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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MAY 1, 1902.

ALCOHOLIC FERMENTATION.

Manual of Alcoholic Fermentation and the Allied Industries. By Charles G. Matthews, F.I.C., F.C.S., &c. Pp. xv + 295. (London: Edward Arnold, 1902.) Price 7*s.* 6*d.* net.

MR. MATTHEWS has written an eminently readable book, containing a large amount of useful information. The work is divided into twelve chapters, to which eight appendices are added; it is prefixed by a good and thorough table of contents and finishes with a capital index.

The first chapter deals with "Alcoholic Fermentation. General Considerations leading to Special Ones." In this chapter we have an account of the earlier work of Leuwenhoek, Fabroni, Gay-Lussac, Cagniard de Latour, Schwan, Turpin, &c., and the theories held by Liebig, Fremy and Traube. The work of Reess and of Pasteur receives due acknowledgment, and towards the end of the chapter we find a summary of the various views which have been held with regard to fermentation.

"(1) Fermentation as an effect resulting from the growth or vegetation of an organism. (The accepted theory as established by scientific knowledge.)

"(2) A mechanical theory or theory of chemical decomposition. (Liebig's theory, and that of the Liebig school.)

"(3) A theory of so-called catalytic action or decomposition by contact—presumably of the ferment and fermentable substance. (An elegant mode of expressing ignorance of the true action.)"

The last remark in brackets appears somewhat hard on members of the catalytic school, and the following statement,

"that apart from the results of the vital processes of the yeast organism or other living cells, the production of alcohol from a saccharine liquid is unknown" (p. 8),

seems scarcely justifiable in the light of Buchner's researches. In fact, the references to Buchner's work on pp. 47 and 121–122 show that the author quite accepts the fact that fermentation may take place in the absence of cells, and is in any case due to an enzyme. "Contact" reactions undoubtedly take place amongst organic as well as inorganic compounds, and really the term "catalytic" is very useful. It would, however, be unfair not to acknowledge that such discrepancies have been observed between the courses followed, on the one hand, during the hydrolysis of esters by mineral acids and, on the other, fermentation by yeast as to lead to the idea that the two processes are fundamentally different. The recent work of Adrian Brown on "enzyme action" (*Chem. Soc. Trans.*, lxxxi. 373), and of Horace Brown and Glendinning on the "hydrolysis of starch by diastase" (*ibid.*, p. 388) prove clearly, however, that enzymes working in dilute solutions (*i.e.* when not overloaded) follow the law of mass action, so that one must conclude that processes of this nature are fundamentally as mechanical as the inversion of cane sugar by a mineral acid.

Chapter ii. deals chiefly with the morphology of yeast, whilst chapter iii., on the "Saccharomycetes and other Organisms acting as Alcoholic Ferments," gives a clear and full account of the various species of yeast which have been identified, the chapter ending with an account of *mycoderma vini*, *mucor racemosus*, &c., and the conditions under which they can behave as alcoholic ferments. Chapter iv., on "The Effect of Physical and Chemical Influences on the Yeast Organism," deals with the food material of yeast, the heat developed during fermentation, and the *optimum* temperature, and naturally leads to a further consideration of theories which have been put forward as to the fermentative action of yeast and to mention of Buchner's *zymase*. Referring to this, the author justly remarks

"that though it pushes the cause of alcoholic fermentation a little further back, there is no reason to believe that Buchner's zymase could be produced by other than vital agencies or in association with living matter."

This does not, however, preclude zymase from acting in a mechanical manner, neither is it *proved* that some inorganic ferment might not have somewhat the same effect, however improbable this appears in the light of present knowledge.

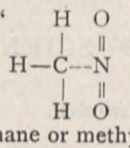
Chapter v., entitled "Chemical Science," one cannot

help thinking would have been better left out. To attempt to cover the range of chemical science from atoms and molecules to the elements of organic chemistry in so short a space is practically impossible, nor should it be necessary in a technical work.

Moreover, if such matter appears to the author desirable, he should take especial pains to be accurate. Chemists will take exception to N_2O_2 as the formula of nitric oxide, also to the triad radical (CH)‴ being called *formyl*.

The footnote to p. 75 is not quite clear, whilst p. 76 contains the following :—

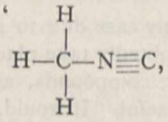
"



(nitromethane or methyl nitrite)"

and

"



belonging to the class called cyanoparaffins." On p. 78 we are informed that

"ethers are a class of compounds bearing the same relation to the alcohols that the metallic oxides do to their hydrates."

"The Carbohydrates" are described in chapter vi., and the author deals in succession with the pentoses and hexoses, passing on to the di-, tri- and poly-saccharides. The subject of the starches occupies several pages and is illustrated by well-executed plates. In considering the question of yeasts, no one can fail to be struck with the influence the scientific work of Pasteur, Hansen and others has had on the fermentation industries, and chapter vi. perhaps brings home to the reader even more forcibly the powerful effect the brewing industry has had in promoting the scientific examination of the carbohydrates.

"Nitrogenous Substances and the Nutrition of Yeast" form the subject-matter of the next chapter, and albumenoids, amido-substances and enzymes are described in succession. A few misprints have occurred amongst the formulæ of the amido-acids, *e.g.* amido-acetic acid, glutamine and tyrosine. Generally the chapter is clear and interesting ; the author has no need to apologise for the space devoted to the topic.

With chapter viii. we come to the first practical application of fermentation, and in eighteen pages we are made acquainted with the chief features in the manufacture of wine, including cider and perry. But it is in the succeeding two chapters (ix. and x.) that the author is really in his element, and devotes upwards of fifty pages to the science and practice of brewing. Chapter ix. is occupied with malting and the physiological and chemical changes involved ; the next chapter leads us by all the intermediate stages from the mash-tun to the barrel, and gives much information on the influence of the composition of brewery waters and the courses of different fermentations.

Chapter xi. deals with "Fermentation from the Distiller's Point of View," and is all too short (twenty-seven pages) to give anything like a complete account of this extensive and important industry. The author confines himself to the manufacture of pot-still whisky and "patent-still spirit." With regard to the former, practice varies so largely that the description given must not be taken as typical of the working of *all* malt distilleries. One may note the temperature at which the "sparge" is applied ; 170° is frequently exceeded, and the use of stirrers in wash stills by no means universal, especially where small stills are employed. "Maturation," according to the author, takes place

"chiefly by a selective absorption which the wood of the cask exercises, and also by some little oxidation and etherification of the higher alcohols" ;

certainly a more definite and rational view than that which supposes new whisky to contain objectionable substances which, as the reviewer has sometimes been assured, break up into substances communicating a fine flavour to old spirit.

The manufacture of patent still spirit as carried out in this country is next described, and we then pass on to continental processes. German methods deservedly receive a large amount of attention, and the author draws particular attention to the preparation of the "Vormaisch" by sowing vigorous yeast in a strong wort, slightly acidified by a small lactic fermentation and subsequently sterilised. The ripe "Hefegut" so obtained is used for pitching the chief mash ; the effect of the small quantity of lactic acid is not only favourable to the yeast, but restricts the growth of bacteria. Mr. Matthews mentions the fact that artificial acidification has been frequently resorted to ; the subject has been recently ventilated by Dr. Lange before the Verein der Spiritus-Fabrikanten. Dr. Lange states that hydrochloric acid at first gives excellent results ; unfortunately, the bacteria soon become accustomed to it, as they also probably would to sulphuric acid. Butyric acid appears to be efficient if properly handled, the yeast remaining cleaner.

The course of fermentation is illustrated by diagrams taken from Märcker's "Spiritusfabrikation." One wishes that this work had also been drawn upon for diagrams of recent German distillery plant, Ilge's automaton, for example.

The last chapter (xii.) deals with the cultivation of pure yeast and the brewing of "lager-beer," the comparative uselessness, and perhaps harmfulness, of endeavouring to brew English beers with pure cultivations being well brought out in the last few pages.

The eight appendices are chiefly concerned with laboratory instructions ; D, E and F are, however, of more general interest, since they deal respectively with conjugating yeast, the nutrition of yeast, and the combined action of diastase and yeast on starch granules.

Mr. Matthews is to be congratulated on the way in which he has treated his subject, but the reviewer cannot help thinking that if he gave the space devoted to matters of general chemical knowledge to the subjects of wine and the preparation of the purer forms of alcohol, the book would gain in usefulness. J. T. H.

THE GEOGRAPHY AND GEOLOGY OF CELEBES.

Materialen zur Naturgeschichte der Insel Celebes, Band iv.—*Entwurf einer geographisch-geologischen Beschreibung der Insel Celebes.* By Dr. Paul Sarasin and Dr. Fritz Sarasin. Pp. xi + 344 + 28; 13 plates. (Wiesbaden: Kreidel, 1901.) Price Mk. 50.

THIS, the fourth volume of the series which the authors have devoted to the natural history of Celebes, is a welcome addition to our knowledge of the East Indian Archipelago. The recent geological history of the island, and the light thrown upon it by the distribution of the animals and plants of the region, has already formed the subject of a special memoir. Here we have a description of the surface features and configuration of Celebes so far as that has been explored, a record of many interesting observations, geographical and geological, made during several years spent in travel in nearly every quarter of the island, with petrographical notes on the rock specimens collected (including a special chapter by Prof. C. Schmidt), a sketch map on the scale of 1 in 2,000,000 and tables of the observed altitudes of many important stations.

The outline of the island, sinuous and branching, is the external expression of its geological structure. A folded mountain chain, of which some peaks rise to 5000 or 6000 feet above the sea, forms the axis or backbone of Celebes. It is not simple, but consists of several parallel ranges, more or less intermittent, with longitudinal valleys between them. These valleys appear to be synclinal or to be due in some cases to depression between parallel lines of fault which trend with the folds. Not much is known about the mountainous interior of the island, but from the specimens of rocks collected, which include granite, gneiss, mica schist, chlorite schist, epidote glaucophane schist, quartzite and crystalline limestones, it is certain that there is a large development of metamorphic rocks. No fossils have been obtained from this series, but the authors believe that some of the crystalline limestones may be of Jurassic age.

This axis of metamorphic rocks is bent almost at a right-angle where it crosses the equator, and in the interior of the bend another less important series of folds runs roughly parallel to the main external ridge which forms the dominant structural feature of the island. A striking peculiarity of the surface configuration is the presence in each system of folds of a longitudinal depression flanked on each side by ridge-like elevations. This central valley runs from end to end of Celebes. It largely determines the direction of the drainage, as the principal interior streams run in it for long distances, parallel to the shores, till they take advantage sooner or later of one of the breaks in the continuity of the hill ranges to pass outwards to the sea.

The narrow and not very well defined coastal plain consists, for the most part, of Tertiary and later deposits very frequently intercalated with volcanic rocks. The Eocene is well represented by massive nummulitic and orbitoidal limestones, often coralline. Beneath these there are sometimes exposures of sandstone, and not uncommonly radiolarian clays and cherty beds which may be lower Eocene or possibly Cretaceous. Overlying the Eocene are sandstones and conglomerates known as the "Celebes Taveyannaz beds" (from their similarity to the Taveyannaz group in the Alps) and an extensive "Celebes Molasse," with fresh water, brackish water, marine and land fossils. Pliocene shell beds and Pleistocene strata are well developed in the lower grounds and along the shores. The Tertiary geological history of Celebes is outlined as follows:—The Eocene began with deep-water conditions (radiolarian clays) followed by shallow coral seas. In the Miocene the great upheaval took place and the mountain axis attained its complete development. This was an epoch of land conditions, and was accompanied by the deposit of the "Celebes Molasse." During the Pliocene the land area was much greater than at present, but in the Pleistocene depression ensued, and is regarded as having been at least 300 feet. Thereafter minor oscillations have taken place; a well-marked raised beach can be traced at heights of 90 feet above the sea-level indicating recent elevation, while in other places submerged forests point to slight and local depression.

Over most of the island signs of volcanic activity abound. One crater named Una Una was in eruption in 1898, but there are few historic records of volcanic outbursts, though many may be traced in the traditions of the natives. In the extreme south the great peak of Bantaeng (2970 m.), an Etna covered with parasitic cones, is a well-known object and has already been described by several travellers. The authors ascended it, and give a map of the higher parts of the mountain. This map shows a very large breached crater occupying the summit and accompanied by two enormous depressions (presumably also craters) to the south of the principal one. Beds of ash and lava flows are very frequently interbedded with the Tertiary strata, and in the Minahassa region at the north-east termination of the island there is a cluster of volcanic mountains, some of which must have been very recently in eruption, while others are in various stages of denudation and decay. This is one of the most interesting parts of Celebes, and some of the best chapters of the book are those devoted to the description of these volcanic cones and craters. For the excellent photographic illustrations which accompany them there can be nothing but praise.

The volcanic activity appears to have first manifested itself in the Miocene, and to have followed the era of folding and upheaval. Many types of effusive rocks are found. The commonest are apparently andesites (propylites) and basalts. But leucite-tephrites, trachytes and phonolites were also emitted, and Prof. Schmidt has furnished descriptions of some very fine nepheline-bearing shonkinites which appear to be the plutonic representatives of this group. They are accompanied by bostonites and gauteites as dyke rocks. In the volcanic areas hot springs are numerous, and some of the quartz veins are auriferous. Some interesting notes are also given on the configuration of volcanic bombs.

A special feature of the geography of Celebes which has attracted a good deal of attention is the existence of inland lakes of considerable size. These are found in the central valley depressions between the hill ranges, and they occur in well-defined chains in these valleys. The largest is the Towuti Lake, but Lake Posso and

Lake Tempe are also considerable sheets of water. Their great depth is notable; Lake Posso is 160 fathoms deep, Lake Motana 260 fathoms. The authors believe that they are of tectonic origin and are due to depression in the synclines between the mountain uplifts. They may be flanked by lines of fault, and the very steep slopes of their shores, as shown by the soundings, is easily explained on this hypothesis. Their resemblance to the Central African lakes is close and is heightened by the presence in them of a molluscan fauna the affinities of which are said to be Miocene. Their great depth would appear to be against their Miocene origin, but as the areas that drain into them are small, it may well be that the deposition of sediment is too slow to have produced any very great effects. It is suggested that depression has also taken place and has counterbalanced the accumulation of alluvial material brought down by the streams.

In conclusion, it may be noted that the work contains a full bibliography of the geology and geography of Celebes, and the description of each district is accompanied by a synopsis of the observations of previous travellers.

OUR BOOK SHELF.

More Tales of the Birds. By W. W. Fowler. Pp. 232; illustrated. (London: Macmillan and Co., Ltd.) Price 3*s.* 6*d.*

THIS is a delightful little book of stories, admirably written and beautifully illustrated, in which birds play a more or less important part. It is in no way one of the numerous works on the popular natural history of birds with which the market is nowadays flooded, but strikes a line peculiarly its own. In the first chapter we have a pathetic story of a young soldier whose thoughts were turned to home and its associations during the Waterloo campaign by a lark's nest which escaped destruction although situated in the midst of the great battle-field. The second deals with the toils and troubles of a house-martin, as supposed to be narrated by the bird itself. In regard to the reason for the annual migration, the bird is made to say: "We always do come here, and our ancestors always came, so I suppose we shall go on doing it. Besides, this is really our home. We were born here, you see; and when the heat begins in South Africa there comes a terrible feeling in our hearts, a terrible home-sickness, and we *must* go." Evidently, so far as birds are concerned, the author does not believe in the theory that Africa was a great centre of animal evolution.

Jackdaws, magpies and starlings severally form the texts for other chapters. To ornithologists, perhaps, the interest of the book will centre on the exquisite illustrations, by the accomplished pencil of Miss F. L. Fuller, which are alone worth the price charged. Although there are some to whom this class of writing does not appeal, many readers of all ages and both sexes will doubtless find pleasant occupation for a spare hour or two in this bright and entertaining little volume. R. L.

College Algebra. By L. E. Dickson, Ph.D. Pp. viii + 214. (New York: Wiley and Sons. London: Chapman and Hall, Ltd., 1902.)

THE usual profession of "rigour" is followed here by the usual inaccuracies. On page vii. we are told that = means "equal"; on p. 69 it is stated without proof that if r is a proper fraction the limit of r^n is zero when n increases indefinitely; the discussion of the exponential theorem in art. 129 is thoroughly unsound, and the proof that every equation has a root (pp. 211-12) is marred by serious defects. On the other hand, the chapters on logarithms, mathematical induction and theory of equations are good. Probably this book has been written rather hastily; otherwise it is difficult to understand how such a competent mathematician as the author is known to be should have overlooked so many deficiencies. Even in the chapter on the binomial theorem for any index, he calmly applies the rule for multiplying two power-series without discussing its validity either there or in any other passage of the book! Finally, Mr. Charles Smith is made responsible for the assertion that the binomial expansion of $(1+x)^n$ converges for $x=1$ if $n<-1$. Very likely this is an uncorrected misprint for $n>-1$; but why refer to Mr. Smith instead of to Abel's classical memoir? M.

A Laboratory Manual of Physics. By H. Crew, Ph.D. and R. R. Tatnall, Ph.D. Pp. xii + 230. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1902.) Price 5*s.*

EACH exercise commences with references to certain school text-books, but, unfortunately for the British reader, these are all American works, and, so far as the reviewer knows, they are not used in any schools here. We are amused to find that metre scales are called metre "sticks" in the States. There is a good simple chapter on inertia, and a form of inertia balance is described. It seems to us a mistake to omit all experiments on velocity and acceleration because of their difficulty. Friction occurs in all real machines, and it ought to be studied in elementary works. The apparatus is generally of quite a simple character and very suitable for school use. Appendix A contains an extract from one of Boyle's papers in which he describes an instrument virtually the same as Nicholson's hydrometer, and the authors call attention to this in their description of that instrument. The book will prove very useful in conjunction with the text-books to which references are made. S. S.

