THURSDAY, JUNE 9, 1898.

## LORD RAYLEIGH'S "SOUND."

*The Theory of Sound.* By J. W. Strutt, Baron Rayleigh, Sc.D., F.R.S. Second edition, revised and enlarged. Two volumes. Pp. xiv + 480, and xvi + 504. (London: Macmillan and Co., 1894 and 1896.)

IT was neither to be expected nor to be desired that any alteration of the general plan of Lord Rayleigh's "Sound" should be introduced in a new edition. A few errors have been detected and corrected (they are very few indeed), and the book has been considerably enlarged; but the characteristic features of the new portions are those of the old, and our admiration is again aroused by the skilful interweaving of theory and experiment, each supporting and adorning the other.

We are grateful, too, that there is a continuance of the help which we have received from the author in "clearing our minds of cant," or rather of that unquestioning employment of conventional explanations which is its equivalent in physical science. For example, many would even now be contentedly repeating the ordinary text-book theory of the maintenance of vibrations in an electric bell had he not awakened them to the knowledge that it was wholly beside the mark; and the statement that "a simple vibration involves *infinite* continuance, and does not admit of variations of phase or amplitude" should be very useful to many more.

The first important addition is an investigation of the resultant of a large number of vibrations whose phases are accidentally distributed. An expression is found for the probability of a resultant intensity of any specified magnitude, and the mean intensity is shown to be the sum of the intensities of the components.

Under the head of intermittent vibrations, the difference between intermittence artificially imposed upon a simple vibration and the intermittence of beats is pointed out and employed to explain some experimental results obtained by Prof. A. M. Mayer.

A section is added dealing with unstable systems with one degree of freedom, and we are reminded that the possibility of periodic motion under the operation of impressed periodic force is no proof of stability.

The maintenance of vibrations is then discussed, and it is shown that if impulses are given to a vibrating system whenever it passes through its equilibrium position their effect is mainly upon the amplitude and the period is sensibly unaltered; while if they are given at the moments when the system is at rest the effect is mainly upon the period, the vibrations being neither encouraged nor discouraged. An investigation is also given of the theory of the maintenance of vibrations by a periodic force whose frequency is double that of the maintained system, as in one form of Melde's well-known experiment and in the crispations of a liquid observed by Faraday.

Next we come to a description of some of the principal methods for the accurate determination of absolute pitch, including, of course, the author's excellent comparison of a fork with a clock pendulum by the use of the phonic wheel. An account of this instrument has been given earlier in the book, and its use with a counting apparatus certainly brings a fairly good determination within the reach of experimentalists of very moderate skill. Another interesting method which is described is that of counting the two sets of beats of overtones which are heard when two notes whose interval is an equal temperament-whole tone are sounded on a harmonium. The method depends, of course, on the fact that in *maintained* vibrations the frequencies of overtones must be accurately multiples of that of the fundamental. The necessity of this correspondence is proved later, but a hint of it might have been given here with advantage to the student; for in acoustics, as in other matters, the progress of the human mind is from the vulgar credulity of accepting all overtones as accurately harmonic through the vulgar incredulity of doubting whether any can be so.

In the general treatment of vibrating systems an investigation of the effects of imposed constraints upon the periods is given, also the theorems of Routh relating to the roots of the equation defining the periods, with an extension to unstable systems; a section dealing with the reaction upon the driving-point of a system thrown into forced vibration is also added. Under the head of transverse vibrations of strings the propagation of progressive waves along a string whose mass is supposed to be concentrated at equidistant points is considered, and it is shown that there will be no such propagation if the frequency is above a certain critical value. The reflection of waves at the junction of two strings is treated, also reflection produced by gradual change of density, and it is shown how the analogue of dispersion in optics is introduced if the string is considered to possess finite stiffness, and that in this case the ordinary formula for the intensity of the reflection must be modified. Reflection at a junction is also discussed in the case of longitudinal vibrations of bars, and the weakness of the transmitted intensity when the change of velocity at the junction is considerable is pointed out.

A summary is given of the experiments of Elsas on forced vibrations of membranes, and the march of the nodal lines with varying frequency is described. In the chapter on vibrations of plates an account is given of the author's interesting observations on the notes of bells, and his ingenious method of obtaining the nodal lines corresponding to each note by utilising the beats produced by asymmetry.

The first volume ends with two new chapters, one on the vibrations of thin cylindrical and spherical shells, and one on electrical vibrations. In the latter the theory of oscillatory currents in circuits with capacity and induction is given, and applications to Hughes' induction balance and Wheatstone's bridge are discussed. The concentration of currents of high frequency on the outside of a conductor is also worked out, and the propagation of current waves along cables is treated, justice being done to Heaviside's work on the effect of inductance in diminishing distortion in telephony. The mode of action of the telephone is also discussed, and the author's results as to the minimum audible current are given.

In the chapter on aerial vibrations, which opens the second volume, some interesting phenomena depending upon the second order of small quantities are explained,

the best known being the striations which are always seen in a Kundt's tube, and which are shown to be due to the tendency of solid particles to arrange themselves in chains perpendicular to the lines of alternating flow. An investigation of reflection at a corrugated surface follows, next comes a description of some experiments on diffraction of sound.

A general account of the mode of maintenance of the vibrations of a flute organ-pipe is then given, and attention is called to the fact that the note of the pipe when sounded is higher than the note to which it would resound, and that the difference increases with the wind pressure. The mutual influence of organ-pipes mounted side by side is considered; it has been shown how this influence militates against the successful application to pipes of Scheibler's method of determining absolute pitch. The maintenance of vibrations by increasing the pressure at a node at a time of maximum pressure and decreasing it at a time of minimum pressure by the introduction and removal of air or of heat is considered. (The student will find it a profitable mental exercise to satisfy himself that this mode of maintenance is consistent with the general principle that the force should be applied when the system passes through its equilibrium position; he may also note the analogy to the maintenance of the oscillations of a galvanometer needle by a small current suitably controlled by a reversing key). If, on the other hand, the moments of the most rapid addition and subtraction of heat are those of most rapid change of pressure, it is shown that the vibration is neither maintained nor damped, the effect being concentrated upon the period. It may be remarked that the passage from Newton's theory of sound to Laplace's, or *vice versâ*, in calculating the pitch of a pipe is a case exactly in point. Among the more important applications of maintenance by heat, singing flames and Rijke's sounding tubes are treated, also the sounds sometimes heard when a bulb has just been blown at the end of a glass tube. The maintained vibration of mercury contained in a U-tube, one end of which is connected with a heated bulb, is a visible example of the latter phenomenon, and the principle has been successfully applied to small hot-air motors. A short account of the conditions of maintenance in reed instruments is also given.

