written by Mr. Herluf Winge. The known mammals of Greenland are stated to be thirty in number, but sixteen of these are Cetaceans. On land there are two rodents (the polar hare and the lemming) and two ungulates (the reindeer and the musk-ox) found in Greenland, but the remaining ten are all Carnivores, of which four only are terrestrial and six are marine, *i.e.* seals. The four terrestrial mammals are the Arctic fox, the wolf, the polar bear and the stoat or ermine.

IN the *Sitzungsberichte der niederrheinischen Gesellschaft* (Bonn), Herr Constantin Koenen discusses the age of the human remains of the Neanderthal. The first of these, known as "Homo neanderthalensis I.," is referred to the second epoch of the Quaternary Palæolithic period, or "Moustèr's epoch," and the second form, "Homo neanderthalensis II.," to a somewhat later period.

MR. LOUIS BEVIER'S paper on the vowel I (as in pique), forming one of a series of papers on the various vowel sounds in the *Physical Review*, leads to the conclusion that the sound of I is characterised by a powerfully reinforced upper partial at some pitch generally lying between 1900 and 2500, usually nearest the value 2500, a chord tone which is generally present with a much larger amplitude than for the more open vowels, and beyond these two tones comparatively little intermediate resonance. The latter peculiarity seems to give the vowel its peculiar thin tone. It appears that the American I is more open than the German, and its characteristic upper partial lower pitched. The author proposes to present, in the course of time, similar studies on the labio-gutteral vowels from A to U.

IN the Cracow *Bulletin*, No. 8, Dr. Ladislaus Natanson discusses from a mathematical standpoint the problem of the deformation of a thin cylindrical disc of plastico-viscous material under the action of normal pressure on its opposite faces. The investigation bears directly on Von Obermeyer's experiments. In connection with the question as to how far a plastic solid is representable as a viscous fluid, an interesting idea is introduced. If we imagine it possible for the pressure on the disc to be varied in such a way as to maintain the disc of constant thickness, then, according to the theory considered by Dr. Natanson, the pressure would be an exponential function of the time, the modulus of decay and therefore also the time of relaxation being finite. For a viscous liquid, on the other hand, the time of relaxation vanishes. From experiments such as those of Von Obermeyer, Dr. Natanson considers it possible to determine both the "coefficient of internal friction" and the time of relaxation.

In the third part of the *Beiträge zur Psychologie und Philosophie*, Dr. Götz Martius gives a detailed investigation on the duration of light sensations. It is pointed out that "Talbot's Law," while defining the limits within which intermittent sources of light give rise to a uniform light-sensation of mean intensity, gives no information as to the actual duration of the light-sensation itself. Dr. Martius, after describing an apparatus used by Prof. Exner, gives an account by Karl Minnemann of a new light interrupter. It appears that the time which elapses before the sensation is a maximum depends on the intensity of the stimulus, decreasing in general as the intensity increases, while the duration of the sensation depends both on the intensity and on the duration of the stimulus. A discussion of the bearing of the actual results on kindred investigations such as those of Charpentier and Shelford Bidwell is noteworthy.

A somewhat remarkable attempt to trace points in common between such apparently different subjects as biology and education is made by Prof. Leopoldo Maggi, writing in the Lombardy *Rendiconti* in a paper entitled "Tachygenesis and University Studies." Both in the vegetable and animal kingdoms, it is pointed out that in the transition from the lower to the higher forms there is a continuous acceleration in the development of maturity, and this law of embryonic acceleration, which, following E. Perrier, the author describes as Tachygenesis, is an inevitable consequence of the struggle for existence. The same laws may be applied to social life, and it is suggested that they tend to bring about a reduction of the time given to university study in the lifetime of a man, but against this tendency there is the at present insuperable barrier opposed by regulations which fix the number of years required to complete the university courses. The new university regulations in Italy have reduced the minimum number of lectures in any course from about seventy to fifty, and this the author considers a good reason for reducing the length of the qualifying period for the university degrees. Prof. Maggi suggests several other applications of biological principles to allied social problems.

An interesting article on the transmission of vision to a distance by electricity is contributed by Lieut. J. H. Coblyn to *L'Éclairage Électrique* for December 27. The author reviews briefly the theoretical aspect of the subject and the attempts which have been made at its practical solution. He suggests that some less sluggish transmitter than a selenium cell may have to be sought before satisfactory results are obtained, and as receiver proposes the use of a Blondel oscillograph, the moving part consisting of a tube which, as it is deflected, cuts off more or less of the light from a source of constant intensity. This is a modification of the method of Ayrton and Perry; another method proposed by M. Weiller is to use a sensitive flame the intensity of which is varied by a telephone diaphragm actuated by the transmitted current. In addition to the problem of reproducing the intensity of the illumination, a satisfactory solution has to be found to the difficulty of exploring the object and image synchronously at transmitting and receiving stations as the whole surface has to be covered in less than one-tenth of a second, the time of duration of the retinal impression. The author concludes that the problem is still surrounded with great difficulties.

Symons's Meteorological Magazine for December last contains a climatological table for the British Empire for 1901, so far as it can be shown by nineteen representative stations, but it is not claimed that the records quoted furnish more than a few useful samples of the various climates included in the British dominions. The highest temperature in the shade was 110° at Adelaide, in February. A new station has been included, viz. Dawson, where a temperature of −50° in the shade was recorded in December, but the observations are incomplete. The highest mean temperature was 82°·1 at Colombo, and the lowest 36°·4 at Winnipeg. The driest station was Adelaide, mean humidity 59°, and the dampest Colombo, mean humidity 82°. The highest temperature in the sun was 168°, at Trinidad. The greatest rainfall was 114 inches, at Lagos, and the least 18 inches, at Adelaide. None of the extremes referred to can claim distinction as "records," but at individual stations the sun temperatures at London, 139°·8, and at Malta, 162°·9, are the highest observed there, and at London the number of rainy days, 128, is the lowest since these interesting tables were commenced.

The latest issues of the *Bulletin* of the Entomological Division of the U.S. Department of Agriculture include the *Proceedings* of the fourteenth annual meeting of the Association of Economic Entomologists and some miscellaneous results of the work of the division. In the former, attention is called to the magnitude of the injuries inflicted by insects on the forests and forest-products of the United States, and the crude condition of our knowledge relating to the life-history of the insects in question. It is urged, therefore, that the work of the division is one of great and increasing importance.

The first part of vol. vii. of the *Anales* of the National Museum of Buenos Aires contains a memoir, with portrait, of the late Dr. C. Berg by Señor A. Gallardo. In the same issue, Señor A. Mercerat describes a very imperfect skull of a toxodont from the pampean formation of Azul, which is regarded as representing a new genus and species, under the name of *Carolibergia azulensis*.

We have received from the director, Captain S. S. Flower, a copy of a handy little guide (with plan) to the Zoological Gardens at Giza, near Cairo. The general introduction is written in English, French and German, and the names of the animals are given in several languages. The issue of this guide may be taken as an indication that the institution under Captain Flower's charge is in a satisfactory and progressive condition.

The latest issue, vol. lxxiii. part i., of the *Zeitschrift für wissenschaftliche Zoologie* contains three papers, all of a highly technical nature. In the first, Herr Max Abel treats of regeneration among the oligochætous worms; in the second, Herr J. Müller discusses our knowledge of the land planarians of the family Bipaliidæ; while in the third, Herr K. Hann describes the development of the common hydromedusan *Clava squamata*.

In the December number of the *Zoologist*, Mr. F. Coburn describes and figures a specimen of the British wild goose named *Anser paludosus* by Strickland in 1858. The type of that form has been generally regarded as an old male of the bean-goose (*A. segetum*); but a specimen obtained in 1896 by him at St. Abb's Head, Scotland, leads Mr. Coburn to conclude that it is a perfectly valid species, characterised by its large size, long neck and large feet, as well as by its aquatic habits. Apparently the bird was well known to the Yorkshire "carr-men" and "marsh-men" half a century ago, but no examples are known to science save the type and the one procured by Mr. Coburn. Where can be the habitat of this apparently distinct species is now the question.

The first three parts of the second volume of the *Records* of the Botanical Survey of India have been issued. Mr. J. J. Wood has compiled a list of plants mainly from the province of Chutiá Nagpur. This part includes a map of the district and two sectional diagrams. Mr. Gammie has recorded the results of his investigations into plants used during periods of drought. For the purpose of making bread, seeds of species of Indigofera,

Cyanotis and Panicum are used. Other sources of nourishment are the leaves of Amarantus, Rivea and Leptadenia. A systematic enumeration of the species of Calamus and Dæmonorops, by Mr. O. Beccari, is based mostly on plants growing in the Malayan Peninsula and the adjacent islands, and only a few species belong to India or Ceylon.

AN addition to our knowledge of semiparasitic plants is made by Mr. S. Kusano, who contributes the result of his studies on *Buckleya quadriala*, a genus of the Santalaceæ, to the *Journal* of the College of Science, Tokio. The plant was found growing naturally on several hosts, some Dicotyledons and some Gymnosperms, but a decided preference and better development was displayed on the roots of Abies and Cryptomeria. The haustoria arise laterally in the young stage, but eventually appear to originate from the apex, or in reality in close proximity to the apex. A feature which has only been suggested for allied genera, *e.g.* secondary growth due to cambium, is in Buckleya so marked that the contour of the vascular strand is entirely changed and definite medullary layers become differentiated. Since the cambiums are adjacent and develop tissue to the same degree, the sucker keeps pace with the growth of the host root.

A BRIEF critical review of the theories relating to plant evolution, more particularly the origin of new forms, is offered by Prof. Schwendener in a recent number of the *Naturwissenschaftliche Wochenschrift*. The article touches upon the origin of species by natural selection, the variations developed as special adaptations due to environment, the mutation theory and incidentally the production of hybrids. The arduous experimental work of De Vries and the possibilities of mutation or heterogenesis are acknowledged and accepted, but the opinion is expressed that new forms have not all originated after the same manner and that the direct action of external conditions has undoubtedly played an important part in the production of new and the modification of acquired characters. Prof. Schwendener is in accord with Darwin's theory of selection so far as it is limited to the origin of cultivated races of plants and to the breeding of domesticated animals, but does not believe in its application under natural conditions. This view, which coincides with the expressions of other eminent German botanists, naturally tends to diminish the importance previously attached to the theory of natural selection, but the writer pays just tribute to the value of Darwin's work, "whose service it was," he says, "to set on a new foundation the doctrine of descent, and after a struggle which was victoriously pursued to establish the idea permanently in biological science."

PROF. F. FRECH contributes to the *Zeitschrift der Gesellschaft für Erdkunde* (Nos. 7 and 8) a series of studies of the climates of past geological times. He accepts the views of Arrhenius with regard to the effect of variations in the amount of carbonic acid gas in the atmosphere, and considers the changes in the distribution of land and sea as the factor of next importance. The review of the geological evidence is interesting and important, but the author hardly gives sufficient prominence to physical aspects of the question, especially the effect of changes of temperature distribution on the atmospheric circulation and the influence of oceanic currents upon climate. The maps of continents and seas at the end of the Carboniferous period and of Europe during the Glacial period are valuable.

TWO more volumes of the excellent *Scientia* series of scientific monographs published in Paris by M. C. Naud have reached us, viz., "Le leucocyte et ses granulations," by Dr. C. Levaditi, and "Les phénomènes des métamorphoses internes," by Dr. J. Anglas. The volumes fully maintain the high character of preceding books in this series.