Photographic Apparatus. Making and Repairing. By F. W. Cooper, D. W. Gawn and others. Edited by E. Brown. Pp. xvi + 128. (London: Dawbarn and Ward, Ltd., 1902.) Price 1*s.*

IT is not every photographer who wishes to make or repair his own apparatus, but those who are acquainted with the use of tools will find this small book a useful help if they require it in aiding them to fit up all kinds of convenient accessories to the photographic camera and dark room. The information given is concise and the instructions are clear; and numerous illustrations, 180 in number, are included which materially aid the text from a beginner's point of view. The ground covered is by no means meagre, for the worker is made acquainted with such subjects as the studio and studio fitments, the dark room and its fixtures, cameras and accessories, printing and enlarging apparatus, concluding with numerous and useful miscellaneous attachments. That the instructions are the result of practice is shown by the numerous writers on the varied subjects, most of the information being reprinted with additions from articles in *The Photogram.*

Monographie der Gattung Alectorolophus. Von Dr. Jakob von Sterneck (Trautenau). (*Abhandlungen* der k.k. zool.-botan. Gesellschaft in Wien, Band i., Heft 2, October 31, 1901.) Pp. 150. (Wien: Holder.)

AN exhaustive monograph of a genus of plants, variously known under the names of Fistularia, L., Rhinanthus, L., Alectorolophus (Haller), Allioni, and Mimulus, Scopoli. Fifty-one species and two hybrids are described by the author. The genus is most numerous in Europe (a familiar British representative being a common meadow-plant, known as the Yellow Rattle); but it also extends throughout a considerable portion of temperate Asia and North

America. The species are divided into six sections, and the synonymy, variation, distribution, &c., of each species are given in great detail, at least in the case of well-known species. The probable evolution and phylogeny of the genus are also discussed, and to the latter subject the elaborate "Stammbaum" is devoted. The three maps show the distribution of various species of the genus. Scientific botanists should find much to interest them in Dr. Sterneck's work.

A Text-book of Insanity. By Charles Mercier. Pp. xiv + 222. (London: Swan Sonnenschein and Co., Ltd., 1902.) Price 6*s.* net.

MR. MERCIER addresses his little work directly to the ordinary medical student, for whom, it appears from the preface, there has hitherto been no text-book of insanity of moderate compass. For the practical student so clear and brief a description of the leading types of mental disorder from the pen of a recognised authority will be of high value. The work has also its merits from the standpoint of the theoretical psychologist, though he will probably prefer to study the author's views in his larger work, "Psychology Normal and Morbid." The account of normal mental activities by which the description of insane deviations from the normal is preceded is eminently clear and judicious. The psychologist should also be thankful to the author for discarding the bewildering nomenclature of *manias* and *phobias*, and offering a simple and intelligible classification of mental diseases, based on the distinction between forms of insanity (*i.e.* the aggregate symptoms presented simultaneously at any stage by a patient) and varieties of insanity (*i.e.* specific types of the course run by a case from first to last). Besides purely medical and psychological information, the book contains some useful remarks on the legal responsibilities of the practitioner in connection with insane patients. A. E. T.

Leçons sur les Séries à termes positifs. Par Émile Borel. Recueillies et rédigées par Robert d'Adhémar. Pp. viii + 94. (Paris: Gauthier-Villars, 1902.) Price fr. 3·50.

THIS appears as the third instalment of Prof. Borel's lectures on the theory of functions. It is somewhat more fragmentary than its predecessors, and has, in fact, the typical qualities and defects of a set of lecture-notes. As an introduction to the memoirs of Hadamard, Mittag-Leffler and Poincaré, as well as to those of Prof. Borel himself, these chapters will be very serviceable. Perhaps the most noteworthy articles are those which deal with the theory of increment (*croissance*); it is there shown that there is no natural scale of orders of magnitude. In fact, an aggregate of orders of increasing functions can be constructed which is not numerable. Moreover, functions have been invented which have no regular order of increase; thus an example is given of a function which is comparable with $exp\ x$ for an infinite number of values of the variable, and with $exp\ (exp\ x)$ for another infinite number of values. This will cause searchings of heart in certain quarters, no doubt; even Prof. Borel remarks that "fort heureusement, les fonctions qui se présentent *naturellement* aux géomètres sont, en général, de nature plus simple."

Practical Exercises in Magnetism and Electricity. By H. E. Hadley, B.Sc. Pp. xii + 232. (London: Macmillan and Co., Ltd., 1901.) Price 2*s.* 6*d.*

THIS is an excellent collection of laboratory experiments, suitable for the higher classes in secondary and public schools. Magnetism is taken first, then electrostatics and current electricity. An appendix gives some instruction for making the necessary apparatus. The author wisely confines the experiments to those which can be performed with quite simple apparatus.

LETTERS TO THE EDITOR.

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

A Remarkable Lunar Halo.

ON the night of January 19 of this year a singular lunar phenomenon was visible here. The sky had clouded over and was covered with a nearly uniform whitish sheeting of cloud, through which the brighter stars could be seen. There was no wind. The barometer stood at 29·20 inches and the temperature was 28° F. The moon, which was near the meridian, was ten and a quarter days old and had a north declination of 19°.

Surrounding the moon was the ordinary lunar halo of 45° or 50° in diameter, which is so often seen at the approach of bad weather. This ring was clearly defined on its inner edge, which was of a reddish or brownish colour; it rapidly diffused on its outer edge and was perhaps a couple of degrees in thickness. The whole interior of the ring was darker than the sky outside of it anywhere, which is its customary appearance.

Cutting exactly through the moon, with its centre near the

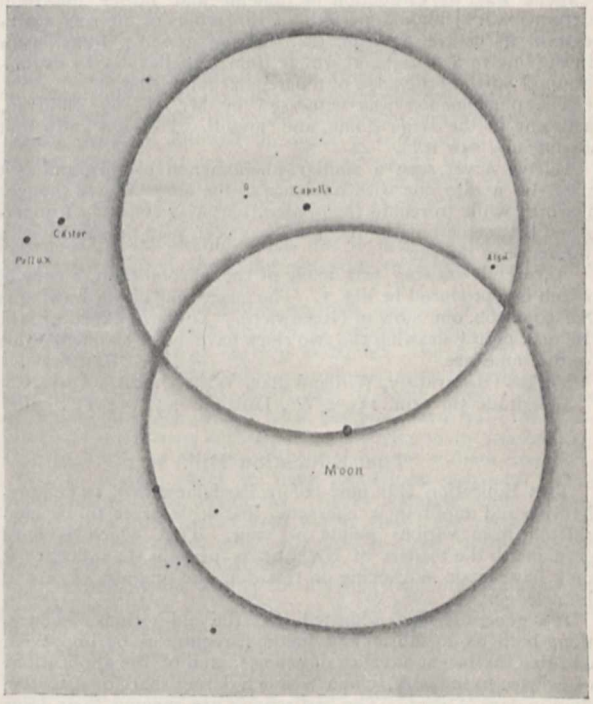


FIG. 1.—Lunar Phenomenon 1902, January 19, 9 p.m.

zenith—in the region of Capella—was another ring of apparently the same dimension and brightness, and similar to the other in every respect. It too was sharply defined on its inner edge, where it was fringed with a reddish or brownish colour. The general colour of the two rings was whitish, with a suggestion of yellow. The interior of this ring was also darker than the sky outside. There was no noticeable increase of light where the two rings intersected. They seemed to merge into one another without any evidence of the crossing.

This phenomenon was first seen at 8h. 50m. (6h. 0m. slow of Greenwich Mean Time). It was perhaps visible for some time before this. I had been observing with the large telescope when the increasing cloudiness had stopped work. It was noticed (a few minutes before seeing the phenomenon) that the seeing had suddenly got excessively bad.

The extra ring remained visible until 9h. 20m., at which time it disappeared—not all at once, but gradually and unequally.

During the time it was under observation, from 8h. 50m. to 9h. 20m., this ring revolved eastward in position angle, about

17°. The moon remained bisected by it throughout the entire visibility.

Only the brighter stars were visible, on account of the thickness of the sky, and hence its exact dimensions could not be accurately determined from the want of comparison stars. An endeavour was made to secure pointings on different portions of the ring with the 12-inch equatorial by sighting along the tube, but this was found to be impossible because of the narrowness of the slit in the dome, which prevented its being seen with sufficient distinctness.

At 9h. 17m. Algol was on the inner edge of the extra ring near its junction with the ring surrounding the moon.

At 9h. 20m. Castor was central on the ring, and at 9h. 24m. this star was on the inside edge. By this time the ring had almost entirely disappeared, only a fragment of it being visible at Castor. After this it was not seen again, though the ordinary ring remained visible for several hours. When the extra ring was disappearing, the ordinary ring became brighter, and at 10h. 30m. a bright spot (a moon dog?) became visible on its north edge.

At 8h. 50m. α Orionis was bisected by the ordinary ring, from which the diameter was found to be 48″·9.

Following are some estimations of the position of the extra ring. At 8h. 50m. a line prolonged through Pollux and Castor would touch the extra ring 8½° from Castor. At this time Capella was by estimation (a difficult and rather uncertain determination) about one-fifth of the radius of the ring north-east of its centre. At 9h. 0m. the ring passed 7° from Castor in the line to β Aurigæ, at which time Capella was by estimation 4¾° north of the edge of the regular lunar ring.

The phenomenon was witnessed by Mr. Frank Sullivan, assistant in the large dome, and myself. I do not know that anyone else saw it.

I have never seen a similar phenomenon to this, and as it must be a rare one with reference to the moon I have thought it worth while to record the observations in NATURE. I understand that something of the kind has been seen previously with reference to the sun.

A careful drawing was made of the phenomenon, a copy of which is reproduced in Fig. 1. The exact time of the drawing is 8h. 50m. (6h. 0m. slow of Greenwich). This will explain itself. In making the drawing the two rings have been assumed to be of the same size.

E. E. BARNARD.

Yerkes Observatory, Williams Bay, Wis., U.S.A., April 8.

Longitude 5h. 54m. 13s.·2 W., Latitude +42° 34′ 13″.

The Education Bill.

THE Education Bill now before Parliament is of so comprehensive and important a character that it deserves to be considered from various points of view. That which is most germane to the readers of NATURE is perhaps the influence it may have upon advancing or retarding the progress of natural knowledge.

It is generally now admitted that the old notions of education, both as to subject and method, require to be improved, and that the recent advance of science, and of the applications of science to industry, claim a much larger share of attention than in days of yore. The best schools are opening their doors to this knowledge, if not welcoming it, and any change in the management of schools ought to be in this direction. How far will the present Bill fulfil this requirement? It says nothing about the curriculum of the schools, and concerns itself solely with the constitution of the local education authority, and the machinery for raising and distributing the necessary funds and for appointing representatives on the management of the schools. The personnel of the managers in the first instance may not be much changed, but their powers may be seriously limited by their superior authorities, who have the revision of the expenditure and the settlement of the rate to be levied. The influence of the electors in School Board districts will be lost; an influence which at the present time is generally directed towards rendering the schools of as much practical value as possible. The Act of 1870 secured the coming forward of men or women sufficiently interested in the subject to stand the ordeal of a popular election, and who, when elected, worked under the stimulus of public responsibility; whereas under the present Bill the managers of transferred schools will apparently retain their office indefinitely, and the nominees of the new local educational authority will always be in a minority and therefore unlikely to be able to develop the newer ideas of education.

Our methods are undergoing a slow but very real change; good object-lessons from the infant classes upward, involving the proper use of eyes and hands, are coming to the fore; with a training afterwards in such branches of natural history and physical science as may bear on the probable occupations of after life—agriculture, mining, manufactures, trade, &c.—or on domestic pursuits. Much of England's prosperity in the future will, in fact, depend upon the proper adaptation of this fundamental training to the wants of the various sections of the community. Hence the paramount importance of selecting such persons as shall not only be acquainted with the wants of the neighbourhood, but shall also be imbued with the importance of this kind of teaching.

It is interesting in this connection to observe that the statistical returns of the Board of Education show that in the schools under the management of popularly elected bodies the attention given to the scientific subjects of instruction is more than twice as great proportionally as that in the "voluntary" schools. These returns have shown a gradual advance in this respect since 1890, except that in 1899–1900 there is a small retrogression perceptible in most of the subjects, including mechanics, animal physiology, chemistry and general physics. (See British Association report on "Teaching of Science in Elementary Schools," 1901.) The cause of this is not obvious, and it is impossible to say whether it continues, as the figures for the year 1900–1 are not yet issued.

Small schools are always worked at a great disadvantage, as the children attending them cannot be properly divided into classes and have almost necessarily to be taught by one teacher. This cannot be avoided in districts of very sparse population; but the Government Bill gives direct encouragement to the multiplication of small schools, each of which will be recognised as necessary provided it can draw thirty children from some neighbouring school.

The Bill is defective in not providing that the education commenced under the code in the elementary schools should be continued in the department of higher education, whether in evening, technical or secondary schools. The only correlation attempted consists in the putting all schools within a given area under one local authority; but it does not ensure that there should be any organic connection or unity of aim between the lower and the higher schools.

I cannot help thinking that men and women elected for the express purpose, and subject to periodical re-election, are the most likely to support the more modern and practical views of education and so to enable the children under their charge to become more intelligent and valuable members of the community.

J. H. GLADSTONE.

17 Pembridge Square, April 26.

Resultant Tones and the Harmonic Series.

MISS DICKINS'S method of determining from the harmonic series the resultant tone would be of more worth than it is if it did not yield results which are untrue to the facts. These, as is, or ought to be, well known from the observations of the late Dr. Koenig, in some cases differ from those assumed. For example, the combination of two pure tones of the ratio 9:4 does *not* yield as the resultant tone 5. And in the case of the ratio 8:5 the resultant tone actually heard is just as likely to be 2 as 3, or both may be heard. The remark that the method is evidently as applicable to summational as to differential resultant tones is evidently made in ignorance of the circumstance that the "summational" tones are not, in fact, ever heard if the two fundamental tones are *pure*. They are one of the myths of science.

SILVANUS P. THOMPSON.

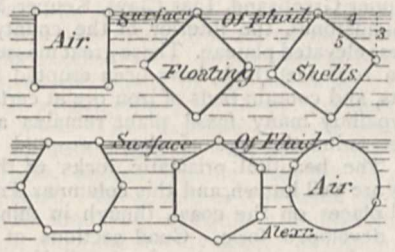
April 19.

Thin Floating Cylinders.

IN a letter to NATURE of February 18, 1897, I pointed out that a thin cylindrical floating shell was in equilibrium under the actions of its own weight and the external fluid load, the shell having its axis horizontal and just touching the surface or else completely submerged. The method was that of Rankine's conjugate load-areas, and building on this Dr. Thomson and myself made practical graphical solutions of the circular masonry arch; these were privately printed and circulated, and

met with the approval, among others, of Prof. Perry, London, and Prof. Malverd Howe, America. In revising this matter for the new edition of our "Applied Mechanics," I find that polygonal cylinders of uniform plates freely hinged at their edges and displacing their own weight of fluid and lying horizontally are also in equilibrium, provided the polygon be regular.

In the diagram the square shell is shown just reaching the surface and rolled into three positions. The proof is the same as for the ordinary statical problems on festoons of rods hinged at the ends, only now there is the external fluid pressure in addition to the weights. The fluid is kept out by face plates at the ends, the face plates having the same density as the fluid and being quite smooth, so as to allow the shell freely to change its shape. If the shell be slightly compressed it will collapse, but



the friction of the face plates and the confined air afford a slight degree of stability. The diagram shows the regular hexagonal shell, and by increasing the number of sides we arrive, as before, at the circular cylinder. In the polygonal shells there are bending moments on the sides as well as the thrust, but on the circular there is only hoop thrust, as it may be a plenum of joints. Submerging only adds a symmetrical load all round, and the shells are still balanced. As they are also balanced with the axis vertical it follows that they are in equilibrium in any position whatever.

My first letter led to some correspondence, and I hope this may be of interest to your readers. THOS. ALEXANDER.

Trinity College, Dublin, April 19.

Mycoplasm.

SINCE 1889 a fungus hyphal layer has been known to exist in the nucellar remnants of the grains of the Darnel grass, *Lolium temulentum*, and to these hyphæ have been attributed the poisonous properties of the Darnel. Later investigations have shown that the fungus could be found in the growing point of developing plants, in the inflorescence, and finally in the ovular rudiments. The manner of entrance of the fungus had, however, escaped detection. Nestler (*Ber. d. deutsch. bot. Gesellsch.*, B. xvi., 1898, p. 210) and others failed to observe the fungus in the embryo in the mature grain. The hyphæ in the growing point could not be observed before the eighth day of germination.

Eriksson has recently[1] quoted the work of Nestler and others on the fungus of *Lolium temulentum* in support of his theory on mycoplasma. According to Nestler, the embryo does not contain the hyphæ, which appear in the seedling on the eighth day. In only one case was he able to see hyphæ in the embryo. In view of the support which this work appears to give to Eriksson's mycoplasma theory, an advance note on some of my results in the investigation of the fungus of *Lolium temulentum*, which has been carried on in the laboratory of Prof. Marshall Ward at Cambridge University, may be of interest. In appropriately stained sections of the embryo taken from the mature seed of *Lolium temulentum*, hyphæ in great abundance may be seen in the growing point, sometimes but two cells from the tip; these hyphæ may be traced to their point of entrance at the juncture of the coleorhiza and scutellum on the outer surface of the latter in the region of the median longitudinal plane of the scutellum. Previous investigators had entirely overlooked the presence of a considerable amount of mycelium in that part of the grain which lies directly against the scutellum in the median basal region, where it has grown around the end of the aleurone layer. The infection takes place apparently before the grain has reached complete maturity, as the fungus is well established in the ripe grain. There can, therefore, be no question here of mycoplasm, since direct hyphal infection can very easily be demonstrated. There is no evidence to prove that the fungus is a Uredine. The detailed results, with other particulars of the nature and development of the fungus, will be published soon.

April 20. E. M. FREEMAN.

[1] Eriksson, *Ann. des Sc. Nat.*, T. xv., 1902, p. 73, says:—"Les tentatives infructeuses d'A. Nestler d'apprendre à connaître de quelle manière le champignon qu'on trouve presque toujours dans les fruits du *Lolium temulentum* est entré dans le cone végétatif de l'embryon du fruit amenent aussi la supposition d'un état mycoplasmatique latent."

Rearrangement of Euclid I. 1-32.

THE rearrangement outlined in my previous letter was devised to meet the difficulty which, as Prof. Bryan states, is the chief objection to Euclid's Elements as an elementary course. Beginners cannot solve riders because

(1) They do not grasp the reasons for Euclid's limited postulates and axioms, and never fairly understand the "rules of the game"; consequently their early attempts violate his conditions, and their rejection discourages.

(2) Too much time is occupied by the propositions, with the result that they regard them, not as tools, but as models, and imitate Euclid's methods of proof. There is nothing in 1-8 worthy of imitation.