Under the head of fluid friction, Kirchoff's investigation of the effects of viscosity and heat-conduction upon the propagation of sound finds a place, and the behaviour of very narrow tubes towards sound is applied to the question of reflection at a porous wall. The theory of the vortices observed by Dvořák in Kundt's tubes is also investigated.

Four new chapters complete the book. The first deals with liquid waves under gravity and cohesion; in it are treated, among other matters, the determinations of surface tension by the measurement of ripples and by observations on the vibrations of a liquid cylinder, the importance of the latter method in permitting the examination of a newly-formed surface being pointed out. The instability of a liquid jet, the behaviour of drops in collision, and the vibrations of detached drops are also considered. The next chapter, on vortex motion, gives an investigation of the instability of stratified motion in a fluid, and its application to the theory of sensitive flames and smoke-jets. Bird-calls and aeolian tones are also shortly treated, some considerations as to pitch being deduced from the principle of dynamical similarity. A brief account of the propagation of vibrations in elastic solids follows, and the last chapter deals with facts and theories of audition. In it the author's experiments on the minimum amplitude of sound waves consistent with audibility are described, a discussion of Ohm's law and its exceptions is given, and, by the application of dynamical principles to the internal vibrators which on Helmholtz's theory form the analysing mechanism of the ear, the bearing of the degree of damping in these vibrators on the origin of dissonance, on the possibility of accurately judging pitch, and on the remarkable results of Kohlrausch as to the exceedingly small total number of vibrations requisite for the appreciation of a definite pitch, is explained. Finally, the conflicting views which have been held as to combinational tones, the perception by the ear of the phase relationship of two tones, and the characteristics of vowel sounds are discussed.

In NATURE of December 12, 1878, Prof. Helmholtz, after suggesting some of the above problems, wrote of the first edition of this book: "Lord Rayleigh certainly deserves the thanks of all physicists and students of physics; he has rendered them a great service by what he has done hitherto. But I believe I am speaking in the name of all of them if I express the hope, that the difficulties of that which yet remains will incite him to crown his work by completing it." This has now been done, but the only voice which could without impertinence utter praise is, alas, silent. L. R. W.

## *HAWKS AND HAWKING.*

*Hints on the Management of Hawks* (Second Edition); *to which is added Practical Falconry Chapters, Historical and Descriptive.* By J. E. Harting. 8vo. Pp. viii + 268, illustrated. (London: H. Cox, 1898.)

MR. HARTING is such an authority on the art of hawking, and is, furthermore, such an excellent field naturalist, that it was only to be expected his volume on this branch of sport would reach a second edition. But, as the author states in his preface, the additions to the new edition, both as regards letter-press and illustrations, are so extensive as almost to give it a claim to rank as a new work.

From all points of view, management, rearing, training, and use in the field, as well as regards their natural history, Mr. Harting appears to have furnished all that there is to be told concerning hawks and hawking; and if the votaries of this sport are not satisfied with his efforts, they must indeed be hard to please. Some of the most interesting chapters in the volume are those relating to the now obsolete kite-hawking and heron-hawking; the one of which has ceased to exist from the practical extinction of the quarry, and the other from the altered physical conditions of the country. In all portions of his subject the author owes much to the artist, some of the illustrations being really exquisite, especially those from the pencil and brush of Mr. Lodge. What, for instance, can be more striking than the contrast between the figure of

the heron sailing gracefully at ease on p. 153, and the same bird after being stricken by the peregrine two pages later? It is, of course, a drawback that so many of the illustrations depict birds and other animals in postures of pain, but this is inseparable from the subject. While commending the illustrations as a whole, a few, like the one of the hobby, appear to have been printed from somewhat worn blocks.

To those not conversant with the sport, it may come as a matter of surprise that so many species of the *Falconidæ* are trained in various countries for hawking; these ranging in size from the merlin and the hobby to the golden eagle, and their quarry from the snipe and the lark to the roe-deer, or even the wolf. As hawking with eagles is unknown in western Europe, the portion of Mr. Harting's work relating to that branch of the sport cannot fail to prove generally interesting. It would, of course, have been mere waste of space if the author had attempted to give full descriptions of all the various hawks and falcons employed in the sport; but as there is some considerable degree of confusion in regard to the species of eagles trained for hawking in Turkestan and other parts of the Russian empire, he has done well in giving a full discussion on the question. And here Mr. Harting, as usual, displays an intimate acquaintanceship with the zoology of the subject and the literature relating thereto. It appears from these observations that the bird commonly employed in Turkestan, where it is known as the berkut, is the golden eagle, but that other species, such as the Imperial eagle, are likewise trained; while it is stated that occasionally sea-eagles of two species are made use of.

Although it is by no means meant to displace the older and more bulky treatises, Mr. Harting's little volume ought to give the beginner all the information he requires for setting up a hawking establishment, either on a large or a small scale, and it will doubtless aid in maintaining interest in an ancient and exciting sport which ought by no means to be allowed to fall into neglect. R. L.

## *THE RUDIMENTS OF PHYSICS AND CHEMISTRY.*

*General Elementary Science.* Edited by William Briggs, M.A., F.C.S., F.R.A.S. Pp. viii + 390. (London: W. B. Clive.)

*Elementary General Science.* By A. T. Simmons, B.Sc., and Lionel M. Jones, B.Sc. Pp. viii + 328. (London: Macmillan and Co., Ltd., 1898.)

THE new regulations for the matriculation examination of the University of London provide that on and after next January all candidates must present themselves for examination in the rudiments of physics and chemistry included in a syllabus under the head of "General Elementary Science." Following the "stream of tendency" of science teaching at the present time, the examiners announce in a note prefixed to their syllabus that the subjects "will be treated wherever possible from an experimental point of view. Candidates will be expected to have performed or witnessed simple experiments in illustration of the subjects mentioned in this syllabus." By making this announcement, the University of London has shown its intention to encourage the introduction and extension of practical methods of science teaching into our secondary schools; and there can be no doubt that if the examiners insist upon the possession of knowledge gained by demonstration and experience, instead of the transient information acquired by reading, their action will be the means of greatly improving the character of the scientific instruction given in the smaller secondary schools. Hitherto, many schools of this character have trained candidates for matriculation without showing them a single scientific experiment; the new curriculum will, however, make this state of things impossible, and will therefore be the means of increasing the efficiency of secondary schools.