THE Orient Steam Navigation Company announce the commencement of their 1903 season of pleasure cruises. No. 1 cruise, starting February 26, is to the Riviera and on to Palestine, calling *en route* at Tangier, Palma, Sicily, Crete and Cyprus, returning home by way of Alexandria, Naples, Algiers and Gibraltar. The second cruise, leaving London March 14, is to Tangier, Malaga, Nice, Palermo, Crete, Smyrna and Constantinople, visiting on the return voyage the Piræus (for Athens), Nauplia, Katakolo (for Olympia), Naples, Algiers and Gibraltar.

THE reversible transformation of ammonium thiocyanate into thiourea has recently been investigated on a large scale by Reynolds and Werner, who give an account of their experiments in the *Journal* of the Chemical Society. At temperatures from 170°–180° C., the fused product obtained by heating either ammonium thiocyanate or thiourea for a sufficient time consists of 75 per cent. of the former and 25 per cent. of the latter. It is believed by the authors that the reversible change is partly conditioned by the greater stability at this temperature of a complex compound consisting of three molecules of thiocyanate and one molecule of thiourea.

THE first number of vol. i. of the *Biochemisches Centralblatt* has just been published. In twenty-eight pages it gives abstracts of some sixty papers dealing with subjects which belong essentially to the borderland of chemistry and medicine. It is pleasing to note that a considerable number of these are auto-abstracts, for this method of summarising is the only one which ensures that the really essential points in the various investigations are brought forward. The issue also contains a short summary by N. Zuntz of the recent work which has been carried out in America on such an elaborate scale by Atwater and his co-workers on the metabolism of the animal body. To physiological chemists, the *Centralblatt* will no doubt prove of considerable value, serving, as it is intended to do, for the collection of reports on all published medico-chemical investigations.

THE much-discussed question of the relationship between the red and yellow oxides of mercury may now be regarded as definitely decided. The experiments which lead to this conclusion form the subject of a paper by K. Schick, published in the last number of the *Zeitschrift für physikalische Chemie*. The results indicate that Ostwald's view that the difference between the two oxides is merely due to a difference in the size of the particles is the correct one, and that the older hypothesis, according to which the oxides are isomeric, is no longer tenable. Determinations of the solubility of the pure oxides in pure water at 25° C. show that they have practically the same solubility. Of the yellow oxide, one part dissolves in 19,300 parts of water, and one part of the red oxide in 19,500 parts. Such a small difference is due, in all probability, to the difference in the size of the grains.

THE current number of the *Zeitschrift für physikalische Chemie* contains an interesting paper by Dr. M. Wildermann on chemical dynamics and statics under the influence of light. The author's object has been to ascertain, if possible, the law which regulate the velocity of chemical change and the condition of chemical equilibrium, when such change is conditioned by the introduction of light energy into the system. In other words, it was proposed to investigate whether the velocity is proportional to the amount of light absorbed in unit time independent of the concentrations of the reacting bodies. The special chemical change which has been studied is the union of carbon monoxide and chlorine, a reaction which takes place only under the influence of light. A theoretical discussion of the experimental results leads the author to conclude that the velocity of a chemical reaction which is brought about (or influenced) by

the introduction of light energy follows the same law in the light as in the dark. In the latter circumstances, the only active forces are those of chemical affinity. The influence of the light energy is therefore quite different in its effect upon the reacting substances from that of electrical energy, the effect of the latter being regulated, of course, by Faraday's law.

THE additions to the Zoological Society's Gardens during the past week include a Bennett's Wallaby (*Macropus bennetti*) from Tasmania, presented by Lady Boord; a Spotted Salamander (*Salamandra maculosa*) from Italy, presented by Mr. G. Bottini; two Bennett's Wallabys (*Macropus bennetti*) from Tasmania, a White-fronted Amazon (*Chrysotis albifrons*) from Cuba, three Ring-necked Parrakeets (*Palaeornis torquatus*, var.), a Gangetic Trionyx (*Trionyx gangeticus*) from India, a Ruff (*Machetes pugnox*), a Skylark (*Alauda arvensis albino*) British, a Himalayan Monaul (*Lophophorus impeyanus*) from the Himalayas, deposited.

OUR ASTRONOMICAL COLUMN.

NEW VARIABLE STAR 21, 1902, SAGITTÆ.—From photographs taken by M. S. Blakjo at Moscow, Madame Ceraski has found that the star having the position

1855 α = 20h. 13m. 47s., δ = +20° 39′·0,
1900 α = 20h. 15m. 46s., δ = +20° 47′·3,

is a variable.

The magnitude varies from 9·5 to 11·5 or a little more, and M. Blakjo believes the period to be a long one, perhaps several weeks or months. In September, the actual visual magnitude was 11·5 (*Astronomische Nachrichten*, No. 3836.)

"THE HEAVENS AT A GLANCE," 1903.—The seventh yearly publication of this handy card is full of useful astronomical information for amateur observers. In addition to the usual monthly "Celestial Diary," tables of "Sidereal Objects" and "Descriptive Notes," it contains two small star charts which will be found very useful. The card may be obtained from its compiler, Mr. Arthur Mee, Llanishen, Cardiff, price sevenpence, post free.

OBSERVATIONS OF LONG-PERIOD VARIABLE STARS.—In Nos. 3835-6 of the *Astronomische Nachrichten*, Father Esch, S.J., of Valkenberg, gives the detailed results of his observations of seventy-eight long-period variables. The objects are denoted by their names and numbers in Hagen's "Atlas Stellarum Variabilium," and the dates of their maxima, with the amount of variation from the elements given in the Atlas, are given, together with their range of variability and remarks by the observer.

OBSERVATIONS OF OCCULTATIONS.—Mr. G. W. Hough, director of the Dearborn Observatory, gives the details of his observations of ninety-one occultations of stars by the moon, during the years 1900 and 1901, in No. 528 of the *Astronomical Journal*.

He divides the phenomena into four classes, and in the fourth class he places those in which the star appears to be projected on the earth-like disc of the moon for some seconds before the final disappearance; he explains this phenomenon by suggesting that, as the edge of the moon is not a smooth outline, the star may pass behind the moon at a point where there is a depression in the limb and so appear to be projected beyond the geometrical outline of that limb.

In the case of the occultation of the star D.M. + 20° 807 on February 25, 1901, the star apparently disappeared and the time was recorded, but it was seen again and a second record made 3·8 seconds after the first. This phenomenon was undoubtedly due to the reduction in light of a close double when the one component had passed behind the limb, for the object was afterwards identified as Ho 332, p = 125°·9, s = 1″·03, 9m.–9m.

The phenomenon observed on the occultation of the star S.D.M. – 20°·4810, on October 17, 1901 (p = 106°), belonged to the fourth class mentioned above, for the star appeared to be projected on the limb of the moon two or three seconds before its disappearance.

THE VACCINATION ACTS.

THE present position of the law relating to vaccination in England is indefensible. There is probably no great question in the domain of medicine on which the medical profession are nearer to absolute unanimity than that of the value and necessity of vaccination as a protection against small-pox. Independently of professional authority, perhaps no medical doctrine has for its basis so great an amount of statistical evidence gathered over so wide an area for so long a time. This unanimity of belief and this statistical evidence are equally strong and of equal value as regards the primary vaccination of infants and the revaccination of adolescents.

It is not the purpose of this paper to cite any of the evidence in question. What the writer desires to point out here is that the existence in this country of Acts of Parliament making vaccination of children obligatory, or even providing expensive administrative machinery for the vaccination of persons voluntarily asking for it, must be taken as proof that Parliament accepts the conclusion that vaccination prevents small-pox. But the legislature is in the strange position of insisting on infantile primary vaccination and of making no requirement whatever regarding revaccination. At one time, and indeed up to a comparatively recent date, this attitude was defensible, for the great mistake of Jenner's life was that he believed a single vaccination to be sufficient for permanent protection, and the veneration naturally entertained for his name and work probably delayed general recognition of the need for repetition of the operation. That need, however, has now long been recognised, and the experience of Germany shows that vaccination in infancy and a single revaccination at a proper interval afterwards are sufficient to confer national protection against small-pox, though no doubt in any such protected nation or empire there will be individuals who owe their freedom from small-pox more to their being surrounded by a vaccinated and revaccinated population not liable to epidemics than to the permanence of their own personal immunity. No argument can be used in favour of a law of primary vaccination which is not also valid for a law of revaccination. If there is any reason for having no Revaccination Act, the same reason exists for having no Vaccination Act at all. Both should stand or fall together.

The importance of a Revaccination Act for England was prominently but unsuccessfully brought before Parliament when the law was being altered in 1898 by the passing of the temporary Act which came into force at the end of that year. The main features of that measure were the provision of domiciliary vaccination and the much-debated Conscience Clause. The Act was passed experimentally only for a period of five years, and comes to an end on December 31, 1903. Next session is practically certain to see one of two alternatives adopted by Government. Either new legislation will be introduced or the Act of 1898 will find a place in the Expiring Laws Continuance Bill. This latter course would shelve several questions which cry out for solution and ought not to be shelved. To prevent its adoption and to help Government to frame any new measure on the best lines are among the principal reasons for the formation of the Imperial Vaccination League, the first meeting of which was held in London lately under the chairmanship of the Duke of Northumberland. The League has other important objects before it. It desires to educate and interest the public generally in the subject of vaccination and revaccination. As concerns legislation, it has under consideration by separate subcommittees the questions of a Revaccination Bill, the supply of lymph prepared by Government or under Government supervision for the needs of the whole country, and the question of the proper local authority for the administration of the Vaccination Acts. The last of these, though an important administrative subject, is after all of much less public moment than the two others—the protection of the lymph supply and obligatory revaccination.

The risks attached to arm-to-arm vaccination in this country were greatly overstated by anti-vaccinationists. In no class of the population was arm-to-arm vaccination more uniformly resorted to than in the families of medical men, and the Royal Commission, which sat for the long period of seven years, concluded, after elaborate inquiry, that the risks were insignificant and were diminishing. Nevertheless, they recognised that the fear of injury from vaccination and especially the fear of syphilitic inoculation was a potent factor in hindering people from securing the protection of their children against small-pox.

Quite independently of such fears—and this also, of course, the Commission pointed out—it is the obvious duty of the State to take every practicable precaution to prevent harm to the individual through the operation of any Act of Parliament. This applies alike to vaccination and to hospital isolation. If, for the public good, a child is removed from the parental roof to a public hospital, the authority so removing it, and coming temporarily *in loco parentis*, is bound to exercise the utmost care in the protection of the child. Though vaccination differs from hospital isolation in respect that it is done directly for the benefit of the child and only indirectly for the good of the public, yet the obligation remains. Every risk, no matter how slight, should be minimised by every practicable and reasonably available means before the State compels the parent to procure the vaccination of his child. The demand, therefore, that Government shall itself supply for every required vaccination calf lymph treated according to the best known methods—methods which have been much improved since the Commission issued its Report—or shall efficiently supervise the manufacture of lymph by private makers, is a most reasonable one, and has the support alike of lay and medical opinion.