(3) They do not distinguish between data and quæsita unless they have drawn accurate figures. It is impossible to draw accurate figures by proved methods in Euclid's scheme (*e.g.* I. 4), and we therefore have recourse to figures drawn on the principle of Artemus Ward's horses. This is the great difficulty in working riders. Allow a boy to assume the mid-point of a line and he will assume the most impossible constructions. He should never be allowed to quote a construction which he cannot perform, and no construction should be shown him without proof. Freehand copies of blackboard figures are useless; if he has drawn a dictated figure, there is no confusion between hypothesis and conclusion. There is also the additional advantage that the less intelligent feel that in drawing the figure they have accomplished something, and this frequently stimulates to further effort.

To remove these difficulties we must extend the axioms and postulates, reduce the number of standard propositions, and introduce problems as early as possible. The advocates of a purely theoretical scheme have two courses open to them—either they must teach constructions first without proof (which is extremely illogical), or they must postpone them until the completion of the theory, and therefore postpone riders indefinitely. Geometry without riders resembles arithmetic without examples.

In the scheme which we have found most successful, riders commence with the definitions. Every standard proposition is treated as a rider and evolved by the class; one proposition a fortnight is considered sufficiently rapid progress, the intervening lessons being devoted to riders.

The circle gives a method of drawing equal lines, and, with the idea of angular measurement, a method of constructing equal angles. Of course we assume the shape of the circle.

I. 15 and 32 give the fundamental fact of rotation and introduce easy theorems and numerical examples.

I. 8 with its riders elicits I. 9, and I. 4 is followed by I. 10, locus of points equidistant from two given points, I. 11, 12, 5. Having reached this point, possible riders are endless, and the only difficulty lies in their selection; many propositions of III. and IV. may be included in the riders. Every pupil can now draw an accurate figure from dictation, and knows exactly what data he has to work upon. The rate of progress may appear slow, but we are teaching Book VI. in the second year. It should be noted that I. 1 is a rider, 20 an axiom, and that 2, 3, 7, 18, 19, 21, 24, 25 are not read.

In teaching riders, theorems should, as a rule, be grouped on methods of proof; the required figure should be dictated and the class asked to prove any fact they can concerning it. A general enunciation should then be invented; in this way standard propositions for future proof are frequently suggested. It is a mistake to hurl a general enunciation at a class of beginners. Problems usually give more trouble, but if grouped on loci their difficulties vanish.

There would be no examination difficulty if papers were set on riders only. Euclid's Elements might then be reserved for university examinations—a geometrical "Paley."

Leyton Technical Institute, April 25. T. PETCH.

THE FORTHCOMING BELFAST MEETING OF THE BRITISH ASSOCIATION.

PREPARATIONS for the forthcoming meeting at Belfast are already well advanced, and careful attention is being paid by the various committees to those details which make so much towards a satisfying and successful issue.

The last meeting in Belfast was under the presidency of Prof. John Tyndall, whose famous address on that occasion will be remembered. It is interesting to note that at this year's meeting the president-elect, Prof. Dewar, F.R.S., who has so widely extended the bounds of our knowledge of the properties of liquefied gases, comes to preside over this meeting of the Association in the place where the late Dr. Andrews made his classical researches on the same subject, and where a collection of his apparatus is preserved in the laboratory where he worked.

The meeting will have ample accommodation in Queen's College and neighbouring buildings, all within a radius of three minutes' walk from the reception-room, which, as on the last occasion, will be the large examination hall of the College. Most of the sections will, as before, find place in the lecture-rooms close at hand, those sections dealing with allied subjects being close to each other, an arrangement made more easy by the recent additions to the College buildings. These include chemical laboratories, physiological and pathological departments and a students' union.

The first general meeting will be held on Wednesday evening, September 10, in the Grosvenor Hall, which seats about 2500 persons, when the president-elect will deliver his inaugural address.

The Friday evening discourse will be given by Prof. J. J. Thomson, F.R.S., on "Becquerel Rays and Radioactivity," one of the most fascinating fields of advance in modern physics and a subject which affords scope for a wide range of experimental illustration. On Monday evening a discourse will be given by Prof. W. F. R. Weldon, F.R.S., on "Inheritance." The Saturday evening lecture will be delivered by Prof. Louis C. Miall, F.R.S., and the subject will be "Gnats and Mosquitoes," about which so much interest has recently centred in connection with the propagation of malarial fever. Conversaziones will be given on the Thursday and Tuesday evenings.

It is intended to organise a loan collection illustrative of Irish antiquities and archæology and also of the progress of Belfast and its industries since remote times, and supplementing the interesting collections of a similar kind already existing in the local museums.

It has been thought best to arrange for excursions on Saturday, September 13, to the most important and interesting localities only, and to provide for large numbers in each party rather than to have many excursions, the want of interest in the less important of which might cause disappointment. Efforts will be made to facilitate the attendance of the more distinguished members on these occasions.

The chief excursions will be to: (1) Portrush and Giant's Causeway. (2) Glenariff, Garron Head and Coast Road. (3) Newcastle, Tollymore Park and Mourne Mountains. (4) Warrenpoint and Carlingford. (5) Drogheda and the Valley of the Boyne. Specially prepared pamphlets will be issued as guides to the excursions. A number of minor excursions will be so arranged as to suit the spare time that may be at the disposal of members. In connection with the meeting and the excursions, the following notes upon Belfast and the neighbourhood are of interest.

For the paragraphs dealing with geology and botany I am indebted to Mr. S. A. Stewart, for that on zoology to Mr. Robert Patterson, and for that on archæology to Mr. F. J. Bigger. Further information on these or other allied subjects will be most willingly given to members by the hon. secretaries of either the Belfast Natural History and Philosophical Society, Belfast Museum, College Square, or the Belfast Naturalists' Field Club at the same address.

Geology.—The geological characters of the counties of Antrim and Down differ very widely. The river Lagan, which separates them, is also the dividing line between the Palæozoic rocks of the south-east and the interesting secondary series to the north. The city of Belfast is built mainly on drift deposits which overlie Triassic marls and sandstones. The hills which almost encircle the city are made up of eruptive masses of dolerite covering sedimentary deposits, which consist of hard Chalk, Upper Greensand, Lias Clays, Keuper Marls and Bunter Sandstones, the interior of the county being a more or less elevated plateau. These great masses of Trap, more than 1000 feet thick, have been erupted in successive sheets, and contain beds of iron ore at certain levels. At Ballypallidy many fossil plant remains are found which determine the age of these erupted rocks as Eocene. The beautiful prismatic rocks of the Giant's Causeway are well known, and this columnar Trap is seen in several places on the coast, though in minor masses and less developed form. Good sections of the sedimentary rocks may be seen in the Belfast hills, the Antrim coast road, Portrush, and elsewhere. A much indurated but fossiliferous bed of Lias clay, so hard as to appear flinty, occurs at Portrush. In the Cushendall district some older rocks are interpolated. At Cushendun, between Cushendall and Ballycastle, is a massive conglomerate which has been supposed to be of the age of the Old Red Sandstone; where it crops out on the shore some fine caverns have been excavated by the action of the sea. Carboniferous shales and sandstones occur near Ballycastle, and coal mining in these beds is of very ancient date.

To the south and east of Belfast lies the county of Down, with its range of mountains stretching from Newcastle to near Warrenpoint. There is little variety in the rocks of the county. The higher mountain peaks are of granite, while the stratified rocks of less elevation are very much hardened Lower Silurian grits and shales. The granite masses of the Mourne Mountains are valuable building material, and they yield beryl, topaz and other much-prized minerals. Save the Silurian, there are scarcely any stratified rocks in the county. A very small patch of Permian occurs below high-water mark at Cultra, Belfast Bay, and with it a strip of Carboniferous Shale. At Newtownards is Scrabo Hill, which is an outlier of the New Red Sandstone; and at Castle Espie, on Strangford Lough, is a very small exposure of Carboniferous Limestone. Carlingford is in the county of Louth; it is a Carboniferous Limestone country, as indeed is the greater part of that county. At Coalpit Bay, near Donaghadee, are Silurian shales with graptolites.

Zoology.—The zoology of the district is exceedingly interesting, and specialists in any branch might well devote additional time to it beyond the official week. To the conchologist the district is a happy hunting-ground, fully two-thirds of the species of British land and freshwater mollusca being found here, some of extreme rarity, while several species that are very rare in England are found here in some numbers. The marine mollusca will also repay investigation, this being the only British locality for several species, while the richness of this fauna is shown by the fact that recently a single day's dredging produced one species new to science and two more new to Britain. The coleopterist will also find an interesting fauna awaiting him, several species being found here which are unknown elsewhere in Britain. September is rather late for the lepidopterist, otherwise some good things might be found. But,

indeed, remarks such as the above might be made of almost all the various branches of zoology; the district is well worth thorough searching; the Mourne Mountains have been scarcely touched by the collector, and important finds might be made at any time. The field naturalist could easily spend a profitable week on or around Lough Neagh—by far the largest lake in the British Islands—which is comparatively close to Belfast and easy of access. Here the pollan is found in great numbers, and those interested in fish can investigate this species, which is not found in either England or Scotland. The Toome Eel Fishery is also worth a visit, ten thousand pounds' worth of eels being caught annually.

Botany.—Though the peculiar group of plants, styled in the Cybele Hibernica "Cantabrian," which enrich the flora of south-west Ireland are absent in the north-east, yet the floras of Antrim and Down are both extensive and varied. The recent "Irish Topographical Botany," by Praeger, gives the plants of co. Antrim as 777, in an area of 1191 square miles; co. Down, 742 species, area 957 square miles. The coast-line of these two counties, more than 200 miles, with its sand dunes, mud flats and maritime rocks, affords suitable sites for very diverse groups of plants. The visitor to Newcastle in co. Down will find on its sandy warrens quite a number of uncommon species, while the muddy shores at Dundrum yield such plants as *Atriplex portulacoides* and *Juncus obtusiflorus*. This sea-coast is girt in almost its entire extent with hills and mountains of considerable elevation and varied mineral composition. The visitor to the Mourne Mountains will meet with siliceous rocks, granites and indurated Silurian grits and shales, yielding at Tollymore and elsewhere hawkweeds, some of much rarity. The Trappean hills which characterise almost exclusively the greater part of co. Antrim give a flora differing considerably from that of its neighbouring county. Glenariff is typical of the rugged and picturesque ravines cut deep, by the waters flowing from the moors above, into the basalt and secondary rocks of Antrim. The yew tree, formerly plentiful, still lingers on the wild cliffs of Glenariff, but apparently is near extinction. The rare umbellifer *Carum verticillatum* is plentiful on the Giant's Causeway headlands, and Scottish lovage is found on rocks washed by the sea near Portrush. The bryologist will find in "the glens of Antrim" capital hunting grounds, as their moss flora includes many species of considerable rarity. The south of the county has during last year yielded to the researches of Mr. J. H. Davies *Ditrichum vaginans*, a moss new to the British Isles. The valley of the Boyne in co. Louth, to the south, is in a limestone district, and has an extensive flora consisting of species that usually frequent calcareous tracts, but has no special features to note.

Archaeology.—The antiquities around Belfast are numerous and representative, more especially the prehistoric remains. Forts and souterrains are abundant and cromleacs numerous, the finest being the Giant's Ring quite close to the city. Here a fine cromleac is surrounded by a great earthen ring, a wonderful evidence of man's power and labour in the earliest ages. Several fine souterrains, chambered and complicated, are to be found near Antrim town. Standing stones, some holed, are also numerous, whilst Ogam monoliths occur at Connor. Celtic pre-Norman churches can be seen in several parishes with holy wells adjoining, whilst later churches with distinctive features, several round towers, such as those at Antrim, Armoy and Drumbo, can easily be visited. Of the abbeys, the most attractive are Grey Abbey, a Cistercian house, Inch Abbey, and Bun-na-Margie, a Franciscan foundation. Some ancient crosses and cross slabs, such as those at Downpatrick, Donaghmore, Dromore, Movilla and Bangor, are well worth inspection, whilst armorial stones abound in every churchyard.

The great Norman castle of Carrickfergus, with its bold central tower and surrounding ramparts, is still occupied, whilst Dunluce, the chief residence of the MacDonnells, overhangs the stupendous cliffs of the north coast, one of the finest sights in the three kingdoms. The Knights Templars had a stronghold at Dundrum, where a great circular keep and encircling battlements still defy the hand of Time.

Smaller castles abound on every hand both in Antrim and Down, showing how the Normans and subsequent settlers obtained a firm foothold, for the Irish were not given to castle-building.

In many districts primitive manners, utensils and customs are still common. Wooden vessels and quaint candlesticks, wheel cars and slipe carts, donkey creels and straw ropes, the scythe and the hand-reaper are the peasant's usual means of living and carrying on his ordinary husbandry. Nowhere can all the phases of archæology be better studied than in the north of Ireland.

Belfast—the population of which has increased from 185,000 to 350,000 since the last meeting—is well known as the industrial capital of Ireland. Its linen manufacture was in a flourishing condition in the thirteenth century, was still farther improved by the Huguenot refugees who settled in the neighbourhood in the seventeenth, and has now attained to the vastly greater scale made possible by modern machinery. Members of the Association will be given ample opportunities of visiting the most important works.

Inspection of the newer and no less important shipbuilding industry will also no doubt prove of the greatest interest, not only to engineers, but also to the travelling public who may care to see the birthplace of the White Star steamers, the first vessels in the design of which the true characteristics proper to steam-propelled vessels were fully grasped, though their great length at first evoked prophecies of disaster. Permission to inspect these yards has in recent years been only very sparingly granted, partly because of the time lost by the workmen from the distraction of their attention by visitors. Admission to these yards and engine shops will be accorded to members of the Association.

The handbook or guide to the district, a copy of which will be presented to each member, will contain specially prepared maps illustrating the topography, geology and antiquities of the district. The editors in charge of the work are Mr. F. J. Bigger, Mr. R. Ll. Praeger and Mr. J. Vinycomb.

The following subjects will be dealt with:—"History of Belfast and the District," by Mr. F. J. Bigger and Mr. J. Vinycomb; "Antiquities," by Mr. F. J. Bigger and Mr. W. J. Fennell; "Geology and Physical Geology," by Mr. J. St. J. Phillips; "Botany," by Mr. R. Ll. Praeger, Mr. S. A. Stewart and the Rev. C. H. Waddell; "Zoology," by Mr. R. Patterson, Mr. R. Welch, the Rev. W. F. Johnson and Mr. H. Lamont Orr; "Trade and Commerce," by Mr. A. G. Wilson.

Although the journey to Ireland includes the crossing of St. George's Channel, any discomfort that this may have entailed in the past has been reduced to a minimum in recent years by the excellent steamers now available. The shorter sea passages are *viâ* Holyhead and Kingstown or Greenore and *viâ* Stranraer and Larne. Members from England who prefer a night passage have a choice of three direct routes—*viâ* Fleetwood, Barrow or Liverpool. The first mentioned has the largest and best steamers; the others have one or two very good boats. Passengers from Glasgow *viâ* Ardrossan or Greenock will find the direct boats fairly good, though comparatively small, old-fashioned and often overcrowded; but the open sea passage is not long, and daylight passages are available.

The railway and steamboat companies will issue return tickets to Belfast from the principal stations in the United

Kingdom at a fare and a quarter on surrender of the usual voucher issued to members. From stations in England and Scotland such tickets will be available from September 8 to 22, in Ireland from September 8 to 28.

The local railway companies will issue return tickets at single fares to members during the meeting for short journeys, and the Belfast Street Tramways Company has kindly offered to issue passes to members for its cars free of charge. These cars pass the College gates. The accommodation for visitors has increased considerably since the last meeting in Belfast, two large and several smaller hotels having been established since then, and it is expected that a large amount of private hospitality will be offered by the citizens. J. BROWN.

THE COLLEGES OF THE UNIVERSITY OF LONDON.

IN considering the educational needs of London it is important to remember that its extended area, its large population, and its exceptional municipal government all conspire to place the metropolis in a category by itself. Local authorities and other organisations which may serve to meet the requirements of the rest of England are not suitable for the unique wants of the greatest city in the world. When framing the Education Bill now before Parliament, the Government recognised this exceptional character, and very wisely postponed for a future occasion the consideration of the coordination of existing institutions of different educational grades in London, and of the addition of necessary schools and colleges. Similarly, the University of London, as reconstituted by the Commissioners appointed under the Act of 1898, is an institution of a unique character. No other university has a similar constitution, because nowhere, at home or abroad, are the conditions of the metropolitan area duplicated.

As was pointed out in an article in NATURE in 1899 (No. 1548, vol. lx.), if, as is done in the University of London Act, 1898, the area to be served by the London University is that included within a radius of thirty miles from the University buildings, it will be found that the University has, on a very moderate estimate, to meet the higher educational needs of about seven million inhabitants. It was shown in the article referred to that to accomplish this huge undertaking with any hope of success it would be necessary to make the fullest possible use of every existing institution which could be regarded as of university standing.

It is instructive in this connection to compare the provision of university education in some other districts with that to be found in the capital. The population of Scotland is under four millions and a half, yet there are, north of the Tweed, four largely endowed and well-equipped universities, and in addition a university college. The total population of the eight large towns in England provided with university colleges is under three millions and a half; while Wales, with a population of under two millions, has three university colleges. So that, even on the grounds that London should be made as well off as the other parts of Great Britain, it may be urged, fairly and temperately, that there is need for a great and immediate advance.

For these reasons amongst others we are glad to find that University College is making an earnest appeal for largely increased funds in aid of higher education and the facilities for research in London. If the teaching University of London is to be built up on existing institutions, it is of the highest importance that University College should be incorporated with it. A short time ago a joint committee of the council of the College and the senate of the University considered the subject of incorporation, and though they have not finished their deliberations, they have agreed on certain points, viz. :—

(1) For incorporation to take place the College must be free from debt.

(2) The University will not take over University College School. Accommodation must therefore be provided on a new site.

(3) The University will require extensive rearrangements of the Medical School.