The two volumes under notice have both been prepared to meet the new requirements of the London University, and they exemplify the old saying that "there is a right and a wrong way to do everything." In the volume edited by Mr. Briggs little attempt has been made to produce a book in the spirit of the new syllabus. Neither the first section of the book dealing with mechanics, nor the second section dealing with heat, light and electricity, can be regarded in any way as likely to lead to a practical acquaintance with scientific facts; they both contain a large amount of information concisely expressed, but the information is of precisely the same kind as appears in books prepared for students working under the old matriculation regulations. In other words, more attention is paid to arithmetical gymnastics in the regions of mechanics and physics than to experiment. The section on chemistry is better done, nearly one hundred experiments being described in it; but it is unequal in treatment, and contains too many equations and formulæ for a beginner in chemistry to understand. As a whole, the book is unsatisfactory; it contains information to be read and learnt by the student instead of descriptions of experiments to be performed, and though it may be useful as a training in providing exercises in physical arithmetic, it has no educational value.

The book by Messrs. Simmons and Jones is of quite a different character from that compiled under Mr. Briggs's direction. It contains an admirable course of practical work covering all the principles of mechanics, physics, and chemistry included in the new subject for London matriculation. No less than 310 experiments are described, and they are not only practicable, but can also be performed with simple apparatus. Many of the experiments, such as the pin-methods of proving the laws of reflection and refraction of light, the simple experiments on voltaic cells, and the method for heating a solid in a closed volume of gas (p. 258), are distinctly good, while most of them furnish evidence that the authors are describing matters of personal experience, and not hypothetical arrangements. The experiments alone provide a valuable set of practical exercises in elementary physics and chemistry, and if the descriptive text is read in connection with them, the student will be given a sound basis of scientific knowledge. The volume contains an instructive course of work which will be of real assistance to both teachers and pupils in schools where elementary science is taught.

## OUR BOOK SHELF.

*The Flora of Perthshire.* By F. Buchanan White, M.D. Edited by James W. H. Trail, A.M. Pp. lxi + 407; with a portrait of the author, and a map of the county. (Edinburgh: W. Blackwood and Sons, 1898.)

IT had long been known that the late Dr. Buchanan White was preparing a "Flora of Perthshire," when his death in 1894 arrested the progress of the work. The manuscript was then put into the hands of Prof. J. W. H. Trail, who has edited it.

The book is well arranged; clear, perhaps at the expense of detail of secondary value. For such we must consider the long strings of exact localities, common in such works, in this one usually summed up into short general statements. There is no doubt that the book has been carefully planned, that its aims are broad, and that all matter not of real concern has been excluded. Here and there we find critical remarks, or statements of the variability of the species. These are interesting; but the great feature of the book is in the new data relating to the altitudes reached by plants. It will be noticed that the upper limits of species usually are in excess of those given more than half a century ago by H. C. Watson for the Eastern Grampians; also that they differ in different parts of the county. So many of the glens of Perthshire run east and west, and gather from this cause heat in a way which glens open to north winds do not. Perhaps this accounts for the difference. The subject is one yet wanting many observations.

The manuscript appears to have been less complete when it changed hands than was thought. As a result we see a slight want of uniformity. One, who, like Dr. Buchanan White, united into a single species *Viola tricolor* and *arvensis*, would not be likely to follow the division of the genus *Hieracium* to the extreme. It is, indeed, a cause for regret that the author left no outline of the introduction, which he could so well have written. The essay reprinted in its place only deals with one question; and for others, which would have found a place, we must seek in his published papers. A list of these papers is incorporated in the book with a memoir of the author. I. H. B.

*Manual Training: Woodwork. A Handbook for Teachers.* By George Ricks, B.Sc. Lond. Pp. 187. (London: Macmillan and Co., 1898.)

WORKING in wood with carpenter's tools is now provided for in the curriculum of many public elementary schools, as well as in technical schools, with the object of training the manual and visual faculties to act in connection with the mental. Used with care, this manual work becomes a valuable educational agent, but unless it is carried out on an orderly system it degenerates into mere tinkering. Mr. Ricks has kept the true aims of manual training well in mind in the preparation of his work. "Our aims," he says, "must be wholly educational. We must arouse interest and quicken intelligence. We must develop and strengthen habits of attention, industry, and perseverance. We must train the eye to accurate observation, and the hand to dexterity in execution." The aspirations are commendable, and the author's experience has enabled him to develop a practicable scheme of work in which it is shown how they can be carried into effect. Beginning with a chapter on drawing as a factor in manual training in wood, this is shown to be the fundamental basis of the work. The necessity of exact measurement in all work, and the use of working drawings, is insisted upon; and rightly, for without drawings to scale, exact and intelligent handiwork is scarcely possible. An instructive chapter is given on the various woods used as timber, their structure, growth, preparation and properties. We notice that in explaining specific gravity with reference to timber, Mr. Ricks adopts as his standard the weight of a gallon of water (10 lbs.), the specific gravity of oak thus being 8, of beech 7, and so on. This is convenient for some reasons, but it is apt to create confusion; and if the child afterwards learns that the specific gravity of iron is 7, he will wonder whether the metal or the wood is the heavier.

After the preliminary chapters and exercises come systematic work on the use of carpenters' cutting tools, simple workshop operations, and bench work from working drawings. The book shows evidence of thought and experience, and should prove of service to teachers of manual training.

*A Description of Minerals of Commercial Value.* By D. M. Barringer, A.M., LL.B. Pp. 168. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1897.)

A SET of tables for the identification of minerals is very useful to mineralogists and others; and as this note-book contains such tables and little else, it is welcome. The information is conveniently arranged so that it can be quickly referred to, nevertheless there are so many omissions that the book cannot be used to the exclusion of other books on mineralogy, and consequently its chief claim to consideration, that of saving time, falls to the ground. For example, under the heading of lead ores, only galena and cerussite are mentioned, although six compounds of bismuth and five of antimony are described. It may be hoped that Mr. Barringer will see his way to making his book more complete in future editions.

*Ludwig Otto Hesse's Gesammelte Werke, herausgegeben von der Mathematisch-Physikalischen Classe der Königlich Bayeirschen Akademie der Wissenschaften.* (München, 1897.)