It is necessary to consider how this can be done. Here, as in every other mundane affair, questions of finance and economy arise. Before the Act of 1898 came into force, public vaccinators appointed by boards of guardians performed about half of the primary vaccinations done in London and about two-thirds of those done in the provinces. How the figures now stand I do not know, but at present all that Government undertakes with regard to lymph supply is to meet the requirements of public vaccinators. Private practitioners must find their own lymph. This, at first sight, seems a harsh and arbitrary rule, but it may be assumed that the Local Government Board has some ground for its attitude. The facts of the case furnish the explanation. For due removal of extraneous organisms, calf lymph has to be stored for one month in the glycerine with which it is mixed. If lymph be used too soon, insufficient removal of such organisms may result occasionally in an unnecessary degree of inflammation accompanying the formation of the vaccine vesicles. If stored too long, on the other hand, the lymph may become inert for purposes of vaccination. At present there is great irregularity of demand for vaccine lymph in England, depending on the absence of systematic revaccination and the occurrence of epidemics of small pox. If under present conditions the Local Government Board must always be ready to provide sufficient lymph to every medical man who asks for it for vaccination and revaccination during small-pox epidemics, a great establishment will have to be set up, producing month by month such amounts of lymph as may not be wanted at any time for ten or twenty years on end, and month by month this huge excess of valuable material will have to be thrown away. Merely to set forth such a scheme is to condemn it. How, then, is the object to be accomplished? The answer is, only in one way, and that way a Revaccination Act. Under such an Act, revaccination would be obligatory at about the age of twelve years. The information necessary for working the Act would be most readily obtained from the registers of the elementary schools. The vaccination officials would be furnished at frequent intervals, say every three months, with lists of children about to attain the specified age. Primary vaccination would, of course, remain obligatory as at present. Both revaccination and primary vaccination, it may be assumed, would be subject to a Conscience Clause, though the present Clause is open to considerable amendment. The work of vaccination would go steadily on. The Government laboratories would be on a scale suited to meet the requirements of the nation, and the public funds would not be squandered in maintaining an institution the full work of which would be utilised only at rare intervals. Outbreaks of small-pox would be few and local and limited in degree, and the laboratories would easily meet demands for lymph for revaccination of "contacts" and others on such occasions.

Another great advantage from systematic revaccination would be an enormous saving in the provision and maintenance of small-pox hospitals. At present, local authorities are, with regard to this matter, in a most exasperating position, and that through no fault of their own. The Local Government Board insists that, owing to an evil which has often resulted from such hospitals—the spreading of small-pox throughout the surrounding community—these institutions for the isolation of patients shall themselves be isolated. Small-pox is a disease for which hospitals are almost entirely unnecessary in a duly vaccinated and revaccinated community, yet local authorities have no power to enforce such protection of their community, and when they set about trying to provide hospitals, they experience the utmost difficulty in obtaining safe sites. Other economies would result from the scheme here briefly sketched, but the above are the main reasons for asking Government to introduce a Revaccination Bill, and are also among the main reasons for the formation of the Imperial Vaccination League. Already the Jenner Society has done most admirable work in the same field, and both are well worthy of public support, especially at so critical a time in the history of legislation for the prevention of small-pox.

In criticism of the plea for a Revaccination Act as here put forward, it may perhaps be urged that the acceptance without demur of a Conscience Clause with regard even to primary vaccination is hardly consistent with a demand for a law of revaccination. What would be the sense, it may be asked, of establishing all the additional machinery which a Revaccination Act would involve for the protection of the public against small-pox and at the same time telling the public that if they please they can evade both primary vaccination and revaccination by satisfying a bench of magistrates that they have a "conscientious" objection on the subject? The force of such a contention is not to be denied. Admittedly, the Conscience Clause is a concession to expediency. For justification of such a concession, we must go to the facts of the position. In the first place, it is important to note that the Royal Commission on Vaccination suggested a Conscience Clause with the object, not of lessening the practice of vaccination, but of increasing it. In the second place, even before the Conscience Clause was passed, vaccination was not in any real sense of the word compulsory. In order to evade the operation, it was only necessary to pay a fine, either once or repeatedly, according to the activity or otherwise of the local guardians. The law never allowed a local authority to take a child by force out of a parent's arms and vaccinate it. Exemption, therefore, though not by way of certificate, was always possible. Laws must be framed and administered with due regard to the spirit of legislation which prevails in the country. If it so pleases, Parliament has a right to adopt the attitude that, bad as are small-pox epidemics, they are a lesser evil than would be the exercise of absolute force in such a matter as the insertion of vaccine lymph into the arm of a child notwithstanding the determined opposition of the father. The fining of persistent and active anti-vaccinationists, the public sale of their goods in default of payment of such fines, or the imprisonment of objectors where payment of fines could not in this way be obtained, have been in the past measures most favourable to agitation against vaccination. The purpose of the Conscience Clause in the Act of 1898 was to sift the genuine and confirmed opponent of vaccination from the merely careless and indifferent parent who had no opinion on the subject, but would leave the matter alone so long as he himself were left alone, and would, on the other hand, have his child vaccinated if he found that that would cause him less trouble than to take the steps required to obtain exemption from the law. On the whole, the Conscience Clause of 1898 has probably promoted vaccination rather than hindered it. Yet in practice the clause has proved itself defective in two directions. Its administration has been left to benches of local magistrates, and their views vary much as to the proceedings which should be taken. In one place, an anti-vaccination bench may hold evening sederunts where long strings of alleged "conscientious objectors" pass rapidly in front of the bench and are detained only so long as is needed for adhibiting magisterial signatures to exemption certificates. At such gatherings, either fathers or mothers may attend. On the other hand, other benches of magistrates may refuse almost any evidence submitted to them on the ground that it does not "satisfy" them that conscientious objection exists, and in Parliament it has been stated, in answer to questions on the subject, that there is no power under the Clause to compel a magistrate to be "satisfied" with any amount of proof. A parent whose certificate is refused in such a court may afterwards be brought before it for having failed both to have his child vaccinated and to produce an exemption certificate. Obviously, the present Conscience Clause allows too much variety of practice and requires a substitute less open to these objections, a substitute which, if possible, should so detail the proceedings to be taken that, on the one hand, they would involve at least as much parental trouble as the procuring of vaccination would cause, and, on the other hand, would not

needlessly pester nor afford the notoriety of cheap martyrdom to any man sufficiently wrong-headed to be quite determined to resist the vaccinal protection of his child.

As regards the example of Germany, however, and the prospect of similar immunity, which I have ventured to hold forth as an inducement for the passing of a Revaccination Act in this country, it may well be asked, May not the operation of a Conscience Clause result in a condition of national protection far short of that of Germany? It is unsafe to prophesy here, but personally I am not very much afraid of that contingency. With such a well-organised system of vaccination and revaccination as could be easily and, I believe, very economically established, there would, I think, be comparatively little default throughout the country as a whole. The latest returns show that in London conscientious objection is registered with regard to about 1 per cent. of the children, and in the rest of England about 5 per cent. These figures might in the future alter either upwards or downwards, but with a well-thought-out Conscience Clause the change might be downwards rather than upwards. In some special localities, however, the amount of default might, at least for a time, be very considerable, and such places would be a danger both to themselves and to their neighbours. In Germany, a large part of the trifling amount of small-pox that still remains occurs near the frontiers where there is opportunity for importation of the infection from other less protected countries. We, however, have a sea boundary and are less exposed to such risks, so that the existence in our midst of imperfectly protected places might not be more than equivalent to the risk which Germany runs from its imperfectly vaccinated neighbours. Such places in England would have the benefit of being surrounded by a vaccinated and revaccinated nation. Small-pox would not readily reach them, and when it did the surrounding communities would, through their systematic revaccination, be in a much better position than at present to resist the variolous invasion. Moreover, when once small-pox gets a good footing (though, unfortunately, not until it really has a good footing) in an imperfectly protected community, it has a wonderful effect in temporarily promoting vaccination. When Gloucester had attained a higher percentage neglect of vaccination than any large town in England, the result of a great small-pox epidemic was to leave it the best revaccinated town in the realm. In presence of an outbreak in future, it would not be in the least surprising to find the names of some children appearing on two lists in the course of the same year, first as subjects of conscientious objection and later as subjects of successful vaccination. Looking to all the facts of the case, I think this country may be able to afford a Conscience Clause, and it would certainly be infinitely better off under a Revaccination Act with a Conscience Clause than without any Revaccination Act at all.

As reference has repeatedly been made here to the example of Germany, it may be proper just to indicate, in a sentence or two, its position with regard to vaccination and small-pox. The facts are taken from a very useful tract published by the council of the British Medical Association.[1] In Germany, vaccination of children in the course of their second year is compulsory, and also revaccination of all school children in their twelfth year. That has been the law since 1874. In the nine years 1866–74, the small-pox deaths per million in Prussia were, respectively, 620, 432, 188, 194, 175, 2432, 2624, 357, 95. In the years 1875–1898, the corresponding figures have been 36, 31, 3, 7, 13, 26, 36, 36, 20, 14, 14, 5, 5, 3, 5, 1, 1, 3, 4, 3, 0·8, 0·2, 0·2, 0·4. In Austria, without compulsory vaccination, the annual rates 1887–1896 have been 440, 640, 520, 250, 290, 260, 250, 110, 47, 35. The figures for all Germany do not begin until 1886, and are as follows in the years 1886–99:—4, 3·5, 2·3, 4·1, 1·2, 1·0, 2·1, 3·1, 1·7, 0·5, 0·2, 0·1, 0·3, 0·5. In short, "small-pox epidemics are utterly abolished from Germany, and only a few scattered deaths occur each year, mostly on the frontiers (Russia and Austria)."

As illustrating what has been said already about the protection derived from living in a vaccinated and revaccinated community, I quote in conclusion the following passage regarding the Prussian army:—

"The law of 1874 made no difference in the vaccination of the Prussian army, which enjoyed good vaccination ever since 1834: every recruit being vaccinated on joining—twice if necessary. But the law of 1874, which only directly affected infants and school children, made a great and striking difference in the small-pox mortality of the *army*. Previously there were a few deaths, one or two, almost every year, but after 1874 there was not a single death for ten years, and only two deaths (1884 and 1898) in the whole period 1875–98. The first death is that of a reservist twice unsuccessfully vaccinated in the army. This shows that the protection which an individual acquires by vaccination is increased by his being surrounded by a well-vaccinated community." JOHN C. M'VAIL.

[1] "Facts about Small-pox and Vaccination," &c. (British Medical Association, 429 Strand, W.C.) Price 1½*d*.

AN AMERICAN REPORT UPON THE WEST INDIAN ERUPTIONS.[1]

DR. E. O. HOVEY, associate curator of the geological department of the American Museum of Natural History, New York, was sent by that institution to Martinique and St. Vincent to study the phenomena accompanying the great eruptions of Mont Pelée and La Soufrière of last year, and the report referred to below deals almost entirely with his personal observations. The report first discusses the May eruptions of La Soufrière, the author being a member of the first party, on May 31, to ascend that mountain after the eruptions of May 7 and 18. The party found that the old crater lake for which the volcano had been famous had disappeared, but that there was a small lake of (apparently) boiling water in the bottom of a precipitous pit nearly a mile in diameter at the top. The author and Dr. T. A. Jaggar, jun., who also was in the party making the ascent, estimated that the bottom of the pit was about 1600 feet below the part of the rim on which they were standing, or about 2400 feet below the highest part of the rim. A strong column of steam was rising, occasionally including clouds of dust, from the south-east quarter of the lake.

The wall between the great crater and the "New" or 1812 crater seemed intact, and from its lower third there issued a strong stream of water, apparently from waters then collecting in the 1812 crater. The rim of the crater and the upper part of the cone was covered with a thick mantle of mud, which rendered it unwise to attempt to reach the windward side of the volcano along the rim. Ten days later the author, accompanied by Mr. George C. Curtis, of Boston, who was his companion on the first and second ascent and during most of his stay on the islands, made a third and successful ascent from the windward side of the island and stood upon the peak between the two craters. It seemed evident that the small (1812) crater had not taken part in the May eruption, though the summit of the mountain was covered with clouds at the time of the visit.