All outstanding debts are already provided for by the Drapers' Company, which has generously become responsible for them to the extent of 30,000*l.* In addition, about 60,000*l.* have been contributed, a large part of which has been given on condition that the incorporation of the College in the University is really effected. But a much larger sum is needed. To provide a site and new buildings for University College School, to refit the present school buildings and to carry out other indispensable alterations, not less than 110,000*l.* will be required. For the completion of the College buildings, thus providing adequate accommodation for both teaching and research in the many different branches of knowledge, 250,000*l.* are necessary. For departmental expenses, including the maintenance of laboratories, libraries, &c., an annual income of 6000*l.*, or a capital sum of 200,000*l.*, must be provided. For the endowment of existing unendowed chairs and for the foundation of additional professorships a yearly sum of 20,000*l.* must be forthcoming, and this represents a capital sum of 700,000*l.* In short, to perfect and complete the College and to render fruitful its incorporation in the University a sum of at least one million pounds must be found.

If our merchants and manufacturers appreciated the importance, as a factor in our national commercial success, of the higher education of the people of London, there would be no difficulty in obtaining the sum required by the council of University College. As we have chronicled from time to time, the merchant princes of America have supplied for similar institutions in the States very many times the amount asked for by University College. The Leland-Stanford University of California has received nine millions sterling from private munificence; Chicago University has been given over two and a half millions, and many other universities have similarly been provided with their necessary millions.

University College is fully justified in its appeal to the public by a splendid record of activity during the seventy-five years of its existence. The standard of the studies carried on throughout this period has been that of a university, and the yearly output of original work has not been exceeded by that of any constituent college of a British university. We cordially recommend its claims to all those who are able to be munificent, and would suggest that no more suitable way of celebrating the Coronation in London could be found than the provision of this million pounds to begin the work of establishing in the capital of the Empire a teaching university worthy of our imperial aspirations.

But, as has often been pointed out in these columns, the responsibility for the provision of educational facilities which will bring us in line with other progressive nations rests, not upon individuals, but with the State. Private benevolence is never better employed than when it is used to assist higher education and research, but it ought not to be regarded as an excuse for the neglect of a national duty; yet over and over again this is done by statesmen of both parties. Mr. Balfour occupied this position on Wednesday of last week, when speaking at the Mansion House in connection with the distribution of prizes awarded under the commercial education scheme of the London Chamber of Commerce. He acknowledged that our nation "has lagged behind all the great nations of the world, not merely in commercial education, which is a portion of technical education, but also in many of the wider and more important aspects of national education." His remarks upon the importance of studying

commerce in the spirit of impartial scientific investigation and wide knowledge were also to the point. Mr. Balfour said, in effect, that there could be no doubt about our leeway, or upon the value of broad and scientific education as the chief factor of progress, but he looked to the general community to "set itself to work to bear the great responsibilities which the needs of our country have thrown upon our shoulders."

It is only when educational provision is under consideration that our statesmen are content to leave obvious national defects to be remedied by chance munificence in the way suggested. In military and naval matters the Government is held responsible for efficiency, whatever assistance may be obtained from voluntary effort. The same principle must be applied to higher and technical education before we can hope to make our educational forces equal to those we have against us. The States which are making headway, and equipping themselves for industrial war, are those which give the greatest encouragement to the advancement of knowledge. Until our statesmen recognise this fact and act upon it, there can be no assurance against the loss of national position which must come sooner or later. The present policy of drift can only be compared with that of the man who is improvident enough to neglect to provide for old age because he hopes that some generous friend will present him with an endowment assurance.

The Government should lead the way to improving higher education, not by words, but by deeds. Practical sympathy is what is needed at present more than anything else, and the University of London offers a good opportunity for the State to show it. Let a liberal grant be made from the national exchequer, and private donors would understand that the statesmen who express fine sentiments upon the value of higher education to national welfare are actually convinced of the urgent necessities of the case. It is because this example has not been set that the various colleges of the University have to carry on their work with very inadequate resources. We commend these considerations to the Duke of Devonshire, who is to speak at the Mansion House on May 9 at a meeting to be held in support of the appeal for funds for advanced secondary education and research at University College.

It must be remembered that, when looked at broadly, this question of the provision of an adequately endowed and fully equipped University of London is a much larger one than that of securing sufficient funds to make possible the incorporation of University College in the University. Even when its incorporation has been effected, University College will be but a constituent college of what we hope is destined to be a powerful and comprehensive University, binding together all those institutions located within the metropolitan area which, by a little adaptation and some necessary expansion, can legitimately claim university rank. The consummation for which every earnest educationist in London should work is the incorporation in the University of London, in the same large way that University College desires, of all suitable colleges and polytechnics. There is King's College, which in one important respect, since it has already moved its secondary school to Wimbledon, has

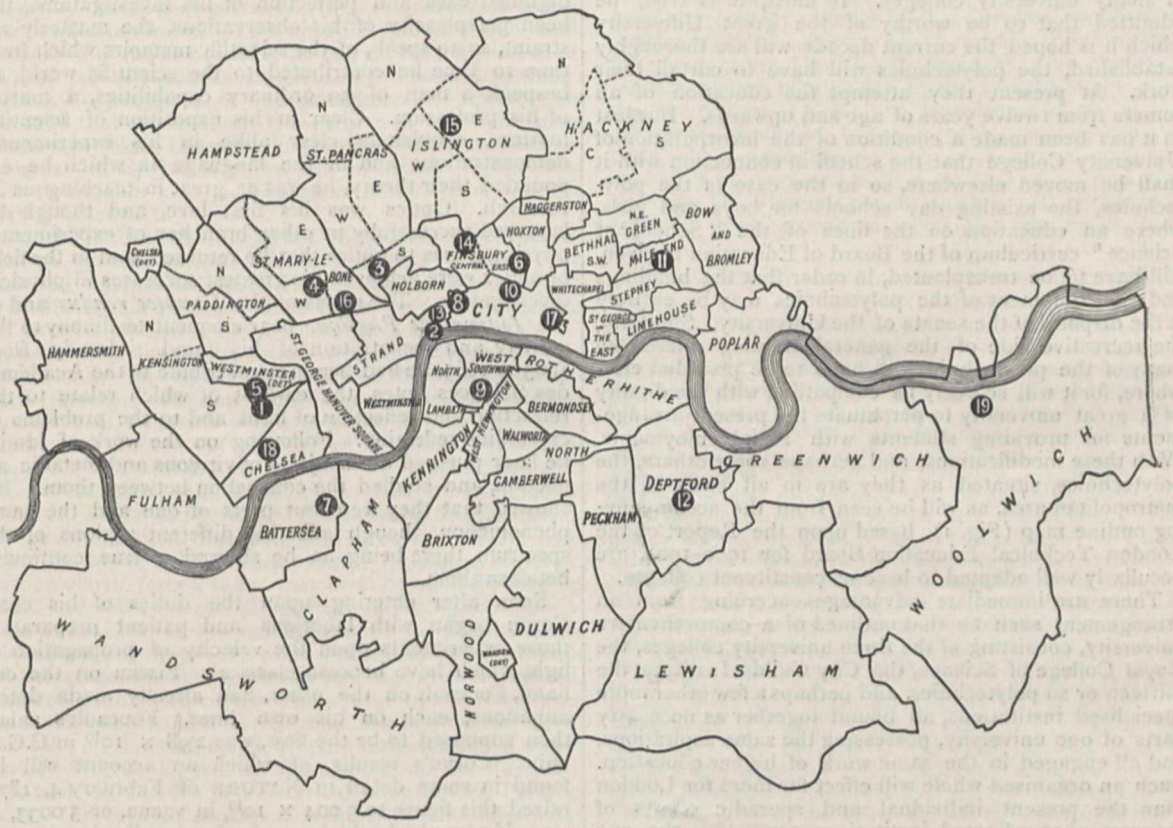


FIG. 1.—Distribution of Colleges and Polytechnics in London. The order is that given in the Report of the London Technical Education Board.

1. Royal College of Science. 2. King's College. 3. University College. 4. Bedford College. 5. Central Technical College. 6. Finsbury Technical College. 7. Battersea Polytechnic. 8. Birkbeck Institution. 9. Borough Polytechnic. 10. City of London College. 11. East London Technical College (People's Palace). 12. Goldsmiths' Institute. 13. London School of Economics and Political Science. 14. Northampton Institute. 15. Northern Polytechnic. 16. Regent Street Polytechnic. 17 Sir John Cass's Aldgate Institute. 18. South-Western Polytechnic. 19. Woolwich Polytechnic.

advanced a step further on the road to incorporation than University College. The Royal College of Science, with its intimate connection with the Board of Education and its exceptional facilities for training teachers of science, would worthily fill an important part in the work of the University. The Central Technical College of the City Guilds, subsidised by the wealthy City companies, provides higher education, and could immediately take its place in the University to teach advanced technology. Bedford College, too, which has specialised in the direction of the higher education of women, must be included.

Finally, there are the polytechnics. On more than one occasion it has been pointed out in NATURE that the amount of research work accomplished in the polytechnics of greater London rivals successfully that done in many university colleges. It must, it is true, be admitted that to be worthy of the great University which it is hoped the current decade will see thoroughly established, the polytechnics will have to curtail their work. At present they attempt the education of all comers from twelve years of age and upwards. But just as it has been made a condition of the incorporation of University College that the school in connection with it shall be moved elsewhere, so in the case of the polytechnics, the existing day schools for boys and girls, where an education on the lines of the "School of Science" curriculum of the Board of Education is given, will have to be transplanted, in order that the buildings and the equipment of the polytechnics may be entirely at the disposal of the senate of the University. Similarly, the recreative side of the general training offered by many of the polytechnics will have to be provided elsewhere, for it will scarcely be compatible with the dignity of a great university to perpetuate the present arrangements for providing students with social enjoyments. With these modifications, and perhaps some others, the polytechnics, situated as they are in all parts of the metropolitan area, as will be seen from the accompanying outline map (Fig. 1), based upon the Report of the London Technical Education Board for 1900-1901, are peculiarly well adapted to become constituent colleges.

There are immediate advantages accruing from an arrangement such as that outlined of a comprehensive university, consisting of the three university colleges, the Royal College of Science, the City Guilds Institute, the thirteen or so polytechnics, and perhaps a few other more specialised institutions, all bound together as necessary parts of one university, possessing the same aspirations, and all engaged in the same work of higher education. Such an organised whole will effect far more for London than the present individual and sporadic efforts of separate uncoordinated institutions competing the one against the other. And such an university could still preserve its former character as an imperial examining board for granting degrees.

A development of this kind and on this scale will doubtless necessitate the expenditure of many times the million pounds asked for by University College. But when the inhabitants of the wealthiest city in the world are educated to understand that no spending is so profitable as that on higher education and on the endowment of research, there will be little difficulty in obtaining the necessary funds. The immediate necessity is the provision of the amount required to ensure the incorporation of University College in the University of London; but this must be followed by a strenuous endeavour on the part of all men of science and influential men in every other department of mental activity to instruct Londoners in their duty towards their city and country of providing a permanently endowed University of London, consisting of constituent colleges situated in every part of the enormous area for the higher education of which the University is responsible.

PROF. ALFRED CORNU.

CORNU was born in 1841 at Châteauneuf, and entered the great military school of Paris, the École Polytechnique, at the age of nineteen. After four years of study there he entered the École des Mines, which he quitted in 1866, thus completing a brilliant career as a student. One year later, at the age of twenty-six, he was chosen as professor of physics at the École Polytechnique, a post which he filled to the end of his life and adorned with the many results of his scientific researches.

It would be impossible in a brief review of Cornu's life to give more than the barest outline of his contributions to original knowledge. His position as a teacher gave him, amidst the material surroundings of his laboratory, the leisure to work. The beauty, the dignified ease and perfection of his investigations, the keen perspicacity of his observations, the masterly restraint, so to speak, of the scientific memoirs which from time to time he contributed to the scientific world, all bespeak a man of no ordinary capabilities, a master of his profession. Clear in his exposition of scientific matters, exquisitely clear alike in his experimental demonstrations and in the language in which he expounded their theory, he was as great in teaching as in research. Optics was his first love, and though he laboured successfully in other branches of experimental physics, it was to optics that he returned, and in the field of optics were achieved his greatest successes in physical investigation. The pages of the *Comptes rendus* and of the *Journal de Physique* bear eloquent testimony to the activity and penetration of his mind. Already, from 1863 to 1865, he had begun to contribute to the Académie des Sciences notes, the earliest of which relate to the refraction and reflection of light and to the problems of crystalline reflection. Following on the work of Jamin, he later pursued the subjects of vitreous and metallic reflection, and studied the connection between them. He showed that they were but parts of one and the same phenomenon, though affecting different regions of the spectrum, there being, as he showed, a true continuity between them.

Soon after entering upon the duties of his chair Cornu began with laborious and patient preparation those experiments upon the velocity of propagation of light which have become classical. Fizeau on the one hand, Foucault on the other, had already made determinations, each on his own lines. Foucault's value, then supposed to be the best, was $2{\cdot}98 \times 10^{10}$ in C.G.S. units. Cornu's results, of which an account will be found in some detail in NATURE of February 4, 1875, raised this figure to $3{\cdot}004 \times 10^{10}$, in vacuo, or 3·0033, in air. His method, which was fundamentally the same as that of Fizeau, was applied to the transit of light over a distance of 46 kilometres (or between two stations 23 kilometres apart, the one at the Observatoire, the other at Monthéry); and the instrumental perfection of his rotatory apparatus enabled him to observe up to the twenty-first extinction of the beam, thus securing a precision far in advance of that attained by Fizeau. For his determination of the velocity of light he was awarded the *prix Lacaze* in 1878, the same year in which his merits were recognised by his admission to the Académie des Sciences. In 1872 he wrote papers on the theory of electrostatics, in which he expounded the potential theories of Gauss and Green, then little known in France. They are to be found in vol. i. of the *Journal de Physique*, then recently founded by his friend d'Alméida.

For several subsequent years Cornu was occupied with researches on the spectrum. He measured the wave-lengths of the hydrogen rays with a precision previously unknown, enabling a comparison to be made between the values so obtained by experiment and the theoretical formulæ which had been

proposed by Balmer and others to express them. The suggestions of Dr. Johnstone Stoney and the later developments of Kayser and Runge will not be forgotten in this relation. He also made observations on atmospheric absorption in the spectrum, using photographic methods, at his country house at Courtenay, where he used to spend most of his vacations. He thus was able to fix the inferior limit to the ultra-violet end of the spectrum, so far as it is visible at low elevations, and found that in the laboratory air is opaque to ultra-violet waves of a lesser wave-length than 0·185 μ. His work on meteorological optics has thus been summarised by M. Guillaume :—"Such researches, in the course of which he was often led to a scrutiny of the sky, could not fail to draw his attention to the optical phenomena of the atmosphere, the study of which, though energetically pursued by the French physicists of last century, is to-day somewhat neglected. The splendid glows which were observed in the sky toward the end of 1883 furnished to Cornu an occasion to utilise the profound knowledge which he possessed of the phenomena of optics. He showed that the twilight glow, which at that time gave such marvellous charm to the sunsets, was due to a diffraction caused by fine powders, and it became evident that the formidable volcanic explosion of Krakatoa was the prime cause of it."

Cornu published an elegant method for the investigation of the optical constants of lens systems. He devised the optical lever for the measurement of the curvatures of lenses, and he perfected the Jellett prism for polarimetric work. To him is due the elegant geometrical construction in which spirals are applied to express graphically the relative intensities of the light in diffraction images. His preference for geometrical demonstrations of theorems which might otherwise be hidden under a burden of analytical symbols was well known. He worked at acoustics in conjunction with M. Mercadier, and at elasticity, and in conjunction with M. Baille redetermined the constant of gravitation. He was occupied, too, with the problems of the synchronisation of two resonant systems capable of vibration under elastic forces, these memoirs being published in 1888 and 1889, the second of them including the application of his ideas to the synchronisation of clocks for the distribution of time. His plan was closely akin to that of Wheatstone, depending on the sending, at every second, of feeble induction currents generated by the movement of a magnet attached to the pendulum of a master clock. In 1884 he reported on the electric transmission of power by M. Marcel Deprez on the Chemin de Fer du Nord. He took part in the first electrical congress at Paris in 1881. In 1886 he became a member of the Bureau des Longitudes, and in 1900 of the International Commission on Weights and Measures. He was president of the Académie des Sciences ; twice, at different periods, president of the Société de Physique ; and by general consent was elected to preside also over the International Congress of Physics in 1900.

He was elected a foreign member of the Royal Society in 1884, and was also an honorary member of the Physical Society of London. In 1878 he received for his work on the velocity of light the Rumford Medal of the Royal Society. At least twice he gave Friday evening discourses at the Royal Institution ; the last of these in 1895 on the physical phenomena of the high regions of the atmosphere.

In 1899 he delivered, with delightful eloquence and learned ease, the Rede lecture at Cambridge, on the wave-theory of light and its influence on modern physics. On this occasion, which was at the time of the jubilee celebration of Sir George Stokes, he received the honorary degree of Doctor of Science.

In Cornu, France has lost one of her most distinguished men of science, and one who, not only as investigator, but as teacher and wise counsellor, had won universal esteem and respect. A true follower of the great traditions of France in the pursuit of science, and a passionate follower of Arago, Biot, Fresnel and Fizeau, he was in his own person much more than this. He was the ideal of a well-equipped, well-balanced, intellectual leader in scientific thought. SILVANUS P. THOMPSON.

M. VIGNON'S RESEARCHES AND THE "HOLY SHROUD."

AT the meeting of the Paris Academy of Sciences on April 21, some remarkable photographs of brownish stains found on the "Holy Shroud" kept in the Treasure Chamber of Turin Cathedral, and traditionally said to be the winding-sheet of Christ, were exhibited in connection with a paper by Dr. P. Vignon, of which a translation from the current number of the *Comptes rendus* of the Academy is given below. Upon reproducing these stains by photography, Dr. Vignon found that he obtained a realistic picture of a human figure, and the suggestion is that the picture is actually a representation of the body of Christ, produced by radiographic action from the body, which, according to ancient texts, was wrapped in a shroud impregnated with a mixture of oil and aloes. We give Dr. Vignon's paper, which it will be noticed is confined to an account of principles relating to radio-activity.

ON THE FORMATION OF NEGATIVE IMAGES BY THE ACTION OF CERTAIN VAPOURS.