COLLECTED into one large quarto volume of over 700 pages, ranging in date from 1838 to 1874, we find here the mathematical articles in which Hesse laid the foundations of the modern analytical theory of Solid Geometry, with the details of which we are familiar in the treatise of Dr. Salmon.

The subjects discussed are all of geometrical interest, even where the title may indicate an algebraical flavour, as the analytical developments are such as arise from the investigations of geometrical properties. We may instance the researches on the Functional Determinant, called after the inventor the Hessian, which has played so important a part in the hands of Sylvester and Cayley. A biography, based on a memorial lecture by Prof. G. Bauer, completes the volume; in it a characteristic remark of Sylvester is embodied. It is interesting to learn that Jacobi utilised Hesse as a collaborator in developing the theory of the Attraction of Ellipsoids.

G.

*Krömsköp Colour Photography.* By Frederic Ives. Pp. xvi + 80. (The Photochromoscope Syndicate, Ltd., 1898.)

MOST of our readers have either seen or heard of Mr. Ives' process of colour photography, known now under the name of the Krömsköp System. In the small book we have before us, Mr. Ives gives the reader a concise account of the principles involved in this method of producing coloured pictures, describing and explaining at the same time the construction and action of the various krömsköpes which are now being manufactured. This information will be found very serviceable to any one who wishes to attain the maximum of efficiency in this branch of photography. In addition to the above instructions, reference is made to the literature on the subject, and various extracts relating to the nature, theory, &c., of colour from writings of well-known men are inserted.

## 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.*]

### Liquid Hydrogen.

THE letter of W. Hampson, which appears in your issue of May 26, can only mean by implication to charge me with having utilised without acknowledgment an idea of his, conveyed through a third party, in my paper on the liquid hydrogen jet, published in 1895. Such a suggestion is absolutely without any foundation in fact. My results would have been attained had Dr. Hampson never existed, just as they have been developed. He certainly in no way contributed directly or indirectly to the success of those hydrogen experiments. Had Mr. Hampson attempted to consult me as to his plans, I should have declined to entertain them, just as I had treated, under similar circumstances, distinguished colleagues engaged in low temperature research; for no other reason than to avoid the possibility of controversy. Further, I never would have allowed my assistant either to consider or advise on the projected scheme of some other person about to engage in the same field of investigation, simply because such a position would be quite unprecedented, and certain to result in misunderstandings. W. Hampson is the only inventor or investigator who has not in a straightforward way approached me directly in such matters, and it is no excuse for his dubious course of action to say he had an "introduction." My assistant has explained his position in the matter in letters addressed to "*Engineering*" within the last few weeks. The paper of 1895, on gas jets containing liquid, has been a fruitful source of recrimination. No less than three patentees of low temperature apparatus—viz. Solvay, Linde and Hampson—have each recognised in its contents part of the essential subject-matter of their respective patents. It will be for these gentlemen to fight the matter out. Suffice it to say, that the statements made in my paper of 1895 remain a correct record of facts. Further remarks on the subject can be found in the Society of Arts *Journal* for March 1898; made during the course of a discussion on the Linde process.

The Hampson patent was not published before April 1896, and the first exhibition of the working apparatus took place towards the end of March of the same year; or some three months subsequent to my Chemical Society paper. Mr. Hampson declares in his letter that he "*was afterwards the first in this country to liquefy air and oxygen without employing other refrigerants.*" Now, in my paper of 1895 the following passages occur:—"With such a simple apparatus and an air supply at 200 atmospheres, *with no previous cooling*, liquid air begins to collect in about five minutes, but the liquid jet can be seen in between two and three minutes." "In the above experiments air is taken *at the ordinary temperature*, which is a little above twice its critical temperature, and is partially transformed in a period of time, which in my experiments has never exceeded ten minutes, simply and expeditiously into the liquid state at its boiling-point—194°, or a fall of more than 200° has been effected in this short period of time." J. DEWAR.

May 30.

### Printed Matter and Photographic Plates.

IN connection with this subject it does not appear to be generally known that photographic negatives, after they have been developed and fixed, and especially if they have been intensified by means of the bi-chloride of mercury and ammonia process, are often strongly impressed by prolonged contact with printed matter. I first observed this many years ago, and have a large number of negatives in my possession which show the effect very strongly. I enclose a photographic negative taken by myself in 1882, which has remained since 1886 wrapped up in the accompanying advertisement sheet of the *Electrician*. As will be observed, the greater portion of the print in contact with the film is clearly legible. It is, however, worthy of note that it does not appear to be the printer's ink in this case that has produced the chemical action, but rather the paper itself, or some ingredient therein. Those portions of the film protected from contact with the paper by the ink have retained their original colour, while the other portions not so protected have become very considerably bleached. The printing on the side of the paper removed from the film does not seem to have had any effect.

It has probably been noticed by others that ordinary albumenised and sensitised photographic paper is also strongly affected in the course of time by contact with printed matter. In this case, also, the printing comes out as white lettering upon a darker ground. A. A. C. SWINTON.

### The Transport of Live Fish.

YOUR readers may be interested to know of an experiment with the transport of live fish I am making, and so far successfully. I left Brisbane on April 16, taking with me four specimens of Ceratodus. This remarkable fish is doubtless sufficiently well known to your subscribers to render a description on my part unnecessary. D. O'CONNOR.

S.S. *Duke of Devonshire*, Colombo, May 16.

## CEREMONIAL DANCES OF THE AMERICAN INDIANS.

READERS of NATURE do not need to be reminded of the important work being done by the Bureau of American Ethnology, which is conducted under Act of Congress "for continuing ethnologic researches among the American Indians under the direction of the Smithsonian Institution." The value of the researches that are being carried on, and the results of which are issued in the form of annual reports and bulletins, cannot be over-estimated; for the Indian customs and beliefs, which form the subject of the majority of the papers, are not destined to survive for many years. The Indian reserves are gradually being curtailed, the Indians themselves are slowly becoming civilised, and this process is naturally attended with change and decay of their primitive ceremonial and belief. It must be admitted that the Indian nature is slow to change, and retains its tribal instincts under a veneer of civilisation. In fact, the case of a young Arapaho Indian, who, though speaking good English and employed as a clerk in a store, thought it but natural that he should join his tribe in dancing the sun-dance for three days and nights without food, drink or sleep, is far from exceptional. But the change, though gradual, is constant, and at no distant period the American Indian will have ceased to furnish the anthropologist with opportunities for the study of primitive man. When that time arrives the value of these reports, compiled by trained observers in accordance with a scientifically organised plan, will be unique.