The explosions attending the May eruptions of La Soufrière expended their strength radially in all directions from the crater. The principal evidence of this is the trees, which lie prone in directions pointing away from the crater, except for modifications due to local circumstances of topography. The roots of the upturned trees showed the effects of the sandblast action of the volcanic tornado, being worn and charred upon the portions toward the crater and preserving the fresh, unburned bark upon the protected parts. The explanation for the explosions suggested is that unusually great masses of superheated steam arriving at the lip of the crater could not find room for expansion upwards on account of the cushion-effect of the column of steam and lapilli preceding them, and the lapilli falling therefrom, and that they expanded with violence horizontally and downward, following the configuration of the mountain. Extensive landslides occurred for two or three miles along the leeward coast.

The particular feature of the May eruptions of La Soufrière was the enormous amount of dust which was thrown high into the air and distributed over a vast, elliptical area, the extent of which cannot yet be calculated for lack of data. The dust appears to have been carried much farther to the east and south-east by the upper currents of air blowing counter to the trade winds, than to the west by the trades. Reports from Barbados and from ships encountering the dust at sea indicate transport by the upper air currents at a rate of about thirty-two knots contrary to the direction of the prevailing surface wind. The other ejecta of the eruptions were fine and coarse lapilli, blocks and bombs. No *stream* of melted lava accompanied either of the outbursts in May. The lapilli first thrown out

[1] Martinique and St. Vincent: a Preliminary Report upon the Eruptions of 1902, by Edmund Otis Hovey. *Bulletin* American Museum Natural History, vol. xvi. pp. 333–372, pl. xxxiii.–li. New York, October 11, 1902.

were fragments of the ancient lavas and tuff agglomerates in the throat of the volcano, those coming out afterwards were unoxidised and seemed to consist of new material, which had solidified, however, before reaching the atmosphere, though the larger lapilli in the September eruptions seemed to be bits of ancient lavas.

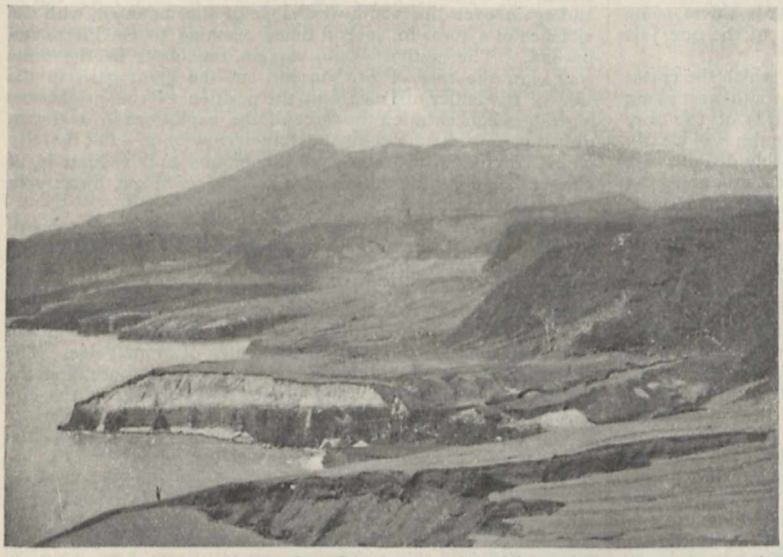


FIG. 1.—La Soufrière, St. Vincent, from Richmond estate. Effects of landslides and encroachment of the sea are shown along the coast. Photo by Clare E. Taylor.

The ejected blocks were of andesitic lavas, for the most part at least, and showed that they had been subjected to a high temperature, but had not been melted. Some of such blocks found four miles from the crater on the windward side were thought to weigh fifty pounds. The bombs noticed were of the "bread-crust" variety, similar to, but not as perfect as, those observed on Mont Pelée or those described by Johnston-Lavis and others from the 1888 eruption of Vulcano. Some of the bombs were of somewhat pumiceous and others of dense lava and they showed by their surface that they had been in a molten or half-molten condition in the throat of the volcano.

The great accumulations of hot lapilli and dust formed in the radial valleys, notably those of the Rozeau, Trespe and Wallibou rivers on the west and of the Rabaka dry river on the east, retained their heat for a long time after the eruptions and gave rise to secondary, or superficial, eruption phenomena of striking character and considerable interest. The river water and the water from the tropical showers percolating through the beds came into contact with the still highly-heated interior, causing violent outbursts of dust-laden steam. One such outburst from the Wallibou Valley near the sea, in the afternoon of May 30 sent up a column of such vapour fully a mile in height with all the cauliflower-like convolutions and mushroom-shaped top which are characteristic of a crater eruption-cloud. The Wallibou was so overloaded with volcanic ash that it could flow only in pulsations, intervals of from fifteen to forty seconds being needed for the stream to gather strength to push its way along with its load. The freshly fallen dry dust presented a ridged surface like that of wind-drifted snow.

The area of devastation on St. Vincent is very large in proportion to the total area of the island. After plotting it out carefully on the British Admiralty chart and measuring the area with a planimeter, I find that due to the May eruptions to be forty-six square miles, practically one-third the entire area of the island. From much of this devastated area, however, the ashes are being washed off so rapidly by the rain that vegetation is already asserting itself, and within another year crops will be growing there again.[1]

[1] Newspaper reports and private advices from St. Vincent show that the area of devastation has been extended on the leeward side of the island by the tremendous eruption of September 3-4 about four miles south of the boundary indicated on the map herewith presented, while the whole western portion of the devastated area got a heavy additional coat of lapilli. The windward side did not suffer materially from this eruption, but the eruption of October 15-16 extended the area on the windward side.

The deaths on St. Vincent are assigned, principally, to the following causes:—(1) most important, asphyxiation by hot, dust-laden steam and air; then (2), burns due to hot stones, lapilli and dust; (3), blows by falling stones; (4), nervous shock; (5), burning by steam alone, and (6), probably, strokes of lightning. The deadly character of the dust-laden steam undoubtedly was enhanced by the presence of a considerable percentage of sulphur gases (SO_2 and H_2S). The action of steam would account for the burns received under the clothing where the clothing was not charred. No autopsies were made on the bodies of persons killed by either volcano, so far as the author is aware. The positions in which many of the bodies were found indicated death by asphyxiation.

Mont Pelée.

The area of devastation caused by the eruptions of Mont Pelée from May 5 to August 28 was less than that caused by the May eruptions of La Soufrière. The author, after plotting it upon the Admiralty chart and measuring it with a planimeter, estimates the area most seriously affected at thirty-two square miles, but observes that the eruptions since August 28 have greatly extended the area to the north, east and south-east, probably more than doubling the earlier devastation. The area of distribution of the ejecta cannot be estimated with any degree of accuracy for lack of data. There is no reason for supposing that it is much, if any, less than the area affected by La Soufrière. The shocks or detonations from some, if not all, of the great eruptions were felt in Antigua, St. Kitts, St. Vincent, Trinidad and other islands, though not in the intervening islands of St. Lucia and Dominica.

The material ejected by Mont Pelée during the series of eruptions consists of dust in vast quantities, fine and coarse lapilli, bread-crust bombs of all sizes from one inch in diameter upwards, and blocks of small and great size, the cracked

FIG. 2.—St. Pierre Valley of the Roxelane or Rivière des Blanchisseusses in the northern part of the city, as it appeared May 22, 1902. Photo by E. O. Hovey.

condition of which shows that they had been highly heated. The bread-crust bombs are more perfect in their development than are those of La Soufrière. The largest mass which seemed to be a bomb, was one fifteen feet long, lying on the south-east slope of Morne Lacroix at an elevation of 3950 feet above the sea. Several bombs between 2 and 3 feet in longest dimension

were observed, and two were brought back to New York, one of which is now on exhibition in the American Museum. The largest ejected block noted was one upon the surface of the mud-flow between the Blanche and Sèche rivers, less than 200 yards from the sea-coast and about three miles from the crater. Its dimensions are 30 × 24 × 22 feet, and it is of the light grey ancient andesitic lava, to be found in all places near the summit of the mountain. Many other great boulders, some of which are of nearly half the dimensions of the one just described, lie near by.

Four ascents of Mont Pelée, in the course of which the crater rim was traversed from the great chasm on the south-west along the southern and eastern edge, about two-thirds of the way around the circle, and the remainder also of the rim was clearly seen, the author was enabled to form a reasonably definite idea of the centre of activity of the volcano and what was going on therein. The crater is somewhat oval in shape, with the longest axis stretching north-east and south-west, and the highest point of the rim is on the north-east, and is what is left of the peak which is known as Morne Lacroix. The average between the readings of two barometers (one being in the hands of Mr. George C. Curtis, the companion of the author) determined the altitude of this peak as 4200 feet above the sea, the original height given upon the chart being 4428. The lava bed, forming what may be considered the rim of the crater on the south-east side of the gash, is 3350 feet above tide, while the real bottom of the gorge where it issues from the crater is 500 or 600 feet less in altitude. From this lava bed the rim rises rapidly (30° to 35°) to about 3750 feet above tide and then more gradually along the southern edge, until 3950 feet is reached on the eastern rim. The north-west side of the south-western gash is formed by a pinnacle of ancient lava, which appears to be about 4000 feet above the sea. From this point the rim drops somewhat toward the north, but gradually rises again toward the east until Morne Lacroix is reached again. This crater is estimated to be about half a mile across. The breadth of the rim varies from a mere knife-edge on the south, west, north and north-east sides to a sloping plateau 50 to 100 yards wide, on the eastern side. This plateau is the site of the shallow body of water known as Lac des Palmistes.

This lake basin was empty when visited by Prof. Heilprin on June 1, but was filled with dust and ashes when the author and Mr. Curtis visited the spot on June 18, 20 and 26. The author considers that the body of water known as Étang Sec, and not the Lac des Palmistes, was the real crater lake of Mont Pelée. The eruptions of the year 1902 have been for the most part from a vent which opened within the large crater at the head of the great gorge in the side of the mountain and just west of Étang Sec. The activity has built up a cone the top of which at the time the author left the islands, July 6, was not less than 4000 feet above the sea, indicating a growth of 1600 to 1700 feet within the two months of volcanic action which had then taken place. There was a crater visible in the top of this inner cone the breadth of which can only be guessed at as being about 400 feet. Measurements of the angle of slope of the outer side of the cone determined it to be 38° to 40°, but there are precipitous portions. The material which rolls and slides down the south-west side of this cone continues directly into the cañon of the Blanche river. The steep-sided valley formed by the inner cone and the inner slopes of the great crater is a continuation of the gorge of the Blanche and rises rapidly from the south-western gash to the base of the rocky precipice of Morne Lacroix, where it may be 800 feet in depth. The valley probably continues round the northern side of the inner cone, rising in a spiral, for it appears at an elevation of at least 3600 feet on its eastern side between the inner cone and the rim of the crater on the north-west side of the great gash. There seemed to be a second centre of eruption of considerably less activity within the crater near the base of Morne Lacroix.