IT is known, from the work of M. Colson, published in the *Comptes rendus* of the Academy of Sciences in 1896, that freshly cleaned zinc emits vapours at the ordinary temperature which are capable of affecting photographic plates in the dark. The researches of Russell have also shown that the striations of a plate of zinc reproduce themselves on a photographic plate. But it is a long step from this to the realisation of an object in relief. I have succeeded in obtaining images either with medals powdered with zinc, or with bas-reliefs or objects fully embossed, in plaster, and rubbed with zinc powder. These images are negatives, not by the inversion of light and shade, since they are formed in the dark, but by the fact that the reliefs give more energetic impressions than the cavities. To interpret these it is necessary then to invert photographically ; positive images are then obtained in which the scale of relief is scrupulously respected, which is far from being the case in normal photographs of the same objects illuminated from the front. Naturally, upon images made at a distance, the reproduction of the most minute details could not be expected, the precision of the detail obtained being less as the distance increased. The clearness of the image depends upon the rapidity with which the action diminishes when the space increases between the emissive surface and the receiving screen.

From a point of the active surface let a perpendicular be lowered on to the receiving plate ; the foot of this perpendicular constitutes the centre of a circle which makes a more energetic impression in its central region than on its edges ; the clearness of the image will thus be greater the smaller the surface of the circle acted upon, and this surface varies inversely as the rapidity with which the actions decrease when the distance increases. It is on this account that the images correspond very nearly to those which would be realised if the actions were produced only according to the orthogonal projections of the different points of the active surface.

It is a curious point that the images converted into positives frequently give rise to the impression of having been lit from above.

This will be the case when a plane, such as the forehead, is seen from the front and forms at the same time a strong relief, whilst a plane near it is rapidly shifting, such as, for example, the region which connects the superciliary arch to the eyeball. When this plane shifts it appears to sink into a deep shadow.

The truly specific character of these negative images which arise from action at a distance lies in the softness of the contours. The limit of the visible portion is the result for the eye of the receding of the surface. If this falling back takes place at a small distance from the receiving plane, the contour is still marked, though vaguely ; but if this falling away is produced

only at a distance greater than that at which the vapours can act, no corresponding effect is produced in the image, which gradually weakens up to its borders by insensible gradations until it disappears altogether.

Practically in spite of the softness of the details and the outlines, the impressions produced by vapour are far from consisting of simple shadows; if the object is in strong relief, the image is energetic and well marked; it appears simply as if the object were seen through transparent gauze, or as if it had half emerged from a fog.

Negative images have also been obtained by acting with ammoniacal vapours upon cloths impregnated with a mixture of powdered aloes and olive oil; it is known that aloes contains a principle which turns brown and is oxidised under the influence of alkalies in moist air. A plaster hand covered with a suède glove which has been moistened with a solution of ammonium carbonate acts similarly. There is obtained in this way a sort of print of the hand, a negative softened at the edges and wanting in proportion in so far that the points where the hand is too far from the cloth are too faint, the points of contact of the hand and cloth, on the other hand, being too strongly marked. The fermentation of urea, easily brought about by the addition of a little urine, leads to the formation of ammonium carbonate and thus causes the browning of the aloes. The fermentation of a febrile sweat, rich in urea, leads to the same result, as is already well known.

The extension of Dr. Russell's researches on the photographic activity of certain bodies in the dark, contained in the above paper communicated to the Paris Academy by M. Vignon, has given rise to a most curious discussion.

There is a so-called "Holy Shroud" at Turin in which tradition states the body of Christ was wrapped after the Crucifixion. An article in the *Times* thus refers to it and its connection with M. Vignon's work:—

"It is said to have been brought from the East in the fourteenth century, and in the following century it passed into the hands of the House of Savoy, and was deposited at Chambéry. Finally, it was transferred in 1578 to its present resting-place by Duke Emmanuel Philibert, who wished to spare Carlo Borromeo, the sainted Archbishop of Milan, the fatigue of a pilgrimage to its distant Savoyard shrine. The Shroud bears upon it, traced in hues of brown, what is alleged to be a double impression of the figure of Our Lord, the outlines both of the face and back of which have reproduced themselves with wonderfully distinct exactness. So seldom, however, is it exposed to view that this remarkable characteristic had almost been forgotten when, in May, 1898, some photographs specially taken of it by Signor Secondo Pia, of Turin, with the consent of its possessor, the King of Italy, once more drew attention to this strangely living likeness. Eighteen months ago these photographs came under the notice of M. Vignon, who, recognising their exceptional importance, at once began that inquiry of which the results were made public in a paper communicated to the Académie des Sciences."

In Paris, therefore, it has been generally accepted that a demonstration has been given by science of the authenticity, not only of the so-called shroud, but of all the historical events connected with it, and a much closer rapprochement between science and theology is predicted for the future.

Here, however, difficulties have been raised. Father Thurston, a learned Jesuit, writes to the *Times* as follows:—

"Before we can profitably discuss the value of Dr. Vignon's scientific explanation of the marks on the 'Holy Shroud' a serious difficulty of quite another order has to be cleared up. 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. M. l'Abbé Chevalier is a scholar of distinction, and of his perfect loyalty to the Catholic Church there can be no possible question. Moreover, his essay ("Etude Critique sur l'Origine du S. Suaire," Paris, Picard, 1900) has been warmly welcomed by the more critical journals devoted to hagiography. In the Bollandist periodical, the *Analecta Bollandiana*, for instance, its Jesuit editors state (vol. xix., 1900, p. 350) that the Abbé Chevalier's discussion of the subject is final, and that 'il ne reste plus qu'à proclamer "à haute et intelligible voix," comme le voulait le Pape Clément VII.: "Hæc figura . . . non est verum sudarium Domini Nostri Jesu Christi."'

"They go on to state that the story of the 'image of the shroud' given by Geoffroy de Lirey to the college founded by him in 1353 is not lost in the mist of ages, and does not happen to present any of those obscurities by which the historian who wishes to impart his own laboriously-acquired conviction to others must at times find himself baffled. We have, for instance, the document addressed to the Pope by Bishop Peter d'Arcis, in which he denounces the fraudulent dealing of the Chapter of Lirey, who for motives of avarice pretended that miracles were worked by this shroud, whereas his predecessor in the see of Troyes had officially investigated the matter and proved it to be a forgery. 'Et probatum fuit eciam per artificem qui illum (pannum) depinxerat, ipsum humano opere factum, non miraculose confectum vel concessum.'"

There is also another difficulty. It is stated that there is at least one other Holy Shroud in another holy place.

NOTES.

THE governing body of the Jenner Institute of Preventive Medicine has appointed Major Ronald Ross, F.R.S., whose name is well known in connection with his researches on malaria, to be head of a new department in the Institute at Chelsea.

WE learn from the *British Medical Journal* that the Legislature of New Jersey has passed a Bill which sets aside 10,000 dollars for the support of an experiment station where scientific investigations are to be made into the habits and breeding-places of mosquitoes and their relations to public health.

WE regret to see the announcement of the death, at the age of sixty, of M. Henri Filhol, professor of palæontology at the Jardin des Plantes, Paris; and also of Prof. I. L. Fuchs, professor of mathematics in the University of Berlin.

THE council of the Royal Institute of Public Health has conferred the Harben Gold Medal for the year 1902 upon Prof. W. R. Smith, late medical officer of the School Board for London, in recognition of his eminent services to the public health.

THE Washington correspondent of the *Times* reports that Lord Kelvin and Mr. Westinghouse both gave evidence on April 24 before a committee of the House of Representatives appointed to consider the present system of coinage and weights and measures. Lord Kelvin advocated the passing of a Bill to substitute the metric system for the standard now employed in the United States. Mr. Long, Secretary of the Navy, expressed the hope that England would take the lead in this change, but said that if England did not the United States should, and England would then follow. Mr. Westinghouse supported the Bill, but declared that it would take ten years for the people to learn to use the metric system.

IN connection with the second International Congress of Medical Electricity and Radiography, to be held at Bern on September 1–6, there will be an exhibition of apparatus relating to electro-physiology, electro-therapy and radiography. The physiological apparatus will be exhibited in the Physiological Institute, and will be in charge of Prof. Kronecker, director of the Institute, to whom communications relating to it should be addressed. The induction coils, contact-breakers, vacuum tubes and other apparatus connected with the production and uses of Röntgen rays in medicine will be in charge of Herr O. Pasche, chief of the Röntgen Institute of the Bern

Hospital. The exhibition will be opened on August 29, and intending exhibitors should communicate as soon as possible with Herr Pasche, Röntgen Institute am Inselspital, Bern.

AT the present time, when much attention is being given to the reform of mathematical teaching associated with the name of Prof. Perry, the pamphlet entitled "The Cultivation of the Mathematical Imagination," by Miss Mary Everest Boole (Colchester: Benham and Co., price 6*d.*), appears very opportunely. The methods advocated by the authoress belong chiefly to the kindergarten stage of education, but there are many suggestions that are appropriate to a slightly more advanced stage; the central idea is always that of leading up to general truths by means of concrete processes. The pamphlet should be very helpful to teachers who wish to find out how to prepare the minds of young children to receive formal mathematical instruction.

PROF. R. W. WOOD writes:—"It may perhaps be a matter of some interest to teachers whose laboratory facilities are limited to know that solid carbon dioxide can be obtained from the sparklets now sold everywhere for a penny or two for the aëration of beverages. The larger of the two sizes gives the best yield, of course. It is best to cool the sparklet in ice and salt for a few minutes before the experiment, and doubtless the amount of solid obtained would be still further increased by chilling the metal reservoir with which the bottles are fitted. A small square of black velvet should be held, or tied with a turn or two of string, over the end of the tube which delivers the gas into the fluid. The nap of the cloth should be on the inside, and the part over the tube should form a little bag about the size of a marble. On discharging the sparklet and quickly removing the bag, the interior will be found to be lined with the snow-white solid, with which a small drop of mercury can be easily frozen. The substance shows off most beautifully on the jet black surface of the velvet."

THE death is announced of Mr. William Henry Penning. After pursuing a course of engineering under Mr. C. H. Gregory, he joined the staff of the Geological Survey in 1867 and was engaged in mapping portions of Essex, Suffolk, Cambridgshire and Lincolnshire. He was joint author of memoirs on the geology of the neighbourhood of Cambridge, Lincoln, and parts of Essex. He was author also of "A Text-Book of Field Geology," 1876 (edit. 2, 1879), and of "Engineering Geology," 1880. In 1882, through ill-health, he resigned his post on the Geological Survey and spent some time in South Africa. He died on April 20. We have also to regret the death of Mr. Joseph Nolan, who joined the Geological Survey in Ireland under Jukes in 1867, and after many years of active service in the field became in 1890 resident geologist in the Dublin office. He was author or part author of several memoirs in explanation of the Geological Survey maps. He retired from the public service in 1901 and died on April 19.

A STRONG earthquake was felt round Lake Baikal on April 12. It began at Irkutsk by a severe shock at 6h. 40m. a.m., the pendulum of the observatory being deflected by 22 mm. About twenty fairly severe shocks followed during the first minute. Groups of shocks next occurred, the strongest of them being at 7h. 13m., 7h. 31m., 7h. 36m. and 8h. 14m. All these shocks could be felt even without instruments, their force attaining the value of 5 in the seismic scale. The earthquake was widely felt round Lake Baikal. At Selenghinsk the chief disturbance travelled in a direction from S.W. to N.E. and the following shocks were noticed:—at 7h. 0m., 7h. 50m., 7h. 54m. and 8h. 35m. At the village Snyezhnaya, on the eastern coast of the lake, several chimneys were destroyed and crockery was thrown down. Further east, at Verkhneudinsk, and on the western coast, the shock was much feebler. During the night of April 10-11 a very strong earthquake was felt in the north of Finland. At Uleaborg window panes rattled and crockery fell from its place. Shocks of earthquake continue also to be felt at Shemakha. Two severe shocks were noticed on April 17 at 10h. 0m. and 10h. 30m. p.m.

IT seems at first sight to be a bold statement to put forward that the study of the distribution of plants may be dated back to the time of Alexander the Great. But no more weighty opinion could be obtained than that of a scholar who has combined the study of classics and botany. Herr Hugo Bretzl, as a thesis for his doctorate in Strassburg, has made a careful study of Theophrast's "Plant-geography," and comes to the conclusion that from the description there given of the air-roots of *Ficus bengalensis* the writer must have been able to refer to the original accounts of Alexander's expedition. The brochure received gives two chapters from the whole work, which is to be published in book form and promises to be exceedingly interesting. Not only does the author show that the Greeks realised such facts as the absence of the pine in all the countries which intervene between Macedonia and India, but incidentally his references suggest that the Aristotelian writers have not received due justice at the hands of other writers of historical botany.

IT will be remembered that in a recent issue notes of the discovery of a blood parasite occurring in man and belonging to the genus Trypanosoma were recorded. The case was one of a European, whose chief symptoms were irregular rises of temperture with afebrile intervals, the attack being accompanied by increased frequency of respiration and pulse. The parasite was present only during the febrile attacks, and whilst it closely resembled *T. Brucei* in form and staining reactions, it was, however, considerably smaller and in fixed specimens assumed a characteristic "set." Another striking feature, which reminds one of the diseases known as Nagana and Surra in horses and cattle, is the occurrence of œdema of the eyelids and feet. Nepveu claims to have discovered this parasite in man in Algiers, but his description is very imperfect and raises considerable doubts as to whether what he saw were really trypanosomes. Mr. J. Everett Dutton, who described the parasite occurring in the blood of a European at Bathurst, West Africa, has within the last few days added the most interesting observation that the parasite occurs also in native children. Whilst examining for malaria parasites a large number of microscopical blood preparations of the native children of a small village, a few miles nearer the mouth of the River Gambia than Bathurst, he found in one preparation a number of trypanosomes resembling in every way those found in the case of the European before recorded. This second observation opens up a large field for further investigation and points to the extreme importance of the study of the diseases of natives, especially from a parasitological point of view, in West Africa and other parts of the world.

THE Meteorological Office Pilot Chart for May gives a short account of submarine earthquakes and the curious sensations they produce on board ship. Within the basin of the North Atlantic the fairly well-defined seismic regions are near the equator, between 19° and 33° W.; about the West Indies; from the Cape Verde Islands north-westward to about 33° N., 41° W.; and from 34° to 45° N., 13° to 30° W. The ice season this spring is very late, no bergs having been reported down to April 16. The St. Lawrence River was open for navigation at Quebec on April 3, an unusually early date. Numerous observations show that during the month of February last the temperature of the surface water of the Atlantic was below the average over a space extending south-westward from the British

Isles as far as 30° W. longitude. On shore the month was the coldest we had experienced for seven years, the air temperature being from 3° to 5° under the normal for various localities.

THE Meteorological Council has issued a valuable paper entitled "Temperature Tables of the British Islands." The work is divided into two parts: (1) The results derived from thirty years' hourly observations (1871–1900) for the four observatories Valencia, Aberdeen, Falmouth and Kew, showing the means and extremes of temperature for each day of the year and for the month; (2) the means and extremes for each month and for the year for 117 stations, with records of not less than fifteen years. In order to give an adequate representation of monthly temperatures of the London area, a table for Greenwich is included, with the consent of the Astronomer Royal, which gives data for sixty years. In the diagrams representing the seasonal variations at the observatories, the curves for maximum and minimum readings are printed on tracing paper, so that they can be superposed one upon the other, or upon the curve showing the mean values. A special feature, it is stated, in the treatment of the seasonal curves is an attempt to define a normal seasonal variation of temperature by the harmonic analysis of five-day means, to which daily averages and individual observations can be referred.

THE first number of the third volume of the *West Indian Bulletin* is devoted to a summary of the business transacted during the Agricultural Conference at Barbados in January last; to full reports of a number of papers on various phases of the sugar industry, with short accounts of the discussions on them; and to two communications of a general character—"The Organisation and Functions of Boards of Agriculture" and a "Report of the Chemical Section at the Conference." With the approval of the Secretary of State it is proposed by the Commissioner shortly to commence the publication of a new fortnightly review, to be called the *Agricultural News*, intended to contain in popular form agricultural information suited to the circumstances of the West Indies.

A PAPER by Mr Horace C. Richards, on the harmonic curves known as Lissajou's figures, is not the least interesting feature of the *Journal* of the Franklin Institute for April. The diagrams traced by the aid of a harmonograph are remarkably perfect and beautiful.

AN illustrated account of M. Santos Dumont's Parisian experiments is now given in *Prometheus*, No. 642. It includes reproductions of photographs showing the results of the accidents on August 8 and September 6, 1901; the successful ascents of October last are illustrated by views of the balloon when starting and when rounding the Eiffel Tower and a chart of the course.

THE *Rendiconti* of the Lombardy Academy notes that the Bologna Medical and Surgical Society offers a prize of 500 lire for an essay on sero-diagnosis in tuberculosis. Further, the "Olympic Academy" of Vicenza offers a prize of 3160 lire for a study of the Italians living on the South American continent, including more particularly the question of emigration and the relation between the colonists and their mother country.

THE Deutsche Mathematiker-Vereinigung has decided on a new departure in regard to the publication of its *Jahresbericht*. Under the editorship of Prof. A. Gutzmer, of Jena, this publication will in future appear monthly instead of annually, and among other features it is proposed to include academic dissertations, inaugural addresses, obituary notices both of members and of non-members, discussions on questions of teaching, notices of such undertakings as catalogues of current literature or the publication of Gauss's works, accounts of the meetings of societies, and notes and queries.

WE have received the April number of *Le mois scientifique*, which is devoted to a summary of recent books and publications on horticulture and botany. Among these we notice two new books on the cultivated plants of the south of France, one by M. Sauvaigo dealing with the Mediterranean coast, the other on southern flowers generally by M. Granger, and a new flora of France by M. A. Acloque.

UNDER the title of *Théorie nouvelle de la Loupe*, M. G. Quesneville has published, in Paris, a small *brochure* dealing with the optical properties of lenses, considered with especial reference to vision. The principal difference between the present and the conventional treatment is that here account is taken of what happens to the rays of light, not only during their passage through the system of lenses considered, but also after they enter the eye.

THE manufacture of butter with sterilised cream with the view of preventing the spread of tuberculosis is discussed by Drs. Serafino Belfanti and Costantino Coggi in the Lombardy *Rendiconti*, xxxv. 7. In Sweden and Denmark pasteurisation is already adopted on a large scale, but in Germany and Italy a prejudice still exists against butter made with cream that has been subjected to this precautionary measure. The paper shows that the process, so far from being detrimental to the quality of butter, may actually prove of commercial value, and that the problem of preventing the diffusion of tuberculosis by means of milk does not involve such great pecuniary sacrifices as have been sometimes anticipated.