The present article is concerned with three of the papers published in the fourteenth, fifteenth and sixteenth annual reports of the Bureau. These papers may be classed and considered together, as they deal with certain ceremonial dances still practised by many of the Indian tribes. The longest of the papers is that entitled "The Ghost-dance Religion and the Sioux Outbreak of 1890," which is contributed by Mr. James Mooney, and is published in a volume by itself as Part ii. of the fourteenth annual report. The underlying principle of the ghost-dance is the doctrine that at some future time the whole Indian race, whether living or dead, will be reunited in a life upon earth untroubled by the fear of death, hunger, or disease. Most Indians hold that this change will be brought about by spiritual powers who will require no assistance from men, but at times of discontent medicine-men have sought to anticipate the Indian millennium by preaching a crusade against the further encroachments of the white population, and persuading their fellow tribesmen that in this resistance they will have the active support of their dead ancestors and relatives. Such a revival took place in 1890 among the Sioux, the largest and strongest Indian tribe in the United States. The cause of the outbreak may be traced to irritation at the encroachments made on their reserve

and to the neglect of the Government to carry into effect their promises of furnishing supplies. As the area of their hunting-grounds was diminished, they had to depend for subsistence on their cattle and crops and on the rations allowed them by Government. In 1888 their cattle suffered from disease, in the two following years their crops were a failure, and their rations of beef were diminished by half. In 1890 they were on the brink of starvation, and ready to listen to the words of a messiah. In fact there is no doubt that hunger was the real cause of the rebellion, and not the ghost-dance itself, though this ceremonial was adopted as the means of propagating the crusade. That resistance to the whites had no part in the original doctrine of the dance is proved by the fact that in many other tribes which practise it no outbreak has occurred. The Sioux rebellion was put down after a short though costly war, and Mr. Mooney has given a detailed account of the campaign which was brought to a close by the battle at Wounded Knee. We are not here concerned with this somewhat melancholy chapter of Indian history, but will confine ourselves to the interesting account he has given of the ghost-dance with which the rebellion is generally connected.

No one is better qualified to give an account of this ceremony than Mr. Mooney, for he has had exceptional opportunities for studying it. From 1890, when the ghost-dance was beginning to attract attention, to the early part of 1894, he has studied it on several expeditions, his actual investigations among the Indians extending over a period of twenty-two months and entailing some 32,000 miles of travel. Not only has he frequently seen the dance performed, but he has taken part in it himself among the Arapaho and Cheyenne, and by means of his kodak and camera has obtained some valuable photographs. He also visited Wovoka, the messiah who inaugurated the recent revival, and by gaining the confidence of the Indians obtained from a Cheyenne Indian, Black Short Nose, a copy of the messiah's message, embodying the doctrine of the ghost-dance, which he had previously sent to the Cheyenne and Arapaho tribes. Mr. Mooney has given a very full and interesting account of the ceremony of the ghost-dance, but here we have not space for more than a sketch of its most striking features.

The place chosen for the dance is frequently consecrated by the sprinkling of sacred powder. Seven priests lead the dance, and seven women are sometimes added as leaders, the number seven being sacred with most Indian tribes. Those selected as leaders receive two feathers of the crow, the sacred bird of the ghost-dance, or one of the eagle, which is sacred with all Indians; and these feathers they thrust in their hair. Nearly all the dancers wear feathers, the painting and ornamenting of which is attended with great ceremony; while the faces of the dancers are painted with elaborate designs in red, yellow, green and blue. The dance generally begins in the middle of the afternoon, the leaders walking to the spot selected, where they form a small circle facing inwards and joining hands. Then without moving they sing the opening song in a soft undertone, and, having sung it once, repeat it, raising their voices to their full strength, and slowly circling round from right to left. This process is repeated with different songs. Gradually the people of the tribe gather round, and one after another joins the circle until any number, from fifty to five hundred, men, women and children, are in the dance. The object aimed at by all the dancers is to fall into a sleep or trance in which they will see their dead relatives and converse with them. Sometimes a dancer will work himself into the trance-state solely by the influence of the movements of the dance and the singing, but the dancers are generally helped by the medicine-men standing within the circle, who, in Mr. Mooney's opinion, unconsciously exercise hypnotic influence. The first symptom of the trance-state is a slight muscular tremor, and, as soon as a medicine-man perceives this he fixes his eyes on the dancer, uttering sharp exclamations and twirling a feather or small cloth rapidly in his face. Soon the dancer loses control of himself, staggers and breaks away from the ring, which closes up again. The medicine-man continues his passes, generally keeping the sun full in the face of the dancer, who becomes rigid and finally falls to the ground unconscious. The trance lasts sometimes ten minutes, sometimes for hours; for those who continue dancing are careful not to disturb any dancer in the trance. As Mr. Mooney has taken part in the dance himself, he has observed the various stages in the hypnotic trance, as will be seen from the following quotation:

"From the outside hardly anything can be seen of what goes on within the circle, but being a part of the circle myself I was able to see all that occurred inside, and by fixing attention on one subject at a time I was able to note all the stages of the phenomenon from the time the subject first attracted the notice of the medicine-man, through the staggering, the rigidity, the unconsciousness, and back again to wakefulness. On two occasions my partner in the dance, each time a woman, came under the influence, and I was thus enabled to note the very first tremor of her hand and mark it as it increased in violence until she broke away and staggered toward the medicine-man within the circle."

In addition to his observations of the actual ceremony of the ghost-dance, Mr. Mooney has made very careful studies of the songs employed by the dancers. As with church choirs in civilised countries, the leaders of the dance hold numerous rehearsals of the songs which are to be employed at the next dance; for though each tribe has certain songs which form a regular part of the ceremony, new ones are constantly being added by those who have experienced the trance. Mr. Mooney was often present at these rehearsals, and was thus enabled to take down many of the songs, and some of the airs he has put to music. In fact Mr. Mooney has treated his subject exhaustively, and has prefaced it with a discussion of the various Indian revivals due to prophets who preceded Wovoka. His paper, which runs into some 500 quarto pages, is full of material which will be of the greatest value to the anthropologist and student of religion.