The history of the present series of eruptions may be epitomised somewhat as follows: the gradually returning activity of the volcano began to make itself very manifest in the latter part of April, since visitors to the crater found warm water in the basin of the Étang Sec on the 25th of that month, and the lake was "deep." Columns of dust-laden steam rose from an opening within the old crater on the east side of the Étang Sec and from one on the west side of the same basin, and cones rose about these openings. Water in large quantity collected in the old lake basin, assisted, perhaps, by a dam formed across the gorge by the ejecta from the western crater. The water was heated by the action of volcanic forces. On May 5 the heated waters of the crater broke through this dam and rushed, as a deluge of mud and boulders of all sizes, down the gorge of the Blanche river, and overwhelmed the Guérin sugar factory, which was situated at the mouth of the stream. On May 8 began the series of great explosions which have sent steam, laden with sulphurous gases, dust, ashes and stones, again and again over the south-west slope of the mountain with the violence of a tornado, several times reaching to St. Pierre and beyond. The author would explain the blasts in the same way as in the case of St. Vincent, but the great gash in the side of the crater of Pelée and the position of the neighbouring ridges concentrated the force of the explosions in a certain direction and along a comparatively narrow zone—and the city of St. Pierre with its 26,000 inhabitants and thousands of refugees lay in an amphitheatre, a regular *cul-de-sac*, directly in the path of the blasts.

The ruins of the buildings in St. Pierre, the prone trees of the city, the dismounted guns in the batteries of Morne d'Orange and Pointe Ste. Marthe, the position of the iron statue of Notre Dame de la Garde upon the edge of the bluff below and fifty feet from its pedestal and many other circumstances, are the evidences that a blast of tornadic violence swept over the city of St. Pierre from the direction of the crater of Mont Pelée. The degree of destruction diminishes from north to south, and the amount of volcanic ash and stones deposited upon the city becomes less and less in the same direction.

The causes of death on Martinique were the same as on St. Vincent, with the addition of crushing beneath falling walls and other objects and cremation in burning buildings. In connection with the eruptions of both volcanoes, the lack of respirable air probably caused many deaths.

FIG. 3.—Quarter-inch boiler-iron tanks in a distillery in the Fort Quartier of St. Pierre, showing holes made by bombardment of stones from Mont Pelée eruption. Photo by E. O. Hovey.

The author came to the conclusion that there were no real craters or centres of primary eruption anywhere on Mont Pelée, outside of the great crater, though there has been much secondary action along the lower portion of the Blanche, Sèche, Falaise, Grande and Prêcheur rivers and other of the streams the sources of which are high up upon the slopes of the mountain. The secondary action was due, as in the Wallibou Valley and elsewhere on St. Vincent, to the admission of water to the heated interior of great accumulations of volcanic ash. Mud-flows and mud-torrents have been very numerous down the gorges of these streams and on the intervening plateaus. Some of these flows have been due to the breaking of the temporary dams caused by the quantities of loose ash thrown across the stream during the secondary outbursts, but the most destructive, with the exception of the one overwhelming the Guérin factory, have been due to the saturation by rain of the accumulations of dust on the inner and outer slopes of the crater rim, producing fluid masses which have run down the slopes of the mountain and the radial gorges with the destructiveness of avalanches.

The electrical displays in connection with each of the great outbursts were on the grandest possible scale. Such displays characterised the eruption of La Soufrière in 1812 according to contemporary reports.

The author and Mr. Curtis spent four nights (June 17–21) at Morne Rouge, and visited the crater on June 18 and 20. They felt then and told the people that there was great danger to the town in case of succeeding great eruptions, and they saw no reason to suppose that the activity of the volcano was lessening. It was evident that, if the inner cone kept on increasing in height until it considerably overtopped the eastern rim, or, if the greater activity shifted to the eastern vent within the crater and behind the wall formed by the inner cone, the great south-western gash and its cliffs on the north would lose their directive influence, and the force of the explosions would be expended radially in all directions. The early telegraphic reports of the eruption of August 30 stated that the remains of Morne Lacroix had been blown away, which indicated that the violent activity had shifted to the east. Later and authentic reports by Prof. Heilprin made it clear that Morne Lacroix had not suffered much additional damage, and his photographs taken after that eruption show the top of the inner cone well above the crater rim. Hence the former supposition cited above proved to be correct.

PRIZES PROPOSED BY THE ACADEMY OF SCIENCES FOR THE YEAR 1903.

IN geometry, the Francœur Prize (1000 fr.) is offered for discoveries or works useful to the progress of pure or applied mathematics; the Poncelet Prize (2000 fr.) for similar work done during the ten years preceding the award; and the Grand Prize of the Mathematical Sciences (3000 fr.).

In mechanics, the extraordinary Prize of 6000 francs for work tending to increase the efficiency of the French naval forces; the Montyon Prize (700 fr.) for inventing or perfecting instruments valuable in the mechanical arts; the Plumey Prize (2500 fr.) for improvements in connection with steam engines; and the Fourneyron Prize (1000 fr.) for a theoretical or experimental study of steam turbines.

In astronomy, the Pierre Guzman Prize (100,000 fr.) for finding a means of communicating with any planet other than Mars; the Lalande Prize (540 fr.) for the most interesting memoir or observation valuable to the progress of astronomy; the Valz Prize (460 fr.) and the G. de Pontécoulant Prize (700 fr.) for similar work.

In physics, the Hébert Prize (1000 fr.) for the author of the best treatise or most useful discovery for the commercial or practical use of electricity; the Hughes Prize (2500 fr.) for the best discovery or work contributing to the progress of physics; the Gaston Planté Prize (3000 fr.) for an important discovery or invention in the field of electricity.

In statistics, a Montyon Prize (500 fr.) for a work on French statistics.

In chemistry, the Jecker Prize (10,000 fr.) for work in organic chemistry, and the La Caze Prize (10,000 fr.).

In mineralogy and geology, the Delesse Prize (1400 fr.) for a work bearing on geological or mineralogical science.

In physical geography, the Gay Prize (2500 fr.) for a work having for its end the determination, as precisely as possible, of a series of geographical positions in a French colony.

In botany, the Grand Prize of the Physical Sciences (3000 fr.) for a research on the various modes of formation and development of the egg in the Ascomycetes and the Basidiomycetes; the Bordin Prize (3000 fr.) to demonstrate, by a study of numerous and varied types, the generality of the phenomenon of double fertilisation, or digamy, in the Angiosperms; the Desmazières Prize (1600 fr.) for the best work published in the course of the preceding year on Cryptogams; the Montagne Prize (1500 fr.) for work on the anatomy, physiology, development or description of the lower Cryptogams; the Thore Prize (200 fr.) for a work on the cellular Cryptogams of Europe.

In rural economy, the Bigot de Morogues Prize (1700 fr.) for any work tending to forward the progress of French agriculture.

In anatomy and zoology, the Savigny Prize (1300 fr.) for the assistance of young travelling zoologists with especial reference to the study of the invertebrate animals of Egypt and Syria; the Da Gama Machado Prize (1200 fr.) for the best memoir on the coloured portions of the tegumentary system of animals.

In medicine and surgery, a Montyon Prize, three prizes of 2500 fr. and three mentions of 1500 fr. for discoveries or inventions relating to the improvement of medicine or surgery; the Barbier Prize (2000 fr.) for a discovery in medical, surgical or pharmaceutical science or in botany of curative value; the Bréant Prize (100,000 fr.) for the discovery of a radical cure for Asiatic cholera, or for pointing out the causes of the disease so that preventive measures leading to the eradication of the disease can be carried out; the Godard Prize (1000 fr.) for the best memoir on the anatomy, physiology and pathology of the genito-urinary organs; the Lallemand Prize (1800 fr.) for the encouragement of work on the nervous system; the Baron Larrey Prize (750 fr.) for a work treating of medicine, surgery or military hygiene; the Bellion Prize (1400 fr.); the Mège Prize (10,000 fr.); the Chaussier Prize (10,000 fr.) for the best book or memoir which has appeared during the last four years on legal or practical medicine.

In physiology, a Montyon Prize (750 fr.) for researches in experimental physiology; the Philipeaux Prize (900 fr.) for similar work; the Pourat Prize (1000 fr.) for a memoir on the action of high-frequency currents on the phenomena of life.

Other general prizes offered include the Binoux Prize (2000 fr.) for work on the history of science; Montyon Prizes (2500 fr. and 1500 fr.) for the discovery of any means rendering a dangerous trade less unhealthy; the Wilde Prize (4000 fr.) for a discovery or work on astronomy, physics, chemistry, mineralogy, geology or experimental mechanics; the Tchihatchef Prize (3000 fr.) for the encouragement of exploration in Asia by naturalists; the Cuvier Prize (1500 fr.); the Parkin Prize (3400 fr.); the Petit D'Ormoy Prize (two prizes of 10,000 fr.), one for pure or applied mathematics and the other for work in natural science: the Boileau Prize (1300 fr.) for researches in hydraulics; the Estrade-Delcros Prize (8000 fr.); the Cahours Prize (3000 fr.) for the encouragement of young promising chemists; the Saintour Prize (3000 fr.); the Tremont Prize (1100 fr.); and the Gegner Prize (3800 fr.).

Of these, the prizes bearing the names of Pierre Guzman, Lalande, La Caze, Delesse, Desmazières, Wilde and Parkin are expressly stated to be offered without distinction of nationality.

LONDON CONFERENCE OF SCIENCE TEACHERS.

THE fifth annual conference of science teachers arranged by Dr. Kimmins in connection with the Technical Education Board of the London County Council was held at the South-Western Polytechnic, Chelsea, on January 9 and 10. There was a larger attendance than in any previous year, between four and five hundred teachers and others accepting invitations to be present. Adopting the admirable practice of former meetings of selecting for consideration a subject which during the preceding year has been specially receiving attention in the educational world, arrangements were made to give the whole of the first two sessions to a discussion on the teaching of elementary mathematics, more especially the instruction in elementary geometry, and the interest manifested in the subject fully justified the choice. The third meeting was devoted to the teaching of botany in schools and colleges, and the last to methods of illustrating the instruction in chemistry by lecture experiments.

The customary invitation to teachers of science to send for exhibition during the conference home-made apparatus, designed by themselves to simplify their instruction, was not this year responded to with any heartiness. Leaving on one side the exhibits of the staff of the South-Western Polytechnic, the pieces of apparatus on view were few in number and in no way remarkable for the ingenuity displayed. At the same time, the experiments in plant physiology arranged by Mr. H. B. Lacey, of the Chelsea Polytechnic, to illustrate his paper at the third meeting, were well calculated to show teachers of botany how the odds and ends of every day life can be utilised in the experimental illustration of science lessons.

The Teaching of Geometry.

The chairman of the Technical Education Board of the London County Council, Mr. H. Ward, presided at the opening meeting, and after emphasising the value of conferences to teachers, contrasted German and English systems of education; he based his hopes for the future of English education on a combination of the excellences of German methods with the elasticity and originality which characterise education in this country.

Sir William Anson, Parliamentary Secretary of the Board of Education, took the chair at the afternoon meeting of the first day. He confessed that, having been educated in the dark ages, when science and mathematics found but a small place—or perhaps he should more strictly say when mathematics had but a small place and science had no place at all—in the curriculum of the public schools, he came to listen with a perfectly unprejudiced mind to the discussion. After all, a comparison of various methods of teaching seemed to him to be for practical purposes as valuable as anything that could be done in the way of the training of the teacher. A grain of practice was worth a much larger proportion of theory, and it must be of great value to hear men who had been successfully engaged in teaching explain the difficulties of their subjects and the modes in which they brought their minds to bear upon the minds of those who had to be taught. The great secret of teaching was to bring their minds into immediate contact with the mind of the learner and to impart to him what they knew and the processes by which they learned it.