THE Geneva Society of Physics and Natural History has just issued the first part of volume xxxiv. of its *Mémoires*, containing reports of the work done during 1900 both in physical and biological science. Among the most interesting results we notice M. A. Brun's observation during the summer of 1900 of a peculiar kind of snow on Mont Malet, called "neige de Caucase," or Caucasian snow. It is a porous snow the grains of which attain a size of as much as three millimetres, and their want of adherence may readily give rise to avalanches. A new station at the Hospice of the Great St. Bernard is another feature noted in the *Mémoires*. The observations are made at the usual hours of the Swiss meteorological service, and the building is situated to the north-east of the old hospice. This departure is largely due to the energy of Prof. R. Gautier, who has equipped the station with thermometers and hygrometers specially adapted to high mountain work, and whose efforts have been ably supported by the monks.

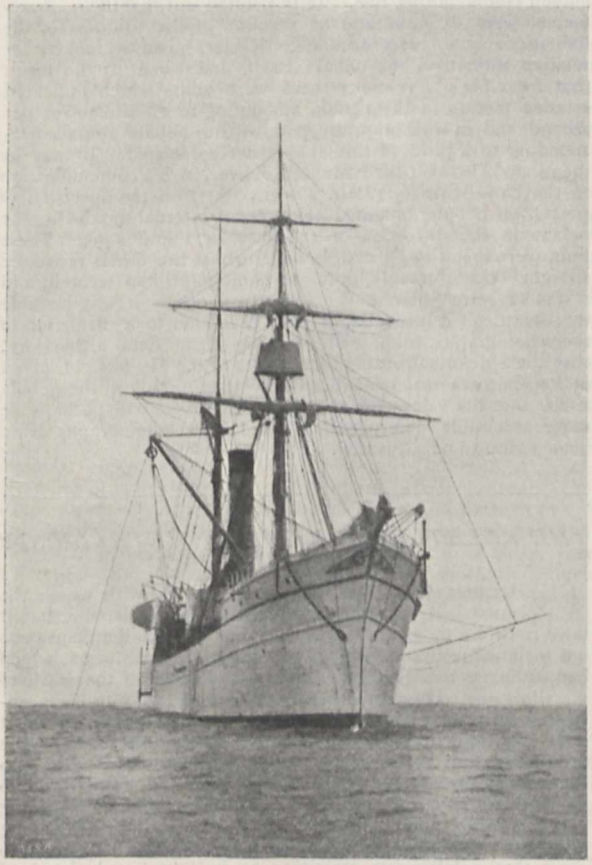
WE have received a copy of an address on the teaching of biology delivered by Prof. Haberlandt on the occasion of the opening of the new scientific and medical institute at the University of Gratz on December 9, 1899.

FROM the Report of the Director for the year 1899–1900, it appears that so long ago as 1857 a Museum was established in the town of Trivandrum, Travancore, but that for many years its condition was far from flourishing. By the addition of a public garden and menagerie, affairs have been placed on a better footing; and it is satisfactory to learn that the museum is now devoted to the illustration of local zoology. The following sentence from the director's Report is somewhat remarkable:—"In 1890 I succeeded Colonel Ketchen as Honorary Secretary and received the honorarium usually given to the Honorary Secretaries."

IN vol. xxiv. (pp. 499–566) of the *Proceedings* of the U.S. Museum, Mr. W. H. Dall describes and figures a number of new or hitherto imperfectly known shells, mainly American, in the collection of which he has charge. A large number of these, belonging to Buccinum, Trophon and allied forms, are

from Alaska and other parts of the Pacific coast of north-western America. Conspicuous among them is the handsome shell from Unalaska Island on which the genus and species *Beringius crebricostatus* were established by the author. A very large number of species belong to that group of Trophon which the author distinguishes as Boreotrophon.

THE numerous cruises of the U.S. Fish Commission steamer *Albatross* undertaken for the purposes of dredging, sounding and other objects connected with biology and hydrography are so important, and the literature relating to them is distributed through such a large number of serial and other publications, that all naturalists will be pleased to learn that a concise bibliography relative to the work of the vessel has been published. The task of compiling this record, which appears in



The U.S. steamer *Albatross* dredging, showing port boom rigged for surface towing.

the Report of the U.S. Fish Commission for 1900, has been entrusted to Mr. C. H. Townsend, the chief of the Fishery Division of the Commission, whose familiarity with the work of the ship, on board of which he served as naturalist from 1886 to 1900, rendered him peculiarly fitted for the task. The record comprises 172 closely printed pages, and is accompanied by a chart and illustrated with several views of the vessel, one of which is here reproduced. The first cruise took place in 1883, and the prime object of the work was the investigation of the fisheries and fishing-grounds. From 1892 to 1898 comparatively little work of this nature was, however, accomplished, owing to the vessel being employed on other services. For instance, at one time it was employed in Alaskan waters in connection with the Committee on Indian Affairs, on another occasion in laying the cable between California and Hawaii, and on a third occasion it was told off for service during the war with Spain. In spite of these withdrawals from its proper sphere, the vessel has made 1786 dredging and trawling hawls, at all depths down to 4173 fathoms, and extending over a very large area; while the soundings taken number at least 4000.

MESSRS. WHITTAKER AND CO. announce that they will shortly publish in their specialist series a work entitled "Mechanical Refrigeration." The volume is by Mr. Hal Williams, and will deal with the whole field of ice-making and cold storage.

THE edition of the "Life of Charles Darwin," just published by Mr. John Murray at the modest price of half-a-crown, is a marvel of cheapness. The volume contains 348 pages, clearly printed on good paper and neatly bound; so that naturalists who do not possess a copy of the life of their master should hasten to add it to their libraries. A life like Darwin's inspires everyone with reverence for his greatness and the desire to walk humbly in the same light. The record and reminiscences of such a great career cannot be too widely read.

TO suggest subjects to study in outdoor nature, and facilitate the record of the observations, Miss W. L. Boys-Smith has prepared a "Nature Note-Book," which has been published by Messrs. Allman and Son. A few hints are given concerning obvious characteristics, dates of appearance and habits of some common animals and plants, and thirty-three questions set by the National Froebel Union to test observation are printed at the end of the book. The remaining pages are ruled for records of observation and remarks, and for drawings. In connection with the revival of nature study or natural history, the note-book should be of service to young students.

MR. JOHN MURRAY will publish almost immediately an important volume by Major Molesworth Sykes, entitled, "Ten Thousand Miles in Persia." During the eight years which Major Sykes spent in Persia, he travelled over and explored the country from the Caspian Sea to the Persian Gulf, and from the Tigris to the frontiers of Afghanistán and Baluchistán, his journeys extending to quite ten thousand miles. The book about to appear will contain a record of his travels, with special reference to the geography and history of the country as well as to its commercial resources, the opening up of trade routes and the journeys of Alexander the Great and Marco Polo.

NEW editions of two volumes in the comprehensive series of manuals of science and technology published by the house of Ulrico Hoepli, Milan, have recently been received. One is the third edition, revised and enlarged, of "Magnetismo e Elettricità," by Prof. F. Grassi. The book contains a good account of the principles of electricity and magnetism, and gives much more attention to the applications of these sciences than is usually the case in similar manuals. Another third edition is the "Manuale del Chimico e dell'Industriale," by Prof. L. Gabba. This volume consists of a valuable collection of tables of standards, physical and chemical data, analytical processes, and similar information of service in laboratories and assay offices.

THE additions to the Zoological Society's Gardens during the past week include a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Lady Stanley; a Scops Owl (*Scops giu*) European, presented by Miss G. Ashley Dodd; a Robben Island Snake (*Pseudaspis cana phocarum*) from South Africa, presented by Mr. T. E. Cartwright; an Antillean Boa (*Boa diviniloqua*) from the West Indies, presented by Mr. E. S. Graham; a Derbian Wallaby (*Macropus derbianus*), three Long-necked Chelodines (*Chelodina longicollis*), two Limbless Lizards (*Pygopus lepidopus*) from

Australia, twenty-one Giant Toads (*Bufo marinus*) from South America, three Spiny-tailed Iguanas (*Ctenosaura acanthura*) from Central America, a Dark Salamander (*Amblystoma tenebrosum*) from California, two Long-tailed Weaver-birds (*Chera progne*) from South Africa, a Starred Tortoise (*Testudo elegans*), three Bungoma River Turtle (*Emyda granosa*), a Ring-necked Parrakeet (*Palaeornis torquatus*) from India, deposited; two Nylghaies (*Boselaphus tragocamelus*, ♂ ♀), four Yellow-billed Liothrix (*Liothrix luteus*) from India, a Grison (*Galictis vittata*), a Condor Vulture (*Sarcorhamphus gryphus*, ♂), four Grey Teal (*Querquedula versicolor*, ♂ ♂ ♀ ♀) from South America, two Mantchurian Crossoptilons (*Crossoptilon mantchuricum*, ♂ ♀), a Bar-tailed Pheasant (*Phasianus reevesi*) from China, a Common Crowned Pigeon (*Goura coronata*) from New Guinea, two White-fronted Geese (*Anser albifrons*), four Bearded Tits (*Panurus biarmicus*), a Waxwing (*Ampelis garrulus*) European, purchased; five Indian Wild Swine (*Sus cristatus*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

SIGNALS FROM MARS.—In the *Proceedings* of the American Philosophical Society for December 1901 (vol. xl. No. 167), Mr. Percival Lowell refers at some length to the observations that led to the announcement in the Press that Mars had been signalling to the earth on a night in December 1900. It may be mentioned that the *original* despatch read as follows:—"Projection observed last night over Icarium Mare, lasting seventy minutes." (Signed) "Douglas." In the present paper Mr. Lowell describes in detail some of the individual observations, and points out how the Flagstaff observations of 1894 showed that on general principles the Martian projections were most probably not due to the existence of mountain peaks. A close study of the surface markings led both Messrs. Lowell and Douglas to the result that these several projections were not caused by such permanent surface markings as mountains, but were the effect of clouds floating in the planet's atmosphere. At the opposition of 1894 more than 400 projections were seen in the course of nine months, and since that time other observations have helped to show that the non-reappearances of these projections at such favourable times when, if they were mountains, they should have been seen, have proved their non-permanent character. In fact, permanences like mountains were found to do violence to the observations, and the alternative explanation chosen was something floating in the planet's atmosphere and capable of reflecting light, or, in other words, clouds. Mr. Lowell, in his concluding remarks, says that the surface marking, Icarium Mare, is undoubtedly a great tract of vegetation, and the observation of December is completely explained if it be assumed that a cloud was formed over this region and rose to a height of thirteen miles, and then, travelling east by north at about twenty-seven miles an hour, passed over the desert of Aeria and there was dissipated after an existence of three or four days. The Flagstaff observations thus tell us that mountains on Mars, if there be any, have still to be discovered.

THE ORION NEBULA AND MOVEMENT IN THE LINE OF SIGHT.—Prof. H. C. Vogel communicates to the *Sitzungsberichte der Kön. Preuss. Akad. der Wissenschaften zu Berlin*, March 13, an account of the results which he and Dr. Eberhard have obtained with reference to the measurements of the spectrum of the Orion nebula taken for the determination of motion in the line of sight. The instruments used were the photographic refractor of 32·5 cm. aperture and 3·4 metres focal length, and a spectroscope with three prisms, the latter being supplied with electrical heating for maintaining a constant temperature during the time of exposure; the comparison spectrum was that of iron in every case. The measurements of all the photographs were made by Prof. Vogel and Dr. Eberhard independently of each other, and the region of the nebula investigated was practically the same as that examined by Prof. Keeler in 1890 and 1891, so that a direct comparison with his results can be made. The following table shows the values of the velocities in kilometres per second relative to the sun obtained from measurements at different parts of the Hγ line.

	Vogel. Km.		Eberhard. Km.
Position angle 90° from star θ′ Orionis Δ=0′·8; beginning of Hγ line ...	+16	...	+17
At θ′	+16	...	+16
Position angle 270°; Δ=0′·6 most intense portion of Hγ line	+12	...	+11
Position angle 270°; Δ=1′·2 to 1′·4 near end of Hγ line...	+8	...	+12

The mean velocity relative to the sun obtained by Keeler, who used the Hβ line, was + 17·7 ± 1·28 kilometres, a value not very much removed from the above-mentioned determination.

Another interesting point obtained from a close examination of the Hγ line was the distinct irregularity or hump of this line in the nebula spectrum, and both Prof. Vogel's and Dr. Eberhard's measures give velocities relative to the sun of + 6, + 28, + 11 and + 6, + 41, + 28 respectively to three chosen points on this line. It is pointed out that the measurements were difficult, and on account of the faintness of the line probably not very accurate. Keeler, however, looked for relative motion in the nebula itself, and came to the result that from his observations there were shifts which indicated relative motion in the nebula amounting to 21 kilometres per second, and in the brightest part of the nebula shifts corresponding to a third of this amount were detected. It may be mentioned also that Sir Norman Lockyer, in his communication to the Royal Society (*Phil. Trans.*, 1895) on the spectrum of the Orion nebula, obtained evidence of internal motion in the nebula in the distortion of the lines 4471 and 4495. These lines were found to be sharply bent, whilst the others remained straight. Unfortunately, only one photograph was secured, and it was suggested that in the absence of others it was possible that this displacement might have been due to a distortion of the photographic film. There seems little doubt, therefore, that these deformations and anomalies of the Hγ lines observed at Potsdam are real indications of relative motion in the nebula itself, and the values for the velocities given will perhaps be more accurately determined when further photographs have been secured and measured.

THE RELATIONS BETWEEN METALLURGY AND ENGINEERING.[1]

THE lecturer stated that this was the subject with which the council had requested him to deal in his lecture, but it must not for a moment be imagined that the metallurgic art was not included in the wide range covered by the Institution, which had, from its earliest days, given prominence to the work of metallurgists. He quoted Mr. G. P. Bidder, who, in his presidential address to the Institution delivered in 1860, said "that if he were called upon to define the object and scope of the profession of civil engineer, he would say that it was 'to take up the results discovered by the abstract men of science and to apply them practically for the commercial advantage of the world at large, and to diffuse their beneficent influence among all classes of his fellow citizens.'" He hoped to be able to show that metallurgists practising an industrial art had helped the engineer to do this, and in evidence that such was the case, he quoted from the presidential address of Sir John Fowler, words to the effect that engineers had been more assisted by members of the Institution and by distinguished men of science generally in relation to iron and steel than as regarded any other material. It was in connection with iron and steel that the illustrations of the lecture would be mainly given. It might at first be thought that the relations between metallurgists and engineers, which had become so close and enduring, arose quite simply from common interest. The case was, however, far from being so simple; communication between those who extracted metals from their ores and adapted them for the use of the engineers, who actually employed metals in construction, was seldom, at the outset, quite direct. The relations with which the lecture dealt had been strangely stimulated by the intervention of men who, in many cases, were neither engineers nor metallurgists, but were men whose lives had been devoted to

[1] Abstract of the tenth "James Forrest" Lecture, delivered by Sir W. C. Roberts-Austen, K.C.B., F.R.S., at the Institution of Civil Engineers on April 22.

abstract science. Such men recognised the value of certain metals and alloys for definite uses, they investigated their mechanical properties, and proclaimed their merits to engineers. The intervener then disappeared, leaving behind some coefficient or constant bearing his name by which he was gratefully remembered. As an instance, Galileo's estimation of the tensile strength of copper cylinders, and Young's determination of the rigidity of steel (which had resulted in Young's modulus) were cited.

It was not easy to fix the period in industrial history at which the metallurgist began to give the engineer material assistance. If in this country Stonehenge were taken as a starting point, the architect-engineer who designed that crowning example of Neolithic art could not have received any assistance from the metallurgist. That stately structure arose from the plain at a time when bronze tools were known but were not in general use, and this period had recently been fixed by Mr. Gowland at about 2000 B.C. In another phase of engineering work it was known that Rome, in the days of her occupation of this country, trusted to the metallurgists of our island to supply the lead which was so extensively used in the Eternal City. The fourth-century wrought-iron column, discovered in India, and the girders and beams of the Orissa temples, rendered it necessary to exercise great caution as to the period at which iron was used in construction. Such magnificent efforts as those given were, however, not maintained, and no widespread or continuous records of the metallurgists' contributions to early constructive work could be presented. On the other hand, the civil engineer had, to quote the charter of the institution, "advanced mechanical science and directed the great sources of power in Nature for the use and convenience of man," for ages before the metallurgists rendered more than incidental service. As examples of great engineering works into the construction of which no metal entered, the lecturer referred to, and gave illustrations of, the primitive cantilever bridges of pine trees used to cross mountain torrents in Savoy. The interesting thirteenth century cantilever bridge made up of 20-foot beams given in the note-book of Villars de Honnecourt was also shown, as was a bascule bridge of the middle ages. The dome of Milan Cathedral, as designed by Leonardo da Vinci, the great Tuscan painter, engineer and architect, was also referred to as an example of a structure in which metal was not used. The employment of cast iron from the time of Queen Elizabeth to the present day was then dealt with, and the proposed cast-iron bridge of 600-foot single span, by Telford and Douglas, was referred to, and it was pointed out that in the nineteenth century metallurgists, by creating the age of steel, more than atoned for their somewhat tardy and intermittent efforts to supply engineers with suitable materials.