Two somewhat shorter papers on certain ceremonial dances among the Indians are contributed by Mr. J. W. Fewkes to the fifteenth and sixteenth annual reports of the Bureau, which were issued during the course of last year. Like Mr. Mooney's memoir, Mr. Fewkes' papers also are of great value, as they are based on personal observations; he does not, however, enter at any great length into the doctrines which underlie the ceremonials he describes. His paper in the fifteenth annual report is entitled "Tusayan Katcinas," and in it he has given a careful record of the Katcina ceremonials as he saw them performed in the Hopi village of Walpi in Tusayan; his paper is the result of observations made by himself and by the late Mr. A. M. Stephen during the years 1890 to 1894. The word *Katcina* has a twofold meaning. It is used as a name for certain supernatural beings, subordinate to the greater gods, who are impersonated in Hopi ceremonials by men wearing masks; it is also employed as a name for the dances in which these men take part. The Katcina dances are carried on at fixed times during the period between the winter and the summer solstices, and their chief point of difference from the ceremonies performed by the Hopi during the rest of the year consists in the presence of the Tcukú-wympkiyas, or masked figures; the men who wear the masks or helmets are supposed to be transformed for the time into the deities they represent. The times for the ceremonies are determined by the priests of the tribe by observing the points on the horizon where the sun

rises and sets (see p. 111). Of the Katcina ceremonials the most elaborate is that termed Powámû. Extensive preparations are made before the dance, the old paint left from previous occasions being scraped off the masks, which are then carefully redecorated and ornamented with clusters of feathers. The dancers also decorate themselves, using iron oxide for painting their legs, knees and waists a pale red. On the occasion Mr. Fewkes describes, preliminary ceremonies took place at Walpi for a week before the first ceremonial day of the Powámû, in which masked men from the neighbouring villages of Tewa and Hano took part. We have not space here to enter into any detailed account of the elaborate ceremonials performed on this and the succeeding days, including songs, a kind of primitive drama, dances, ceremonial smoking, flagellations, sprinkling of liquids, casting of meal and pollen into liquids, the making of small dolls or images, &c. Mr. Fewkes has not attempted to explain the theoretical significance of the ceremonies, but has contented himself with accurately describing them as they were performed. We may note, however, that in his subsequent paper on the snake-dance he throws out the suggestion that these Katcina ceremonies are to be traced to a totemic origin.

Mr. Fewkes' paper contributed to the sixteenth annual report is entitled "Tusayan Snake Ceremonies," and is based on a comparative study of the snake-dance, which is now known to be performed at five Tusayan villages. At Walpi it is celebrated in its most elaborate form, and lasts for twenty days, though only on nine days do ceremonies actually take place. Sixteen days before the snake-dance occurs it is formally announced at sunrise, the chiefs of the village having been engaged in ceremonial smoking during the previous night. For the next seven days no ceremonies are performed, but on the eighth day the assembly takes place, and for nine days secret ceremonies continue, which close at sunset on the ninth day with a dance, in which snakes are carried in the mouths of the dancers; the four following days are days of purification. Mr. Fewkes admits that the meaning of the snake-dance is obscure, but inclines to the belief that the elaborate ritual is performed for two main objects—the making of rain and the growth of corn. He does not consider that the dance is in any way connected with actual snake-worship.

We have said enough to indicate the great interest of these papers, not only to the student of Indian ritual, but to anthropologists generally. If we may make one criticism, it is that in places they would, perhaps, have gained a little by compression.

## *ON A NEW CONSTITUENT OF ATMOSPHERIC AIR.*[1]

THIS preliminary note is intended to give a very brief account of experiments which have been carried out during the past year to ascertain whether, in addition to nitrogen, oxygen, and argon, there are any gases in air which have escaped observation owing to their being present in very minute quantity. In collaboration with Miss Emily Aston we have found that the nitride of magnesium, resulting from the absorption of nitrogen from atmospheric air, on treatment with water yields only a trace of gas; that gas is hydrogen, and arises from a small quantity of metallic magnesium unconverted into nitride. That the ammonia produced on treatment with water is pure has already been proved by the fact that Lord Rayleigh found that the nitrogen produced from it had the normal density. The magnesia, resulting from the nitride, yields only a trace of soluble matter to water, and that consists wholly of hydroxide and carbonate. So far, then, the results have been negative.

Recently, however, owing to the kindness of Dr. Hampson, we have been furnished with about 750 cubic centimetres of liquid air, and, on allowing all but 10 cubic centimetres to evaporate away slowly, and collecting the gas from that small residue in a gas-holder, we obtained, after removal of oxygen with metallic copper and nitrogen with a mixture of pure lime and magnesium dust, followed by exposure to electric sparks in presence of oxygen and caustic soda, 26·2 cubic centimetres of a gas, showing the argon spectrum feebly, and, in addition, a spectrum which has, we believe, not been seen before.

We have not yet succeeded in disentangling the new spectrum completely from the argon spectrum, but it is characterised by two very brilliant lines, one almost identical in position with $D_3$, and almost rivalling it in brilliancy. Measurements made with a grating of 14,438 lines to the inch, kindly placed at our disposal by Mr. E. C. C. Baly, gave the following numbers. *all four lines being in the field at once:—*

| | | |
|---|---|---|
| $D_1$ | ... ... | 5895·0 |
| $D_2$ | ... ... | 5889·0 |
| $D_3$ | ... ... | 5875·9 |
| $D_4$ | ... ... | 5866·65 + 1·7 to correct to vacuum. |

There is also a green line, comparable with the green helium line in intensity, of wave-length 5566·3, and a somewhat weaker green, the wave-length of which is 5557·3.

In order to determine as far as possible which lines belong to the argon spectrum, and which to the new gas, both spectra were examined at the same time with the grating, the first order being employed. The lines which were absent, or very feeble, in argon, have been ascribed to the new gas. Owing to their feeble intensity, the measurements of the wave-lengths which follow must not be credited with the same degree of accuracy as the three already given, but the first three digits may be taken as substantially correct:—

| | | | | | |
|---|---|---|---|---|---|
| Violet | ... ... | 4317 | Blue | ... ... | 4834 |
| ,, | ... ... | 4387 | ,, | ... ... | 4909 |
| ,, | ... ... | 4461 | Green | ... ... | 5557·3 |
| ,, | ... ... | 4671 | ,, | ... .. | 5566·3 |
| Blue | ... ... | 4736 | Yellow | ... ... | 5829 |
| ,, | ... ... | 4807 | ,, | ... ... | 5866·5 |
| ,, | ... ... | 4830 | Orange | ... ... | 6011 |

Mr. Baly has kindly undertaken to make a study of the spectrum, which will be published when complete. The figures already given, however, suffice to characterise the gas as a new one.