In the morning, papers were read by Mr. Usherwood, on the experimental method in geometry, and by Mr. Frank Castle, on the teaching of workshop mathematics. Mr. Usherwood related his experiences of teaching geometry to boys beginning the subject on a practical inductive plan, and advocated the use of paper-folding and similar expedients as means of encouraging the pupil's self-activity. Mr. Castle enumerated some of the shortcomings of the education given in the great public schools, and traced them to the rigid, iron-bound nature of the prevailing system. He referred to recent changes in the syllabuses of many public examinations as a hopeful sign that methods of mathematical instruction were becoming less academic and more suited to the practical needs of the present day. The subsequent discussion, in which the Rev. T. W. Sharpe, Dr. Hoffert, Mr. C. W. Bourne and others took part, showed that the work which has been accomplished by the committees of the British Association and of the Mathematical Association, in the direction of rationalising mathematical instruction, is, on the whole, meeting with the approval of practical teachers.

At the afternoon meeting, addresses on the teaching of geometry were delivered by Messrs. S. O. Andrews, W. D. Eggar and A. W. Siddons. Mr. Eggar said that the first object in the choice of exercises for a young boy beginning the study of geometry was to instil notions of lines, points, angles, areas, volumes and similar subjects, and this was best accomplished by simple measurement. A discussion followed during which Mr. Gerrans, referring to the recent changes in the mathematical requirements for university examinations, said that the universities had in the past deferred such alterations because of their doubt as to whether the schools were ready for change.

Rational Instruction in Botany.

The third meeting, under the presidency of Prof. Farmer, F.R.S., was devoted to a consideration of the methods of botanical teaching. During the course of his remarks, Prof. Farmer said that, examination syllabuses notwithstanding, the best way was to study a small part of the subject thoroughly and in all their instruction to help their students to think. Too little attention, he thought, was given to the economic aspects of the subject. He advocated a careful examination of the reasons, for example, of the peculiar conditions of the distribution of vegetation under beech and pine trees, and pointed out that such problems would lead to the discovery of the effects exerted by light, soil and other influences on growth. The effect of grass in an apple orchard was also instanced, and the information which could be obtained from the study of this problem in leading to an appreciation of the interaction of the grass growth in the matter of drainage and the supply of oxygen was pointed out. Prof. Farmer gave an interesting example of what he called a "museum of mismanagement," in the case of a larch plantation which had been planted on a mountain-side, though it should have been well known that the larch is a deep-rooted plant.

Two papers were read, one by Miss Lilian Clarke, on the rational teaching of botany, and the other by Mr. Lacey, on experimental plant physiology. Miss Clarke, in a preeminently practical paper, described how, by experiments in the laboratory and school-garden at James Allen's school, Dulwich, she has succeeded in making botany an interesting and educational subject of study for girls. She explained that though in the past this work has been somewhat in abeyance in the winter, they hoped in the future to be able, owing to the provision by the London Technical Education Board of a botanical laboratory, to be able to pursue the work without a break throughout the year. Mr. Lacey concerned himself more with the work of advanced students. He described numerous experiments, illustrated by an excellent series of lantern slides, to show how lessons in botany may be made more valuable by the utilisation of the common objects of ordinary life in the experimental work. The slides of botanical objects under the microscope which he also showed were of particular value to teachers in demonstrating how easy it is to supply the student with graphic illustrations of the objects of his study. The informative nature of the papers led to questions from the audience rather than a discussion.

The Art of Illustrating Teaching.

The last meeting, at which Prof. Callendar, F.R.S., presided, was taken up with a consideration of the methods of illustrating lectures by experiments and lantern slides. In introducing the speakers, Prof. Callendar insisted on the importance of experimental work in the teaching of physics and chemistry, and referred to the difference between experiments suitable for performance by the student and those necessary to illustrate the lectures of the teachers. Two addresses were given, one by Mr. G. S. Newth, on experimental illustration in the teaching of chemistry, and the other by Mr. Harold Busbridge, on the making of lantern slides. Mr. Newth, before proceeding to perform certain typical experiments, criticised in some particulars what is commonly known as the heuristic method of teaching, and complained that in important respects it misled the pupil and gave him wrong ideas as to the nature of the great generalisations called chemical laws. In the selection of experiments, he said, the teacher should choose those only which are really illuminative and never introduce one merely because it is amusing. Mr. Newth also gave invaluable hints to teachers as to how to avoid failure in their experiments. The experiments performed were well chosen and invariably met with the success which Mr. Newth's well-known manipulative dexterity led the audience to expect.

Mr. Busbridge provided teachers with practical assistance in the art of making lantern slides at a small cost. He left on one side all photographic methods and confined his attention to the elucidation of simple expedients which could be utilised by a teacher with very little experience of laboratory methods. In a short discussion which followed, Dr. Hoffert referred to an important consideration if the experimental illustration of the ordinary teacher of science in schools is to be improved, that is, the diminution of his duties if time enough is to be provided for him to prepare good, suitable lecture experiments. As Dr. Hoffert said, it is unreasonable to expect the science master to add to his already arduous work by staying after school hours to prepare experiments. All science masters should be given time enough during the hours in which the school is open in which to prepare the experiments necessary for satisfactory lessons in science. A. T. S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is reported that the Italian Minister of Public Instruction has authorised the establishment of a post-graduate school of hygiene and medical jurisprudence in connection with the University of Turin.

AT University College, London, Mr. V. H. Blackman will give a course of about six demonstrative lectures on microscopical technique in botany on Mondays during the current term, commencing Monday, January 19, at 4 p.m.

THE *Daily Mail* states that the late Mr. F. J. Quick, of Eltham, and Trinity Hall, Cambridge, left his residuary estate to the University of Cambridge in trust, to apply the income in promoting the study of vegetable and animal biology, for which purpose the university will probably eventually receive between 50,000*l.* and 60,000*l.*

AT a meeting last week of the Liverpool School of Tropical Medicine, it was announced that since the previous meeting 10,000*l.* had been collected or promised towards founding a chair of tropical medicine in University College, Liverpool, which had been accepted by the college authorities. Major

Ross has been elected to the chair, and his title will be the Sir Alfred Jones professor of tropical medicine. Dr. J. W. W. Stephens has been elected to the Walter Myers lectureship in tropical medicine.

AT the last meeting of the Lancaster Town Council, we learn from the *Lancaster Observer*, a letter was read from Prof. Percy Frankland, F.R.S., addressed to the principal of the Storey Institute, in which he announces his intention of giving to the Institute a sum of one hundred pounds to be devoted to the purposes of a "Frankland Prize" for chemistry, whereby the memory of his late father, Sir Edward Frankland, may be perpetuated in Lancaster, in which town he received his education and spent the early years of his life.

A NEW Technical College, the building of which has been completed at a cost of about 50,000*l.*, was opened at Wigan on Monday. Mr. R. B. Haldane, K.C., M.P., delivered an address, in which he said they had, through the enterprise of a few public-spirited people, established an institution which would take its place in that great organic structure of the national education which was slowly being built up. Referring to the question whether charters should be given to establish teaching universities in Manchester and Liverpool, Mr. Haldane said he was quite sure that, if not in a few weeks, at least in a few years, they would see those great centres of academic learning in full force, with full distinction of university power and stature.

IN November last, Prof. Schmidt accompanied the German Emperor to England, and went to Oxford to investigate the details of the Rhodes scholarships. He has just reported the results of his conference with the Oxford authorities to the Kaiser. The Berlin correspondent of the *Daily Mail* reports that in an interview Prof. Schmidt remarked:—"The German Government unreservedly acknowledges the great value of the Rhodes scholarships, and will do its utmost to assist German students to avail themselves of them. You may state that the prospects of our accepting the scholarships are altogether favourable. There are no fundamental difficulties whatever in the way. Nothing but the difference between German and English university requirements suggests possible obstacles, the preparatory education of German students being so far in advance."

AT the annual dinner of the Bristol University College Colston Society on Tuesday, Sir J. Crichton Browne, who was the principal guest, alluded to the subject of local universities. He said objections to universities were futile in consideration of the educational needs of the hour. What was wanted was not a lot of provincial universities, but a group of national English universities, which should collectively meet the higher educational wants of the country as a whole. Each university should have instructive features of its own, each adapted to its environment, but all supplying the best instructions, the highest culture and the finest discipline of the day. If Liverpool obtained the charter it sought, they would inevitably have modern universities in Manchester, Leeds, Durham, and Cardiff; and Bristol should not be content to be left out in the cold. It seemed inevitable that there would be a great extension of the university system in England; and there was no need to be afraid of going too far for some time to come, especially when one in 520 went now to Scotch universities, whereas only one in 5000 went to universities in England.

THE development of higher education in the United States continues rapidly. The registrar of Columbia University, Mr. Rudolf Tombo, contributes to a recent number of *Science* certain interesting university registration statistics which reveal that the opening of each new academic year shows a marked advance over the last. The statistics are those of the beginning of November of last year, and deal with eighteen of the leading American universities. For the session preceding that with which the statistics deal, the relative rank of the seventeen leading universities on the basis of total enrolment was as follows:—Harvard, Columbia, Michigan, Chicago, California, Minnesota, Cornell, Wisconsin, Yale, Pennsylvania, Northwestern, Indiana, Nebraska, Missouri, Princeton, Leland Stanford and Johns Hopkins. If the students attending courses for teachers are counted, the total number for Harvard is 5468 and that for Columbia 5352. Chicago has had a considerable increase of students, and in Mr. Tombo's table ranks third, with 4296. Syracuse, which is included in the table for the first time, has a larger enrolment than Indiana. The teaching staff at Harvard numbers 533, at Columbia 504; and at the Johns Hopkins University, where the total number of students is only 669, there are 147 teachers of different grades. Indiana seems to have the smallest staff, viz. 65 teachers for 1648 students.

THE Senate of the University of London has adopted a scheme for the inspection of schools and for a school-leaving examination in connection with which school-leaving certificates will be awarded. The purpose of the scheme is to secure that the new certificate shall admit the holder as a matriculated student of the University without further examination at the age of sixteen years, and that schools shall have freedom in the selection of the subjects of study pursued by their pupils. For pupils only able to attain the necessary standard in some, but not all, of the subjects required for the school-leaving certificate, their attainments will be set out on a school record. Opportunity will be afforded to the more capable pupils of obtaining credit for advanced work. As the course of study pursued by a pupil at school, his age, the period during which he has attended school, the subjects in which he has reached the standard required by the University, and also any form of manual, artistic or technical skil will be set out on the record, it should become a valuable testimonial to the pupil on entering life. In order to maintain the same standard for the matriculation examination and the school-leaving examination, the University proposes to appoint a small board of inspectors, consisting of persons of distinction and large teaching experience, who will act as moderators for the matriculation examination and be responsible for maintaining the standard of the school-leaving certificate.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 20, 1902.—"On the Correlation of the Mental and Physical Characters in Man." Part ii. By Alice **Lee**, D.Sc., Marie A. **Lewenz**, B.A., and Karl **Pearson**, F.R.S.

In a second paper on this subject read before the Royal Society, the following conclusions were reached:—

In order to meet an objection raised at the discussion on the first paper, the correlations were found, for the Cambridge graduates, between

(1) Intelligence and the ratio $\frac{\text{length of head}}{\text{stature}}$,

(2) Intelligence and the ratio $\frac{\text{breadth of head}}{\text{stature}}$;

both of these results came out even smaller than the correlations of intelligence and absolute head measurements.

The correlation between auricular height and intelligence in school-boys was found to be insensible. The statement made by MM. Vaschide and Pelletier in the *Comptes rendus* that there is a correlation in this case appears to be based on meagre material and defective method.