As regarded the use of cast iron and malleable iron, the influence of Watt in developing the steam-engine was traced, and it was admitted that the necessity for pumping water out of mines was the main factor in the evolution of the steam-engine, and, in turn, the development of British metallurgy of iron and steel dated from the time when the steam-engine of Watt enabled air to be readily pumped into the blast-furnace employed for the production of cast iron. It was then pointed out that more than half of the last century had elapsed before the "age of steel" began, and that towards the end of the century great attention was devoted to considerations connected with the molecular structure and properties of steel, and to enforcing the action of carbon, the element which gave steel its properties, by the addition of other elements than carbon in very small proportions. With regard to the slow growth of confidence in the qualities of steel, the opinion of successive presidents of the Institution, as expressed in their addresses, was quoted; Sir John Hawkshaw, Sir John Fowler, Sir Frederick Bramwell, Mr. W. H. Barlow, Lord Armstrong and Sir George Bruce being specially alluded to. In 1887, when Sir George Bruce delivered his address, the merits of steel had at last received recognition, and, as regards the crowning triumph of the age of steel—the Forth Bridge—Sir George exultingly exclaimed:—"At the Menai Bridge, the total quantity of iron was 11,468 tons; at the Forth Bridge, there will be 50,000 tons of steel and iron." No one had done more than Sir Benjamin Baker to insist on the importance of phenomena which engineers used to consider "mysterious" in connection with the behaviour of steel, and his warnings and example were at last being regarded and followed. The lecturer pointed out that when metallurgists gave engineers mild steel, they provided a cinder-free *solid solution* of iron and carbon. All subsequent advance had been due to the recognition of this fact, and to the gradual studies of the properties of metallic *solid* solutions. Sir John Hawkshaw, in his presidential address to the Institution, delivered in 1862, had said that if the strength of iron could be doubled, the advantages might be equal to the discovery of a new metal more valuable than iron had ever been. The lecturer contended that this was exactly what metallurgists had done with regard to steel. By suitable thermal treatment, and by suitable additions of comparatively rare metals, they had doubled the strength of steel as it was known in its early days. The nature of solid solutions was then explained, and the importance of allotropic modifications of iron was dwelt upon, this portion of the subject being illustrated by some difficult experiments. The question was then asked, could the past molecular history of a mass of steel be traced by microscopic examination of the solid metal? Some very beautiful experiments by M. Osmond, Mr. Stead, and others, were appealed to in evidence of the possibility of this. It was then demonstrated that solid metals might even reveal, by their structure, the vibrations to which they had been subjected, and Sir Benjamin Baker had constantly insisted on the importance of such vibrations. In making this clear, Vincent's experiments on the beautiful wave-structure that might be imparted to the surface of mercury by the aid of a vibrating tuning fork were then exhibited, and it was demonstrated that the surface of *solid* lead which had been subjected to similar vibrations possessed a similar structure to the vibrating surface of mercury.

Finally, with regard to the efforts metallurgists were making to study the influence of rare metals on iron and other metals, the reducing power of aluminium on metallic oxides was shown. Very high temperatures of 3000° C. and above were attained, and brilliant light was produced during the reduction of chromium, cobalt, nickel and other metals from their oxides.

In conclusion, the lecturer appealed to the new Alexander III. Bridge at Paris as showing the need for the careful measurement of high temperatures in connection with the treatment of large masses of steel. In the construction of the bridge, 2200 tons of *cast* steel had been employed, and a peculiar molecular structure was imparted to the steel by rapidly cooling it in air from a temperature of 1000° C. to 600° C.; this gave the metal certain mechanical properties which it would not otherwise have possessed. With reference to the aid given by metallurgists to engineers in connection with ordnance, reference was made to the address delivered by Mr. T. Hawksley, the father of the president, in 1872. He said that "In no way" other than by the study of such questions "could the Institution" of Civil Engineers "serve its country better, or better promote, in the interests of peace, the advancement of practical Science, and its application, if events should order, to the purposes of protective warfare." The use of copper, aluminium and other metals in electrical engineering was referred to, and the lecture ended with an appeal for the more extended study of the physical properties of metals.

THE GLACIERS OF KANGCHENJUNGA.

MR. DOUGLAS W. FRESHFIELD publishes, in the April number of the *Geographical Journal*, an account of his expedition to Kangchenjunga during the autumn of 1899. The Kangchenjunga group is cut off from the mountains of Nepal by the Khosi Valley on the west, and from the mountains of Bhotan by the Teesta Valley on the east. By crossing the lofty spur which unites it to the Thibetan highlands, it is just possible to get round the mountain without trenching on territory officially recognised as Thibetan. Mr. Freshfield's object was to make this high-level tour round Kangchenjunga, passing as near as possible to the great mountain, and, further, to obtain some accurate idea of the glacial features of the group. Progress was greatly interfered with during the earlier part of the journey by the storm which caused so much damage at Darjiling and by the lowering of the snow-line which resulted from it; but the tour was successfully accomplished, and from the head of the valley of the Kangchen, in Nepal, Europeans looked for the first time on the north-west face of Kangchenjunga, "not a sheer cliff like the three other aspects of the peak, but a superb pile of rock buttresses, terraces of snow and staircases of ice, through whose labyrinthine complexities the future conquerors of the mountain will have to find the least hazardous way to the

summit." Concerning the Kangchenjunga glaciers, Mr. Freshfield says, "Four glaciers radiate from the peak, pointing roughly to the north-east, south-east, north-west and south-west. Those are the Zemu Glacier, eighteen miles long, and the Talung Glacier, both draining to the Teesta, the Kangchen Glacier, fifteen miles long, and Yalung Glacier, both draining to the Arun and the Khosi. The forked spurs that protrude south and west from Kangchenjunga, dominated respectively by Kabru and Jannu, enclose in the first case the Alukthang glaciers, united not long ago in a single stream and now divided by little more than their moraines, and the southern glaciers of Kabru, which fall into a separate glen; in the second case, three considerable ice-streams, one of which almost meets the Kangchen Glacier at its lower extremity, the second builds across the valley, out of the rockfalls of the tremendous cliffs of Jannu which encompass its source, a remarkable wall of moraine stuff, similar to those of the Allalein, or the Brenva in the Alps, and extent of the cliffs surrounding the head of the glacier. The glacier is now in retreat; the ice has sunk somewhat and the lateral moraines appear above it.

FIG. 1.—Kanbachen in Nepal, with Jannu and the Dyke of the Jannu Glacier. (From the *Geographical Journal*.)

while a third fills a glen the stream from which joins the Kangchen torrent at Khunza."

Mr. Freshfield was accompanied by Prof. Garwood, Signor Vittorio Sella and his brother, and Mr. Dover, now road inspector at Sikhim, with an Alpine guide. Prof. Garwood devoted much labour to the compilation of a photo-topographic map of the region, which is to be published in an early number of the *Geographical Journal*, and is described by Mr. Freshfield as a "specimen of the right method to delineate glaciers." The paper is illustrated by a number of photographs taken by Prof. Garwood and Signor Sella. The specimen we reproduce represents Jannu and the dyke of the Jannu Glacier as seen from Kanbachen. The ice crosses the valley at right-angles, over a great dyke of moraine débris, and the torrent from the higher valleys is squeezed against the western hill. There was at one time a lake above the moraine dyke. The cause of the exceptionally large amount of moraine material is the great height

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE installation of the Prince of Wales as Chancellor of the University of Wales will take place at the University College, Bangor, on May 9.

LORD ROSEBERY has been formally nominated as Chancellor of the University of London, in succession to the late Lord Kimberley. As no other nomination has been made, he will be elected by Convocation at the meeting to be held on May 13.

THE London School Board, and the School Boards of most large towns, have for same years provided special schools where their pupil teachers receive instruction at specified times. It has now been decided that these schools are illegal. Mr. Cockerton, the Local Government auditor, has formally notified the London School Board that it has no authority in law to spend the rates in providing and maintaining special schools for the instruction of pupil teachers.

IN the House of Lords on Monday, in reply to a question by Lord Reay, referring to the new Regulations for Evening Schools, the Duke of Devonshire said:—"It is intended that all local expenditure—by which is meant expenditure on evening schools other than that which is provided by Government grants—shall in future be provided by local authorities under the Technical Instruction Acts. As to whether the funds at the disposal of the local authorities will be sufficient for that purpose, the existing local authorities under the Technical Instruction Acts have by no means exhausted the funds at their disposal

which are applicable to the purposes of education. It is probable, however, that the responsibility for the whole of the evening school work, as contemplated by the regulations of the Board of Education for last year and this year, may involve them in an expenditure which their present resources are unable to meet. The Bill now before Parliament provides additional and, we believe, ample resources for all parts of the country except London. The present policy of the Board of Education is that evening schools, the great majority of which are intended for persons older than children, shall be provided and maintained by the local authorities for secondary education and receive grants under the regulations of the Board relating to secondary education."

SIR JOHN GORST spoke at Bradford on Saturday last upon the subject of the Education Bill of the Government. His remarks were aimed chiefly at the justification of the Government in making County and Borough Councils the local authorities for education. The necessity for this one authority in a particular sphere of influence has been almost universally accepted, but the difficulty is to determine the constitution of the body. Proceeding to describe the present position, Sir John Gorst said that the councils which are entrusted with technical instruction are entirely independent of central control. The consequence is that technical instruction as it is now carried out in this country is practically the entire creation of that new authority with very little assistance or direction from anybody. The councils are not bound to use the whisky money for technical instruction. They might have applied it to the relief of local rates, but in the last year for which statistics are available the total amount of the whisky money was 981,000*l.*, and of that sum 901,000*l.* was voluntarily devoted by the councils to technical instruction and only 80,000*l.* went to the relief of rates. Sir John Gorst remarked that the Duke of Devonshire and he selected the councils as the local authority rather than the School Boards, because a body which represented the ratepayers could not be a real local authority unless it had the absolute command of local finances, and if they had any other body levying rates without the consent of the body which properly represented the ratepayers they weakened the authority of the principal body and prevented it from gaining that proper influence over local affairs, expenditure and management which was essential to a properly constituted authority. A further question was whether the local authority was to be independent or to be tied down by the provisions of the statute. The effect of the working of the Technical Instruction Act was such as to be in favour of leaving these great local authorities to themselves. He preferred to trust them and give them ample powers, and leave them to exercise those powers for the benefit of the people whom they represented.

THE remarks made by Mr. Balfour at the Mansion House on April 23 upon the subject of commercial education are referred to in an article on the University of London which appears in another part of this issue. In the course of his address, Mr. Balfour said: "I would impress the doctrine, that important, necessary and essential as that narrow, technical training may be, we are ill learning the lesson of education which is now being taught us by other nations if we do not recognise that something more in the nature of general training and culture is absolutely necessary if we are to maintain the place so hardly won and so proudly maintained among the nations of the world. If commerce is to be treated as a subject of scientific study, it must not be approached simply in the spirit of those who desire to obtain a mastery of one particular instrument, one particular language, one particular form of knowledge, but must be approached, as all knowledge worthy the name should be approached, in the broader spirit of impartial scientific investigation. I do not think that higher praise can be given to the work in which Sir Albert Rollit and his colleagues are engaged than to say of it that, not merely have they given opportunities which would otherwise have been withheld to many persons in our community to learn the arts necessary for their work and success in life, but that they have also, and in addition to that merely technical training, in many cases laid the foundations on which may be built that solid and scientific knowledge of the commercial and economical forces of our time which are absolutely essential, as I think, to the proper conduct of the affairs of a great commercial country." Commercial education is so often understood to mean training in office routine that Mr. Balfour's statement as to what the term should imply ought to be widely known. All commercial an techn cal education of value must be founded upon sound primary and secondary education, and must be studied, not so much with the view of acquiring facility in carrying out the present duties of the office and workshop as with the intention to discover new methods and new processes. As with the individual, the nation that rests content with its achievements must eventually fall behind others which aim at obtaining and using new knowledge. It is in this spirit that commercial education must be viewed in order that it may assist national progress.

SCIENTIFIC SERIAL.

IN the *Journal of Botany* for April, H. W. Pugsley gives the first part of an article on the "British Capreolate Fumitories." Messrs. David Prain and Edmund Baker complete their "Notes on Indigofera." The various forms that have been included in the species *Indigofera tinctoria*, L., and *Indigofera Anil*, L., receive the fullest treatment, and the authors come to the following conclusions:—*I. tinctoria*, L., has been applied to three forms: (1) the wild form, which is probably indigenous to Africa; (2) the variety of the previous one, cultivated in southern India, at the present day more especially in Madras; (3) the plant cultivated in northern India, known as "Nil"; the differences between this and the other cultivated variety are so pronounced and constant that it seems justifiable to separate it off, when it becomes *I. sumatrana*, Gaertner. The specific name Anil, also given by Linnæus, is connected with the Egyptian vernacular word "Nil," which indicates any species that supplies the Indigo dye. In Egypt "Nil" would refer to *I. articulata*, Gouan, in India to *I. tinctoria*, L., while in neither of these countries would it include *I. Anil*, L., which will not grow in Egypt and does not find favour in southern India. De Candolle instituted three varieties of *I. Anil*, L., of which two call for comment. Var. α *oligophylla* is the same plant as *I. truxillensis*, H.B.K., which was probably cultivated in the West Indies in the time of Hans Sloane. Var. β. *polyphylla* is the plant now cultivated in the West Indies and other parts of the New World. This is the true *I. Anil*, L., but to avoid any confusion which may arise from the use of that specific name, it is suggested that it should be established, under another synonym, as *I. suffruticosa*, Miller. Arthur Bennett continues his "Notes on Potamogeton," and deals with some foreign species from Australia, America and Japan. The most interesting of four new British Hepaticæ described by S. M. Macvicar is *Aneura incurvata*. It comes near to *A. multifida* and *A. sinuata*. It may be expected to be recorded again, as it has been found in Austria, Germany and Scandinavia.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, April 25.—Prof. S. P. Thompson, president, in the chair.—Dr. Dawson Turner exhibited and described a mechanical break for induction-coils. The use of induction-coils in the production of Röntgen rays and in wireless telegraphy has made the construction of a suitable break a matter of importance. The ordinary break is unsuitable because of the wearing away at the point of contact, and there are objections to the use of mercurial breaks. The portable mechanical break which was shown by Dr. Dawson Turner consists of two metallic rollers with their axes parallel and kept in contact by a spring. One of the rollers has a cam attached to its spindle, and can be made to rotate by means of a small electric motor. Once in each revolution the cam separates the rollers, thus making the break, and at the same time causing the second roller, which rides loose upon its axis, to turn about one-eighth of a revolution. As soon as the cam has passed, the rollers are brought into contact by the spring, and the next break occurs at a different place. The wearing is thus distributed evenly over a large surface. The break is placed in a box containing alcohol or petroleum, and works best when rotating rapidly. An objection to the arrangement is the noise it makes when working. Some experiments were then shown on the discharge of electrified bodies by ultra-violet light. A disadvantage of the electric arc when used to furnish ultra-violet light for use in medicine

is that the light is accompanied by heat, so that it is necessary to shield the patient from the heat without interfering with the passage of the light. A condenser spark between iron electrodes is useful because it gives a large amount of ultra-violet radiation without much heat. Dr. Turner showed that this light is capable of discharging bodies whether positively or negatively electrified. He then showed that glass and mica are opaque to the radiation while pure rock salt is transparent.—Mr. Wilson Noble exhibited a mechanical break similar to the one already shown. A roller and a disc, with their axes parallel, are placed in contact and made to rotate in the same direction by a motor. Longitudinal slots are cut upon the surfaces of both, and the break occurs when a slot in the roller comes opposite a slot in the disc. Since the two are moving in opposite directions at their point of contact the break is very sudden. To vary the length of the break without altering the rate of rotation, the slot in the roller is wider at one end than the other, and the disc can be placed so as to touch the roller at any point of its length.—Mr. R. S. Whipple exhibited a temperature indicator for use with platinum thermometers, in which readings are automatically reduced to the gas scale. The instrument is very similar to the well-known Callendar and Griffiths' temperature indicator, with the exception that it is so arranged that the readings obtained are automatically reduced to the gas scale, thus avoiding the necessity of applying a correction. It consists of a simple Wheatstone's bridge with equal ratio arms, the other arms being the thermometer and a long helical bridge wire together with the compensating leads. A travelling contact is moved round the wire until a balance is obtained. The bridge wire is wound on an ebonite drum on the outer surface of which a helix has been cut. The contact piece, which is connected electrically with the galvanometer, is carried from the inside of a cylinder fixed to a shaft. A white celluloid tube on which the scale is divided is fixed to the outer surface of the cylinder. A screw of the same pitch as the helix on the ebonite drum is cut on the shaft, so that by rotating the shaft the contact is caused to travel along the bridge wire, and at the same time the scale is carried past an index placed above it. The scale has been so constructed that the reading at the index gives directly the temperature of the thermometer reduced to the gas scale. The instrument reads from 0° to 1400° C.—Mr. S. A. F. White read a note on the compound pendulum. In the determination of the length of the equivalent simple pendulum for a compound pendulum the form of which is a symmetrical bar and bob with one fixed, one movable knife-edge and no sliding weight it is convenient to make the mass of the movable knife-edge small. In this case, small displacements of this knife-edge will not materially alter the position of the centre of gravity or radius of gyration of the pendulum about an axis through its centre of gravity. The time of swing about the fixed knife-edge will therefore remain practically constant. The best determination of the correct position of the movable knife-edge for an equal time of oscillation will be given when for the smallest displacement of this knife-edge there is the greatest variation in the time of oscillation about it. The author has determined the position which makes $\frac{dt}{dh}$ a maximum, h being the distance of the axis of suspension from the centre of gravity. He has also drawn the curve showing the relation between $\frac{dt}{dh}$ and h. The calculations have then been applied to the determination of the position of the movable knife-edge in a particular pendulum. The experimental value of the ratio of h to k deduced from this pendulum when the movable knife-edge is adjusted to its right position agrees well with that predicted by the theory. The author states that when the length of the equivalent simple pendulum is about a metre, it should be possible with a stop-watch reading to 0·2 second to determine "g" to about ·1 or ·2 per cent. If the fixed knife-edge were made the movable knife-edge, the value of $\frac{dt}{dh}$ would be very large, but there would be difficulties in the way of measuring the small time of swing and the small equivalent length.