The approximate density of the gas was determined by weighing it in a bulb of 32·321 cubic centimetres capacity, under a pressure of 521·85 millimetres, and at a temperature of 15·95°. The weight of this quantity was 0·04213 gram. This implies a density of 22·47, that of oxygen being taken as 16. A second determination, after sparking for four hours with oxygen in presence of soda, was made in the same bulb; the pressure was 523·7 millimetres, and the temperature was 16·45°. The weight was 0·04228 gram, which implies the density 22·51.

The wave-length of sound was determined in the gas by the method described in the "Argon" paper. The data are:—

| | i. | ii. | iii. |
|---|---|---|---|
| Wave length in air ... ... | 34·17 | 34·30 | 34·57 |
| ,, ,, gas ... ... | 29·87 | 30·13 | |

Calculating by the formula

$$\lambda^2_{air} \times \text{density}_{air} : \lambda^2_{gas} \times \text{density}_{gas} :: \gamma_{air} : \gamma_{gas}$$
$$(34·33)^2 \times 14·479 : (30)^2 \times 22·47 :: 1·408 : 1·666,$$

it is seen that, like argon and helium, the new gas is monatomic and therefore an element.

[1] Paper to be read before the Royal Society on June 9 by Prof. William Ramsay, F.R.S., and Morris W. Travers. Received by the Society June 3.

From what has preceded, it may be concluded that the atmosphere contains a hitherto undiscovered gas with a characteristic spectrum, heavier than argon, and less volatile than nitrogen, oxygen, and argon ; the ratio of its specific heats would lead to the inference that it is monatomic, and therefore an element. If this conclusion turns out to be well substantiated, we propose to call it "krypton," or "concealed." Its symbol would then be Kr.

It is, of course, impossible to state positively what position in the periodic table this new constituent of our atmosphere will occupy. The number 22·51 must be taken as a minimum density. If we may hazard a conjecture, it is that krypton will turn out to have the density 40, with a corresponding atomic weight 80, and will be found to belong to the helium series, as is, indeed rendered probable by its withstanding the action of red-hot magnesium and calcium on the one hand, and on the other of oxygen in presence of caustic soda, under the influence of electric sparks. We shall procure a larger supply of the gas, and endeavour to separate it more completely from argon by fractional distillation.

It may be remarked in passing that Messrs. Kayser and Friedlander, who supposed that they had observed $D_3$ in the argon of the atmosphere, have probably been misled by the close proximity of the brilliant yellow line of krypton to the helium line.

On the assumption of the truth of Dr. Johnstone Stoney's hypothesis that gases of a higher density than ammonia will be found in our atmosphere, it is by no means improbable that a gas lighter than nitrogen will also be found in air. We have already spent several months in preparation for a search for it, and will be able to state ere long whether the supposition is well founded.

## *LYON PLAYFAIR.*

IT is now fifty-three years since I first met Playfair. He was President of the Chemical Section of the British Association in 1855 at Glasgow. Frankland and I were the Secretaries. Liebig attended the meeting, and stayed with his friend Walter Crum, and it was appropriate that Playfair, who was one of Liebig's most promising English pupils, should preside over a meeting of chemists at which his German master was present. Playfair then was in the height of his activity. His addresses in 1855, and again thirty years later, when he was President of the Association, although not containing much of striking originality, were clear, luminous expositions, as indeed were his speeches in the House of Commons, and latterly in the House of Lords.

In the year 1834, when he was fifteen years of age, he began to study chemistry under Graham, who was then professor at the Andersonian at Glasgow. After a short visit to his parents in India, where his father was Chief Inspector-General of Hospitals in Bengal, he followed Graham to London, and in 1838 went to Giessen to study under Liebig, then the rising star in the chemical firmament. There he became not only Liebig's pupil, but his friend ; he worked at organic chemistry, publishing in 1841 his first paper on a new fatty acid contained in the butter of nutmegs, and in the following year he published an abstract of Liebig's report on organic chemistry as applied to chemistry and pathology. On his return to England, through Liebig's influence with James Thomson, a man who even in those early days saw the value of science as applied to industry, Playfair was appointed as chemist to the well-known calico printworks at Clitheroe. After a few years he exchanged this position for a more suitable one in the Royal Institution, Manchester, where he found more congenial society in the friendship of Dalton and Joule. It was whilst he was in Manchester that Playfair induced Bunsen, who had just perfected his process of gas analysis, to come over to Alfreton to collect the gases of the blast furnace. The results of this visit furnished the first evidence concerning the chemical changes occurring in the blast furnace, and were published in the British Association Reports for 1845.

It was in conjunction with Joule that Playfair's name is best known as an investigator, several memoirs on atomic volume and specific gravity appearing in their joint names in the Chemical Society's *Journal*, the most important result of which was the discovery of the well-known laws relating to the disappearance of the volume of the acid and of the base of crystals of hydrated salts. If Playfair had remained under the influence of Dalton and Joule, his record of original work would probably have been much longer than it is, but his activity was destined to be turned into other channels. Sir Robert Peel, who had heard of Playfair and formed a high opinion of his powers, appointed him on a Commission to inquire into the sanitary condition of large towns, and such matters he found more to his taste than purely scientific research. In recognition of the services which he performed on this Commission, he was appointed chemist to the Museum of Practical Geology. It was here that he carried out his best-known research, namely that on the nitro-prussides, a new class of salts characterised by giving a splendid purple colour with alkaline sulphides. A year or two later preparations were being made for the first great exhibition of 1851, and Lyon Playfair was chosen as a competent man to visit the manufacturing districts to secure the co-operation of persons interested in manufactures and commerce. This somewhat difficult task he accomplished with tact and success, and later on he took a leading part in the classification and arrangement of the exhibits, and the appointment of the juries was mainly left in his hands. A good story is told of his *savoir faire* at the opening of the exhibition, where it was of course desirable to have all nations represented. A very gaily-dressed Chinaman found himself in the procession side by side with the Archbishop of Canterbury, and was about to be removed to some less conspicuous position when the Prince Consort desired he might be left where he was. Playfair's efforts had been successful in obtaining the recognition of China, for, in the absence of any yellow-jacketed mandarin as ambassador, Playfair had got hold of a Chinese ticket-collector of a junk then being exhibited in the docks. Not only during the existence of the exhibition, but even up to the present time, Playfair left his mark on the results of that exhibition, for he was the guiding hand in the numerous and complicated transactions which have taken place since the purchase of the South Kensington Estate by the Royal Commissioners. The foundation of the Science Scholarships, which are now proving such a boon to the aspirants to scientific fame, was entirely Playfair's idea. Working in connection with the exhibition of 1851 brought him into personal contact with the late Prince Consort, in whose household he accepted a post, and it was to Playfair that the Prince was much indebted in his various schemes of land improvement and other scientific matters. A few years later, when the Science and Art Department was put upon a new footing, Playfair was appointed joint secretary with Sir Henry Cole ; this partnership, as might be foreseen from the character of the two men, did not last long, and Playfair became Inspector-General of Government Museums and Schools of Science. A more permanent and satisfactory position was, however, now open to him. In 1856 he succeeded Gregory as Professor of Chemistry in the University of Edinburgh, and in this position he remained for thirteen years, and the wags said that he was the only Scotchman who, having tasted the flesh-pots of Egypt,