The correlations between intelligence and (1) strength of pull, (2) strength of squeeze, (3) long sight are all negative, that is, the honours men have less strength and shorter sight than the pass men, but here again all these values are less than the probable errors, and consequently no weight can really be attached to them individually.

The correlation between intelligence and weight is slightly larger than the probable error.

The correlations of intelligence with

(1) The ratio $\frac{\text{weight}}{\text{stature}}$,

(2) The ratio $\frac{\text{weight}}{(\text{stature})^2}$,

(3) The ratio $\frac{\text{weight}}{(\text{stature})^3}$

were found indirectly by formulæ, and (1) was also found directly; here again the results are of the same insignificant character as when absolute weights are taken.

Summing up the results of the calculations based on the Cambridge measurements, we come to the conclusion that the

honours men are slightly heavier, have slightly longer and broader heads, are not quite as tall or as strong as the poll men, and are slightly more short-sighted.

In no case, however, is the correlation sufficiently large to enable us to group the honours men as a differentiated physical class or to predict the intellectual capacity from the physical characters of the individual.

From the school measurements, the relation was investigated of athletics to health and to intelligence; there was found to be a sensible, but not marked, correlation between good health and intelligence; a marked correlation (0·4570) between good health and athletics, and a correlation of 0·2133 between intelligence and athletics.

Thus, while the intelligent are only slightly the more healthy, the athletic are notably the more healthy and are considerably more intelligent than the non-athletic.

It was found also that the athletic are the more popular and the more noisy, and tend to quick rather than to sullen temper. So far as the athletic character in the school-boy enables us to form a general estimate, the expressions "flannelled fool at the wicket" and "muddied oaf at the goal" seem hardly warranted.

Mathematical Society, January 8.—Dr. Hobson, vice-president, in the chair.—Dr. **Larmor** described the origin and progress of the movement for presenting to Mr. R. Tucker a permanent mark of appreciation of his services to the Society during his long tenure of the office of honorary secretary. The presentation was made by the chairman.—The following papers were communicated:—Prof. A. **Lodge**, Note on a method of representing imaginary points by real points in a plane. There is a (2, 2) correspondence of pairs of imaginary points, represented by conjugate imaginary coordinates, with pairs of real points. When the straight line joining the pair of imaginary points is real, the straight line joining the corresponding pair of real points cuts it at right angles. Examples of the application of the method to problems relating to conics were shown. —Dr. J. **Larmor**, On the mathematical expression of the principle of Huygens. The paper contains a direct intuitive proof of the integral formula put forward by Kirchhoff as the analytical expression of Huygens' principle. The proof is based on a method, analogous to that used by Green in the theory of potential, for determining, by means of its singularities, a function which satisfies the characteristic differential equation of wave propagation. Extensions of the same method to the conduction of heat in crystals and to electric waves are given. The redundancy of the data in Kirchhoff's formula is noted, and a comparison is made of the merits of this formula and of a well-known integral formula given by Poisson, considered as possible foundations for the principle of Huygens.—Prof. A. E. H. **Love**, Wave motions with discontinuities at wave-fronts. It is shown that when the wave motion is represented by means of a function which is not itself discontinuous at the front or rear of an advancing wave, the validity of the integral formulæ given by Poisson and Kirchhoff for the representation of the function is not impaired by a discontinuity in the differential coefficients of the function at the front or rear of the wave. Certain classes of waves admit of being resolved into series of pulses, propagated independently of each other, the front and rear of a pulse being nodal wave-fronts presenting discontinuities of this type. This is the case for spherical sound waves and for electric waves of certain kinds. The paper contains a new explanation of the approximately rectilinear character of the propagation of light, according to which this character does not depend upon the periodicity of the waves, but upon the existence of a series of nodal wave-fronts.—Dr. H. F. **Baker**, Of functions of several variables. The paper is concerned with the problem of expressing a function of several variables, without essential singularities at points where the variables are finite, as a quotient of two integral functions. If p is the number of complex variables, the integral functions can be represented by integrals taken through $(2p-1)$-fold domains which are bounded by $(2p-2)$-fold loci. The domains of convergence of multiple power series are discussed, and the question of the existence of series of simpler functions capable of representing multi-periodic functions without finite essential singularities is considered.—Mr. W. H. **Young**, On non-uniform convergence and the term by term integration of series. The case of term by term integration considered in the paper is the most general possible. Incidentally, the most general distribution of the points of non-uniform convergence of a series of point-wise discontinuous functions the sum of which is at most point-wise discontinuous is found.—Prof. L. E. **Dickson**, Generational relations for the abstract group simply isomorphic with the linear fractional group in the Galois field $[2^n]$.—Rev. F. H. **Jackson**, Series connected with the enumeration of partitions (second paper).—Prof. W. S. **Burnside**, (1) On the Jacobian of two binary quantics considered geometrically, (2) On the resolution of some skew invariants of binary quantics into their factors in terms of their roots.—Mr. J. **Brill**, On the minors of a skew symmetrical determinant.

Geological Society, December 17, 1902.—Prof. C. Lapworth, F.R.S., president, in the chair.—Note on the magnetite-mines near Cogne (Graian Alps), by Prof. T. G. **Bonney**, F.R.S. These mines are situated in the Val de Cogne, one of the larger tributaries to the Val d'Aosta from the Graian Alps. At Filon Licone, the mass of magnetite is probably about 80 or 90 feet thick and some five times as long. At the Filon Larsine, the mass apparently is not nearly so thick. The ore is a pure magnetite, jointed like a serpentine, a thin steatitic film being often present on the faces. At both localities, the magnetite is found to pass rapidly into an ordinary serpentine, the transitional rock being a serpentinised variety of cumberlandite. The serpentine is intercalated between two masses of calc-mica-schists, with which green schists (actinolitic) are as usual associated, no doubt intrusively. The author discusses the relations of the magnetite and serpentine, which, in his opinion, indicate that a magnetitic must have been separated from a peridotic magma at some considerable depth below the surface, and the former, when nearly or quite solid, must have been brought up, fragment-like, by the latter; as in the case of metallic iron and basalt at Ovifak (Greenland).—The elk (*Alces machlis*, Gray) in the Thames Valley, by Mr. Edwin T. **Newton**, F.R.S. During the construction of the Staines reservoirs, some mammalian remains were obtained from the alluvium of the Wraysbury River, near the Thames at Youveney, and the author has recognised among them the skull and antlers, with other parts of the skeleton, of a true elk (*Alces machlis*). These are described. It appears that *Alces machlis* has been frequently found in peaty deposits in many parts of Great Britain and on the continent of Europe, but never in Britain in association with the mammoth; and it seems probable that in Europe and North America it was a rare animal in Pleistocene times, if indeed it was present before the close of that period.—Observations on the Tiree marble, with notes on others from Iona, by Mr. Ananda K. **Coomáraswámy**. The gneiss near Balephetrish has a general south-westerly and north-easterly trend, and the limestone occurs in it as lenticles. Descriptions of the varieties of the limestone in this locality are given. The inclusions comprise those of gneiss containing quartz, felspars, hornblende, augite, scapolite and sphene as characteristic minerals, and mineral-aggregates consisting of sahlite, coccolite, scapolite, sphene, apatite, calcite and mica. The contact-phenomena are not specially well displayed. The dynamic phenomena include the rounding of the minerals and the formation of "augen." The carbonates are present as a fine-grained granular matrix. Although there are exceptions, gneiss-inclusions and mineral aggregates have usually been protected from the effects of extreme pressure. The description of minerals includes carbonates, pyroxene, amphibole, forsterite, scapolite, sphene, mica, apatite and spinel. Various marbles are described from Iona, where they are associated with actinolite-felspar schists and others; they are included in the gneiss.

MANCHESTER.

Literary and Philosophical Society, January 6.—Mr. Charles Bailey, president, in the chair.—Prof. F. E. **Weiss** gave an account of some of the botanical features of Western America. He began with a description of some of the work done at the experimental farms, and mentioned that Dr. Saunders, of the Experimental Station at Ottawa, had been able to obtain a hybrid between the Siberian crab-apple and a larger apple, which was able to grow and fruit freely in Manitoba. He then described the vegetation of the Rockies and the Selkirks, and pointed out the gradual change in vegetation in passing on to California.

DUBLIN.

Royal Dublin Society, December 16, 1902.—Prof. W. E. Thrift in the chair.—On the conservation of mass, by J. **Joly**, F.R.S.—An account of preliminary experiments made with a view to find if a mass change attended such physical transformations as formed the subject of Herr

Heydweiller's recent experiments. The reacting substances are suspended freely, but in separate vessels, at one extremity of a torsion balance the beam of which lies in the meridian, and at noon or midnight the reaction is started by contrivances described in the paper. A deflection of the beam is looked for, or a change in its angular velocity. A loss or gain of mass involves the energy associated with the inertia of matter moving with the earth's velocity, and on the assumption either that the momentum or kinetic energy is conserved, the possibility arises that a mechanical effect on the whole mass may become apparent. The results so far are negative, that is, no gross mechanical effect has been obtained. If such exists, it is not of a magnitude corresponding to the weight-change observed by Heydweiller. Several of Heydweiller's reactions were repeated. The method of observation is being improved.—Improved polarising vertical illuminator, by J. **Joly**, F.R.S. This is an improvement on a method previously described by the author of observing sections of transparent rock-forming minerals by light which has been twice transmitted through the section, the object being to increase the colour differences due to birefringence and so increase the discriminative value of the phenomena.—Prof. T. **Johnson** exhibited specimens of swede-rot, due to Phoma, received from County Down and not hitherto observed in Ireland. The fungus agrees in its characters with *Phoma Brassicae*, Thüm., causing a rot of fodder cabbages in France. It appears identical, including the pink colour associated with the conidia escaping from the pycnidia, with the Phoma described by Potteras causing a turnip-rot in the north of England.

Royal Irish Academy, January 12.—Prof. Atkinson, president, in the chair.—Prof. C. J. **Joly** read a paper on the quadratic screw system: a study of a family of quadratic complexes. He believes that the memoir contains a fairly full account of the arrangement of the screws in this important family. The method employed is that indicated in the author's note on systems of rays in the appendix to the new edition of Hamilton's "Elements of Quaternions."

EDINBURGH.