Chemical Society, April 17.—Prof. Tilden, F.R.S., in the chair.—Dimercurammonium nitrite and its haloid derivatives, by Dr. P. C. Rây. This salt was prepared by the addition of aqueous ammonia to a solution of sodio-mercuric nitrite. On solution in hydrochloric acid the new compound furnishes a mercuric ammonium chloride of the formula $2HgCl_2.NH_4Cl$, and with hydrobromic acid the corresponding bromide. These salts in turn, with sufficient potash, furnish respectively the chloride and bromide of dimercurammonium. The author's observations on these substances support the Rammelsberg-Pesci representation of the general structure of ammoniated-mercury salts.—Preparation and properties of 4-isopropyl-dihydroresorcinol, by Dr. Crossley. A correction in the nomenclature of this substance is made from 2:6-diketo-4-isopropylhexamethylene to that given above, since further investigation has shown that its usual structure is thereby better indicated.—Oxonium salts of fluoran and its derivatives, by Dr. Hewitt and Mr. Tervet. The authors have observed that fluoran and substances related to it, such as fluorescein, form salts with mineral acids, and of these the nitrate and sulphate of fluoran, chloride and sulphate of fluorescein and others have been prepared, analysed and described.—Influence of substitutions on the reactivity of the aromatic diamines, by Dr. G. S. Morgan. The author has studied particularly the influence exerted by the introduction of alkyl groups in various positions into the molecule of aromatic diamines on the reactivity of these substances with methylating agents.—The influence of certain acidic oxides on the specific rotations of lactic acid and potassium lactate, by Drs. Henderson and Prentice. It was found that antimonious oxide exerts no action on lactic acid and its potassium salt, and consequently has no influence of their rotations in solution. On the other hand, arsenious and boron oxides produce a change in the rotation of these substances which is greatest when they are present in quantity sufficient to form with the potassium salt compounds of the formulæ (AsO) $C_3H_4O_3K$ and (BO) $C_3H_4O_3K$ respectively.—The amounts of "ammonia" and "nitric" nitrogen and of chlorine in rain water collected at Rothamsted, by Dr. Miller. This paper gives the amounts of ammonia, nitrates and chlorine contained in Rothamsted rain water for each month from September 1888 to August 1901. The results show that the total nitrogen available to the soil from this source varied during this period from 3·31 to 4·43 lb. per acre per annum, the average being 3·84 lb., of which 1·8 lb. is secured during the winter and 2·03 lb. during the summer months. Of this total nitrogen, 70 per cent. is present as ammonia and 30 per cent. in the more easily available form of nitrates. Chlorine, on the other hand, is found in greatest quantity during the winter, the average content per annum for the period being 14·87 lb., of which 10·12 lb. is obtained during the winter season.—The amounts of nitrogen as nitrates and chlorine in the drainage through uncropped and unmanured land, by Dr. Miller. During the last twenty-four years—September 1877 to August 1901—the loss of nitrates in drainage water has been systematically investigated at Rothamsted, and this paper gives the results obtained. The average loss of nitrogen in this way amounts to 30 lb. per annum per acre, but varies greatly with the amount of rain and distribution of drainage. There appears to be also a considerable loss of lime. The average yearly amount of chlorine per acre in the drainage is about the same as that found in the rain, but wide differences occur occasionally. Drain gauges at a depth of 20 inches have during the last twenty-four years received on an average 7 lb. more chlorine than they have lost in drainage; the values for the 40-inch gauge are 17·5 lb. lost and 31·9 lb. received.—Benzylidene-camphoroxime, by Dr. M. O. Forster. The method of preparation, properties and behaviour towards reagents of this substance have been studied as part of a proposed systematic examination of substituted camphoroximes.

Linnean Society, April 3.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. R. Morton Middleton exhibited two letters from Linnæus to Dr. David van Royen and Mr. Richard Warner, of Woodford, dated respectively April 18, 1769, and September 29, 1758, and also a letter from Sir J. E. Smith to N. Wallich on Nepalese plants, written in 1819.—Mr. R. A. Rolfe, on behalf of the Director, Royal Gardens, Kew, exhibited a series of specimens of *Pachira aquatica*, Aubl., and *P. insignis*, Savigny, from British Guiana, collected by the late G. S. Jenman, Government botanist, to illustrate the great variation which exists in the size and shape of the fruits. There was also a certain amount of variation in the leaves and flowers, though in the latter each species retained its own essential character. These trees were common over the great alluvial forest-region, extending also to Brazil, and were commonly cultivated for ornament.—On behalf of Mr. W. B. Hemsley,

F.R.S., Mr. Rolfe also exhibited some specimens illustrating the precocious germination of the seeds of a species of Dracæna. Germination had taken place through the pericarp while the berries were still hanging on the plant.—Mr. Spencer Moore read a paper entitled "A Contribution to the Composite Flora of Africa," in which he described a number of new species in the Herbarium of the British Museum. He found that the north-eastern tropics, especially British East Africa and the neighbouring parts of Somaliland and Southern Abyssinia, had yielded most of the novelties.—Prof. F. E. Weiss read a paper, illustrated by lantern-slides, on a biseriate halonial branch of *Lepidophloios fuliginosus*. The branch in question, about 7 in. in length, was found in a large nodule by Mr. George Wilde at Haugh Hill, near Stalybridge. Dr. Scott, in a preliminary communication to the British Association in 1898, had identified it with the plant described by Williamson as *Lepidodendron fuliginosum*, now generally included in the genus Lepidophloios. Prof. Weiss supported this identification, and brought forward several instances of halonial branches of Lepidophloios which possessed only two rows of tubercles, instead of the more usual quincuncial arrangement of the tubercles. The specimen referred to, and of which photographs were shown, were from the British and Manchester Museums, and instances were also cited from Williamson's published memoirs. The second part of the paper consisted of a detailed account of the anatomy of his well-preserved specimen, which went to confirm Dr. Scott's previous identification of it.

Geological Society, March 26.—Prof. Charles Lapworth, F.R.S., president, in the chair.—On a remarkable inlier among the Jurassic rocks of Sutherland and its bearing on the origin of the breccia-beds, by the Rev. J. F. Blake. On the coast of Sutherland due south of Port Gower is seen on the scars at low water a long rocky crest of Old Red Sandstone, with its flaggy beds dipping at a high angle. It is of considerable height, and is surrounded by nearly horizontal Jurassic beds containing large blocks of rocks similar to those of the crest, irregularly placed. The size, outline and relation to the surrounding rocks show that this cannot be a transported block, but must have been part of, or directly derived from, a neighbouring coast—like the modern sea-stacks of the present coast at Duncansby. From considerations of the character and distribution of the breccia-beds, it is concluded that they are the product of an ice-foot of Upper Jurassic age, which invaded the normal deposits of that period.—On a deep boring at Lyme Regis, by Mr. A. J. Jukes-Browne. During 1901 a boring was made near Lyme Regis in search of coal, and was carried to the depth of 1300 feet without reaching the base of the Upper Triassic Marls. The beds passed through were compared with those exposed along the cliffs from Lyme to Sidmouth. The author concludes that the boring did not reach the beds which near Sidmouth form a passage from the Keuper Marls to the Keuper Sandstones, and that the Keuper Marls proved by the boring are at least 1130 feet, and may amount to 1200 feet in thickness.

MANCHESTER.

Literary and Philosophical Society, April 15.—Mr. Charles Bailey, president, in the chair.—Dr. Henry Wilde, F.R.S., read a paper on the atomic weights and classification of the elementary gases, neon, argon, krypton and xenon. The recent determinations of the densities of the new gases by Prof. Ramsay and Dr. Travers prove conclusively that they belong to the seventh series of elements in Dr. Wilde's table, which includes nitrogen and the comparatively inert groups of the platinum metals. Within the limits of experimental error and residual interferences, all the members of this series are multiples of seven.—A paper on the hypnotic influence of prolonged vision of persistent motion and sparkling objects, by Mr. Thomas Kay, was read.—Mr. F. J. Faraday exhibited an old copy of Chateaubriand's "Atala," partly written in the huts of the American Indians in Louisiana and Florida during the author's first visit to the New World in 1789, and containing passages showing the continued existence amongst the Red Indians at the end of the eighteenth century of some of the religious beliefs and practices referred to in Mr. J. E. King's recent paper on the Jesuit records of 1611, noticeably with regard to the metempsychosis of the souls of infants, the exhuming of the bones of members of the family from the temporary village grave for reburial in a common national grave on the occasion of the "Feast of the Dead," or the "Feast of Souls," and the transporting of the bones of dead relatives during migration.—Prof. F. E. Weiss exhibited a specimen of *Welwitschia mirabilis*. This curious plant was discovered by Dr. Welwitsch in 1860 in the south-west of Africa, where it grows in very arid regions, rooted by a very long tap root. The upper part of the plant is protected by a very thick mantle of cork. It only possesses two leaves, which last throughout the life of a plant, being constantly renewed from the base, which lies protected in a groove of the stem. *Welwitschia* was first described by Sir Joseph Hooker, who considered it as belonging to the group of Gnetaceæ allied to the Conifers.

PARIS.

Academy of Sciences, April 21.—M. Bouquet de la Grye in the chair.—On some phenomena of voltaic polarisation, by M. Berthelot. Experiments on the polarisation effects of liquid cells, both with and without the addition of reducing agents.—On the methods of proving the electrolytic action of a battery, by M. Berthelot. An examination of the conditions under which the smallest possible quantity of gas set free in an electrolytic cell can be observed, together with some experiments in which formol instead of pyrogallol was used as the reducing agent.—On Abelian functions with complex multiplication, by M. G. Humbert.—The resistance due to companion waves, by M. de Bussy. The proportionality between the height of the companion waves and the square of the velocity of the vessel producing them was proved by three sets of experiments, on a model 1/16th natural scale, on the vessels *Guichen* and the American cruiser *Columbia*.—On Daniellia and their secreting apparatus, by M. L. Guignard. The existence of a secreting system distributed through the whole thickness of the wood is a characteristic feature of the Daniellia; with the Copaifera and the Eperua of tropical America, these are the only leguminous plants known possessing intraligneous secreting apparatus.—New observations on the fossil flora of the basin of Kousnetzk (Siberia), by M. R. Zeiller. The Permian flora of Siberia appear to be closely allied, at all events in the cases of the most abundant and characteristic species, with the normal Permian flora of Europe and North America, from which they are distinguished only by the presence of some particular types.—Observations of the sun, made at the Observatory of Lyons with the Brunner 16 cm. equatorial, during the third quarter of 1901, by M. J. Guillaume. The results are expressed in three tables, showing the number of spots, their distribution in latitude and the distribution of the faculæ in latitude respectively.—On the continuous deformation of surfaces, by M. G. Tzitzeica.—The laws of deformation, the principles of calculation, and rules for the scientific employment of mortars, by M. Rabut. It is shown that the mortar described is altered in shape when fired according to simple and precise laws, easily explained from the properties of the material. The laws resulting from these principles are in agreement with the methods of construction in practical use.—On a new method for the optical measurement of thicknesses, by M. Macé de Lépinay. A sketch of a new method is given which possesses the advantages of requiring no other reflecting surfaces than those of the plate studied, and of permitting exact measurements to be made even if the plate is not quite perfect from the point of view of homogeneity or parallelism of its surfaces.—On the absorption of radioactivity by liquids, by M. Th. Tommasina. Preliminary measurements of the absorptive power of various organic liquids for the radiation from radioactive substances are given.—On the formation of negative images by the action of certain vapours, by M. P. Vignon (see p. 13).—On a case of molecular rupture by bromine, by M. R. Fosse. In the reaction between naphthylol-dinaphthoxanthene and bromine, instead of the expected substitution by the halogen, a molecule of bromine is added on as with an unsaturated body, the trinaphthyl-methane molecule being then split up into a bromo-naphthol and bromo-methanal-1-naphthol-2.—On some derivatives of fumaric aldehyde, by M. R. Marquis. The acetin of nitrosuccinic aldehyde, the preparation of which is described in a previous paper, is decomposed by dilute acetic acid at 80° C. with formation of fumaric aldehyde, $H.CO.CH=CH.CHO$, the phenylhydrazone and oxime of which are described.—The transformation of new into stale bread, by M. L. Lindet. The amount of soluble dextrins in the crumb of bread as it leaves the oven amounts to more than 10 per cent. of the dry weight; this amount was found to decrease steadily on standing, until after four days there is only 2 per cent. The only alteration undergone by the crust is in the amount of water it contains.—On

the Fecampia, endoparasitic turbellaria, by MM. M. Caullery and F. Mesnil. The embryogeny of Fecampia is, on broad lines, similar to those described by Metchnikoff, Hallez and Jijima for certain Triclades and Rhabdoceles.—On a new type of Rhizocephalus, a parasite of the Alpheidæ, by M. H. Coutière.—Pathogenic and teratogenic actions, by M. Étienne Rabaud.—Some new attempts at experimental parthenogenesis in Amphibians, by M. E. Bataillon.—On the primitive form of crystallised bodies, by M. F. Wallerant.—On the geological constitution of the western Maroc, by M. S. Brives.—The recent discoveries of the Prince of Monaco at Baoussé-Roussé. A new type of human fossil, by M. R. Verneau. The cave known as the *Grotte des Enfants* has already yielded such valuable results in the hands of M. Rivière that the Prince of Monaco resolved to continue its exploration methodically. The most important result up to the present has been the discovery, at the depth of 7·75 metres, of a human skeleton of a new type, apparently negroid, for which the name of the Grimaldi type is suggested.—Researches on the experimental production of parasitic races of plants by harmful bacteria, by M. L. Lepoutre. Three abundant species of bacteria were studied—*B. fluorescens*, *B. mycoides* and *B. mesentericus vulgatus*—and attempts were made to infect the tubercles of potato plants grown under varying conditions.

DIARY OF SOCIETIES.

THURSDAY, MAY 1.

ROYAL SOCIETY, at 4.30.—Coefficients of the Cubical Expansion of Ice, Hydrated Salts, Solid Carbonic Acid, and other Substances at Low Temperatures: Prof. J. Dewar, F.R.S.—The Conditions determinative of Chemical Change and of Electrical Conduction in Gases, and of the Phenomena of Luminosity: Prof. H. E. Armstrong, F.R.S.—Contributions to a Theory of the Capillary Electrometer: I. The Insulation-Resistance of the Capillary Electrometer, and the Minimum Quantity of Electricity required to produce a Visible Excursion: G. J. Burch, F.R.S.

ROYAL INSTITUTION, at 3.—Recent Geological Discoveries: Dr. A. Smith Woodward, F.R.S.

LINNEAN SOCIETY, at 8.—(1) On the Mammalian Cerebellum, with special reference to the Lemurs; (2) On the Brain of the Elephant Shrew, *Macroscelides proboscideus*: Dr. Elliot Smith.—On the Early Condition of the Shoulder-Girdle in the Polyprotodont Marsupials, Dasyurus and Perameles: Dr. R. Brown.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Automatic Relay Translation for Long Submarine Cables: S. G. Brown.

RÖNTGEN SOCIETY, at 8.30.—The Relation between X-Rays and allied Phenomena in Light and Electricity: Ernest Payne. (*Discussion.*)

FRIDAY, MAY 2.

ROYAL INSTITUTION, at 9.—Experimental Researches on the Constitution of Crystals: A. E. Tutton, F.R.S.

MONDAY, MAY 5.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—On the mixed Carbides of Manganese and Calcium: J. S. Brame and Prof. Vivian B. Lewes.—Dangerous Chemical Substances: Oscar Guttmann.

SOCIETY OF ARTS, at 8.—Glass for Optical Instruments: Dr. R. T. Glazebrook, F.R.S.

VICTORIA INSTITUTE, at 4.30.—Procopius's African Monument of Joshua's Conquest of Canaan: Martin L. Rouse.

TUESDAY, MAY 6.

ZOOLOGICAL SOCIETY, at 8.30.—On the Mammals collected during the Whitaker Expedition to Tripoli: Oldfield Thomas, F.R.S.—The Wild Sheep of the Upper Ili Valley: R. Lydekker, F.R.S.—A List of the Fishes, Batrachians and Reptiles collected by Mr. J. ffolliott Darling in Mashonaland, with Descriptions of new Species: G. A. Boulenger, F.R.S.

SOCIETY OF ARTS, at 8.—The Printing of Modern Illustrated or Decorated Books: C. T. Jacobi.

WEDNESDAY, MAY 7.

ENTOMOLOGICAL SOCIETY, at 8.—On a new Cricket of Aquatic habits, found in Fiji by Prof. Gustave Gilson: Prof. L. C. Miall, F.R.S., and Prof. G. Gilson.—On the Lepidoptera of the Chatham Islands: Edward Meyrick.—On Asymmetry in the Males of Hemarid and other Sphinges: Dr. T. A. Chapman.

SOCIETY OF PUBLIC ANALYSTS, at 8.

IRON AND STEEL INSTITUTE, at 10.30 a.m.—Report of Council.—The Bessemer Gold Medal for 1902 will be presented to his Excellency F. A. Krupp, of Essen.—A selection of the following papers will be read and discussed:—Report by the Committee appointed to investigate the Nomenclature of Metallography.—On a New Vacuum Tuyere for Blast Furnaces: H. Allen.—On the Microstructure of Hardened Steel: Prof. J. O. Arnold and A. McWilliam.—On the Compression of Fuel before Coking: J. H. Darby.—On Gas from Wood for use in the Manufacture of Steel: J. Douglas.—On a combined Blast-Furnace and Open-Hearth Process: P. Eyermann.—On the Physical and Chemical properties of Carbon in the Hearth of the Blast-Furnace: W. J. Foster.—On the Sulphur contents of Slags and other Metallurgical Products: Baron H. von. Jüptner.—On the Elimination of Silicon in the Acid Open-Hearth Furnace: A. McWilliam and W. H. Hatfield.—Report on Research Work carried out during the past year: J. A. Mathews.—On the Iron Ore of Brazil: H. Kilburn Scott.—On the Recovery of By-products in Coking: J. Thiry.—On Brinell's researches on the influence of Chemical composition on the soundness of Steel Ingots: Axel Wahlberg.

AUSTRALIAN CHAMBER OF COMMERCE (Australian Club), at 4.—The Coal Resources of Australia: James Stirling.

SOCIETY OF ARTS, at 8.—Origin and History of Carriages: A. Chancellor.

THURSDAY, MAY 8.

IRON AND STEEL INSTITUTE, at 10.30 a.m.—A Selection of Papers from the list given under May 7 will be read and discussed.

ROYAL INSTITUTION, at 3.—Recent Geological Discoveries: Dr. A. Smith Woodward, F.R.S.

SOCIETY OF ARTS (Indian Section), at 4.30.—The Past and Present Connection of England with the Persian Gulf: T. J. Bennett.

MATHEMATICAL SOCIETY, at 5.30.—On Groups in which every two Conjugate Operations are Permutable: Prof. Burnside, F.R.S.—Fermat's Theorem on Binary Powers: H. E. Western.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Form of Model General Conditions. (Conclusion of Discussion).

FRIDAY, MAY 9.

COLD STORAGE AND ICE ASSOCIATION (Society of Arts), Afternoon.—The Rationale of Cooling Phenomena: Dr. W. Hampson.—The Business Side of Cold Storage: R. J. Key.

ROYAL INSTITUTION, at 9.—Exploration and Climbing in the Canadian Rocky Mountains: Prof. J. Norman Collie, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 8.

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