Royal Society, December 15, 1902.—Dr. Munro in the chair.—Prof. James **Walker** and Mr. A. J. **Robertson** communicated a paper on freezing-point depression in electrolytic solutions. The interest of the paper lay in the method adopted and in the great delicacy of manipulation required. In all experimental attempts to measure the freezing-point depression of solutions, the divergence of the actually observed temperature is known to depend upon the difference between the true freezing point and the "convergence temperature," and on the rate at which ice is formed or dissolved. The true freezing-point will be registered if either the convergence temperature and the true equilibrium temperature are identical, or the rate of formation or fusion of ice infinitely great. The experimental method adopted was that suggested by the latter condition. For a given quantity of solution, the more ice taken and the finer its division the more rapidly will the equilibrium temperature be restored after any disturbance, and the more closely will the apparent and true freezing points coincide. In the experiments described, the quantity of ice used was never less than 12 per cent. of the weight of the solution. The concentration of the solution was determined immediately after the determination of the freezing-point depression by filtering off a quantity of the liquid and analysing it. A complete experiment consisted in first determining these quantities for an approximately decinormal solution of acetic acid, and immediately thereafter the same magnitudes for a solution of a good electrolyte of approximately the same freezing point. The validity of the method was first tested by experiments with malonic acid which obeys Ostwald's dilution law; and then freezing-point experiments were made on certain strong electrolytes for which previous observers had obtained results which were not accordant with the ionisation values obtained from the conductivities. Taking into account all the difficulties and disturbing factors in experiments of this kind, the authors conclude that their results tend to increase confidence in the methods of exact cryoscopy.—Dr. G. A. **Gibson** gave a preliminary statement as regards the condition of the blood in cyanosis. He showed that the blood is always of high specific gravity, while the amount of hæmoglobin is increased. The number of the red blood corpuscles is almost invariably raised, sometimes to a very great degree, and the white blood corpuscles are usually increased to a considerable extent. The object of the communication was to show that, although in cyanosis the different elements of the blood are increased throughout the whole vascular system, yet the increase is not uniform, as it is greatest in the veins, less in the capillaries and least in the arteries. Some years ago, the author brought forward the hypothesis that this increase in the blood elements is compensatory and is produced by the lessened destruction of the blood in consequence of diminished oxygenation. This explanation appears to be borne out by the fact that there is an increase in arteries, capillaries and veins, but the results of the present investigation show that any method based upon the assumption of a uniform condition of the blood throughout the system is fallacious. The concluding part of the paper was devoted to the effect of oxygen in cases of cyanosis, and the result of its employment thus far is to show that its effect upon the blood in cyanosis is inappreciable.—Dr. **Gibson** also gave a lantern demonstration on cases of acromegaly and gigantism.

PARIS.

Academy of Sciences, January 5.—M. Albert Gaudry in the chair.—Remarks on the composition of the gases from the fumeroles of Mont Pelée, and on the origin of volcanic phenomena, by M. Armand **Gautier**.—The results of the analyses of the gases from the volcanic fumeroles of Mont Pelée recently made by M. Moissan are compared with the analyses by the author of gases extracted from igneous rocks by heating to a red heat in a vacuum. The gases are qualitatively the same and of similar composition quantitatively, and a theory of volcanic action is deduced from these considerations.—A new examination of the objections of M. Leduc relating to the proportion of free hydrogen in air, by M. Armand **Gautier**. It is held that M. Leduc has not succeeded in answering the objections raised by the author in his last note, and in particular it is pointed out that air which has passed over 10 centimetres of red-hot copper oxide cannot be assumed to have been freed from all traces of combustible gases, since a portion of the hydrogen and methane in the air escape combustion even after passing over three times this length of glowing copper oxide.—On the use of the stereoscope in topography and in astronomy, by M. le Colonel **Laussedat**.—On some facts of endomorphism observed in the ruins of St. Pierre, Martinique, by M. A. **Lacroix**. A description of the phenomena which have taken place on the contact of iron materials with fused silicates, and showing the facility with which a volcanic rock, accidentally fused and kept in contact with divers materials, attacks them and transforms them both chemically and mineralogically.—On universal functions in space, by M. A. **Korn**.—On a new classification of the modes of nomographic representation of equations with any number of variables, by M. Maurice **d'Ocagne**.—A new method of testing rails, by M. Ch. **Frémont**. Three modes of testing rails are in actual use: by extension, flexure under a statical charge, and flexure by shock. In the testing by flexure under a sudden load, which is of the highest practical importance, it is assumed that the rails are homogeneous, a condition which is by no means fulfilled in practice, and it is this want of homogeneity which is frequently the cause of the discordance between the results of the trial and those of practice. A method of testing is described in which this defect is avoided.—On a plane representation of space and its application to graphical statics, by M. B. **Mayor**.—On the dielectric cohesion of gases, by M. E. **Bouty**. When the pressure of the gas is of the order of some centimetres of mercury, the critical field necessary to overcome the dielectric cohesion of the gas is a linear function of the pressure; at very low pressures, it is not the field, but the difference of total potential corresponding to the thickness of the gaseous column which remains constant.—On the statical work of muscle, by M. Charles **Henry**.—On the absolute value of the magnetic elements on January 1, 1903, by M. Th. **Moureaux**. A table is given showing the absolute values and secular variation of the magnetic elements at the Val-Joyeux Observatory.—On the activity of some salts of the rare earths as producing oxidation, by M. André **Job**. A solution of cerous acetate, although perfectly stable towards air, rapidly oxidises a solution of hydroquinone to quinhydrone. The acetate of lanthanum behaves similarly, from which the conclusion is drawn that a peroxide of lanthanum must be capable of existence.—On two new methods of synthesis of the oxyphosphinic

acids, by M. C. **Marie.**—On bromo-isopyromucic acid, by M. G. **Chavanne.** From the experiments described, it is probable that the constitution of isopyromucic acid remains still uncertain.—On a cellular structure in amorphous bodies, by M. G. **Cartaud.** The free surface of some suddenly cooled metals and some collodion films presents the appearance of a microscopic cellular tissue. In some cases, each cell contains a circular nucleus in relief.—The oxidation of ammonia and amines by catalytic action, by M. A. **Trillat.** The action of a red-hot platinum wire on a mixture of amines and air has been studied; in presence of water, ammonia is transformed into a mixture of nitrate and nitrite, amines of the fatty series are decomposed and give the separate oxidation products of the alcohol and ammonia, and in the case of the aromatic amines the oxidation chiefly takes place in the chains containing alkyl groups.—The diminution in the amount of lecithin in heated milks, by MM. **Bordas** and Sig. de **Raczkowski.** Milk which has been sterilised by boiling over the naked flame, or by heating at 110° in an autoclave, loses about one-third of its lecithin, and it is possible that some of the digestive troubles traced to the use of sterilised milk may be due to this cause.—On the presence of labial kidneys and a phagocytal organ in the Diplopoda, by M. L. **Bruntz.**—On a new ergometer, by MM. Th. **Simon** and J. Ch. **Roux.** A description of a simple form of ergometer capable of measuring the work done by a muscle in the index finger.—Contribution to the study of locomotor reflexes, by M. Maurice **Philippson.**—On the revivification of the heart. The production of beating of the human heart thirty hours after death, by M. A. **Kuliako.** The heart removed from the body of an infant, aged three months, thirty hours after death, was submitted to an artificial circulation by the method of Langendorff with warm Locke's solution, saturated with oxygen. The heart commenced to beat after twenty minutes and the entire heart gave regular pulsations for an hour.—Researches on the physiology of the skin, by MM. N. **Vaschide** and Cl. **Vurpas.**—An earthquake at Smyrna, by M. **Yung.**

DIARY OF SOCIETIES.

FRIDAY, JANUARY 16.

ROYAL INSTITUTION, at 9.—Low Temperature Investigations: Prof. Dewar, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Discussion on the Bearing of Outbreaks of Food-Poisoning upon the Etiology of Summer Diarrhœa. Opened by Dr. Newsholme.

TUESDAY, JANUARY 20.

ROYAL INSTITUTION, at 5.—Physiology of Digestion: Prof. A. Macfadyen.

ZOOLOGICAL SOCIETY, at 8.30.—Report on his Expedition to Uganda: J. S. BUDGETT.—On the Brain of *Nasalis* and some other Old-World Monkeys: F. E. Beddard, F.R.S.—On the Fishes collected by Mr. G. L. Bates in Southern Cameroon: G. A. Boulenger, F.R.S.—On the Anatomy of the Gephyrean *Phascolosoma teres*, n.sp.: W. K. Hutton.

SOCIETY OF ARTS, at 8.—The Principles which should guide all Applied Art: G. F. Bodley.

ROYAL STATISTICAL SOCIETY, at 5.—The Finances of Federal Government for the United Kingdom: Hon. T. A. Brassey.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion of paper on* Electric Automobiles: H. F. Joel.

WEDNESDAY, JANUARY 21.

CHEMICAL SOCIETY, at 5.30.—Researches on Silicon Compounds. Part VIII., Interactions of Silicophenylamide with Thiocarbamide: J. Emerson Reynolds.—Phenocycloheptene: F. S. Kipping and A. E. Hunter.—(1) On the Relation between the Absorption Spectra and the Chemical Structure of Corydaline, Berberine and other Alkaloids; (2) The Absorption Spectra of Laudanine and Laudanoxine in Relation to their Chemical Constitution: J. J. Dobbie and A. Lander.—The Influence of Molybdenum and Tungsten Trioxides on the Specific Rotations of 1-Lactic Acid and Potassium 1-Lactate: G. G. Henderson and J. Prentice.—Estimation of Ethyl Alcohol in Essences and Medicinal Preparations: T. E. Thorpe and J. Holmes.—Carbon Monoxide as a Product of Combustion of the Bunsen Burner: T. E. Thorpe.—Derivatives of β-Resorcylic Acid and of Protocatechuic Acid: W. H. Perkin, Jun., and E. Schiess.—Synthesis of Imino-ethers. N-Ethyl-, Methyl-, and Benzylbenzimino-Ethers: G. D. Lander.—(1) A Synthesis of 1.3.5 Triphenyl 2,4.Dimethylcyclopentane and of 1.3.5 Triphenyl.2. Methylcyclopentane; (2) The Condensation of Phenyl-Ethylketone (propiophenone) with Benzalaceto-Phenone, and of Acetophenone with Benzalpropiophenone: R. D. Abell.—Formation of Carbazoles by the Interaction of Phenols, in the Orthoketonic Form, with Arylhydrazines: F. R. Japp and W. Maitland.—(1) Dimorphism of α-Methylanhydracetonebenzil; (2) The Oxidation Products of the Methyl Homologues of Anhydracetonebenzil: F. R. Japp and A. C. Michie.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Annual General Meeting.—The president (Mr. W. H. Dines) will deliver an Address on "The Method of Kite-Flying from a Steam Vessel and Meteorological Observations obtained thereby off the West Coast of Scotland."

ROYAL MICROSCOPICAL SOCIETY, at 8.—President's Annual Address.

SOCIETY OF ARTS, at 8.—The Metric System: A. Sonnenschein.

GEOLOGICAL SOCIETY, at 8.—The Figure of the Earth: Prof. W. J. Sollas, F.R.S.—The Sedimentary Deposits of Southern Rhodesia: A. J. C. Molyneux.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.—Address by the President.

THURSDAY, JANUARY 22.

ROYAL SOCIETY, at 4.30.—*Probable papers:*—Preliminary Note on the Relationships between Sun-spots and Terrestrial Magnetism: Dr. C. Chree, F.R.S.—Characteristics of Electric Earth-Current Disturbances and their Origin: J. E. Taylor.—Solar Eclipse of 1900, May 28. General Discussion of Spectroscopic Results: J. Evershed.—On the Electrodynamic and Thermal Relations of Energy of Magnetisation: Dr. J. Larmor, Sec. R.S.

SOCIETY OF ARTS, at 4.30.—Indian Domestic Life: J. D. Rees.

ROYAL INSTITUTION, at 5.—Pre-Phœnician Writing in Crete and its Bearings on the History of the Alphabet: Dr. A. J. Evans, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on the Metric System. Opened by Mr. Alexander Siemens, in favour of the Metric System, and by Sir Frederick Bramwell, Bart., in favour of the British System.

FRIDAY, JANUARY 23.

ROYAL INSTITUTION, at 9.—Recent Volcanic Eruptions: Dr. Tempest Anderson.

SATURDAY, JANUARY 24.

MATHEMATICAL ASSOCIATION, at 2.—On some Class Diagrams for Intuitional Geometry: E. M. Langley.—On the Representation of Imaginary Points on a Plane by Real Points: Prof. A. Lodge.—Incommensurables by Means of Continuous Decimals: Edwin Budden.

CONTENTS.