was ever known to return to the land of cakes not plum —but oats.

As Davy's greatest discovery was Faraday, so it may be said that Playfair's was Dewar, who acted for some time as his assistant. The five months' duties of the Edinburgh chair did not by any means exhaust his energies. On the occasion of the second great exhibition of 1862, his services were again called for, and in 1868 he was returned to Parliament in the Liberal interest as representing the Universities of Edinburgh and St. Andrews, a seat which he held for seventeen years. His Parliamentary labours were arduous and important, and his name will go down as representing the reorganisation of the Civil Service. He also presided over many important Committees and Royal Commissions; indeed, it may be said that for many years no official inquiry was considered satisfactory without the advice of Playfair, whose clear head and common sense were always readily placed at the service of the nation. He was Postmaster-General in Gladstone's ministry of 1873, and on the return of the Liberals to power in 1880 he was elected Chairman of Ways and Means, a post which in those stormy days was no sinecure. At the election of 1885, finding his Liberal views did not coincide with those of the University constituencies, he offered himself as a candidate for South Leeds, and was returned also in 1886 and 1892. He was Vice-President of the Council during Mr. Gladstone's short administration of 1886, but was not offered office in 1892, but received the honour of a peerage, which was given him more for his political than his scientific eminence. Playfair was the last remaining original member of the Chemical Society. The banquet which was to have been given in his honour and in that of the other past presidents of fifty years' standing has had to be postponed owing to his somewhat sudden death.

It is to him that we owe the first movement with regard to technical instruction, and his name will go down to posterity as one "who loved his fellow men."

He was laid to rest at St. Andrews, the city from which his family sprang. His merit was recognised by representatives of the Queen and of the Prince of Wales, and numerous friends and admirers, both scientific and political, as well as by the citizens of St. Andrews.

H. E. R.

## *OSBERT SALVIN, F.R.S.*

ORNITHOLOGY and entomology have sustained a great loss by the death of Mr. Osbert Salvin, which occurred on the 1st inst. at his beautiful residence Hawksfold, near Haslemere. The second and only surviving son of the late Mr. Anthony Salvin, the well-known architect, he was born in 1835, and received his education at Westminster and Trinity Hall, Cambridge, where he graduated as a Senior Optime in the Natural Science Tripos of 1857. Immediately after taking his degree he, together with Mr. W. H. Hudleston (then Simpson), joined Mr. (now Canon) Tristram in his natural history exploration of Tunis and Eastern Algeria, where they passed five months. In the autumn of the same year Mr. Salvin proceeded to Guatemala, where, chiefly in company with the late Mr. G. U. Skinner, the celebrated collector of orchids, he stayed till the middle of 1858, returning to Central America (henceforth always to be associated with his name) about twelve months later. He again went out in 1861, accompanied by Mr. Frederick Godman, and continued the explorations he had already begun, but was home again in 1863. In 1865 he married Caroline, the daughter of W. W. Maitland, Esq., of Loughton in Essex, and with her subsequently undertook another voyage to Central America. In 1874, on the foundation of the Strickland Curatorship in the University of Cambridge, he accepted that office, which he filled until 1883, when, on his father's death, he succeeded to the property at Hawksfold, and removed thither, though there was scarcely a week in which he did not pass some days in London; for with Mr. Godman he had conceived the idea of bringing out a "Biologia Centrali Americana," being a complete natural history of the countries lying between Mexico and the Isthmus of Panama. This gigantic task, by far the greatest work of the kind ever attempted, taxed all their united efforts, and those of the many contributors they enlisted, and is still in progress. Before beginning this, Mr. Salvin had edited the third series of the *Ibis*, of which he was one of the founders, and had brought out a "Catalogue of the Strickland Collection" in the Cambridge Museum. He contributed also the *Trochilidæ* (Humming-birds) and *Procellariidæ* (Petrels)—on which he was the acknowledged authority—to the British Museum "Catalogue of Birds," and almost his latest labour was that of completing and arranging the late Lord Lilford's "Coloured Figures of British Birds"; while the Royal Society's "Catalogue of Scientific Papers" enumerates forty-seven published by Mr. Salvin alone, twenty-three by him and Mr. Godman jointly, and fifty-four by him and Mr. Sclater—all before 1884.

Mr. Salvin was a Fellow of the Royal, Linnean, Zoological and Entomological Societies, on the Councils of each of which he frequently served; and it may be truly said that there were few naturalists whose opinion was more often sought, for his advice was generally sound. His figure was well known at the Athenæum Club, and last year he was elected an Honorary Fellow of his old College. He will be greatly missed by a large circle of friends, to whom his quiet and unassuming manners greatly endeared him.

N.

## *NOTES.*

THE freedom of the city of Edinburgh is to be conferred on Lord Lister on June 15.

THE annual ladies' conversazione of the Royal Society was held yesterday, as we went to press.

THE Prince of Wales will open the new buildings of the University Extension College, Reading, on Saturday next, June 11.

A FLORAL fête and children's floral parade will be held in the gardens of the Royal Botanic Society, Regent's Park, from 2 to 7 o'clock to-morrow (Friday).

THE city of Como, the birthplace of Alexander Volta, is preparing to worthily celebrate in 1899 the hundredth anniversary of the invention of the Voltaic or Electric Pile. To commemorate this important event, which has led to some of the greatest discoveries of the present century, there will be held at Como, from May 15 to October 15, an International Electrical Exhibition, to which will be annexed a national exhibition of the manufacture of silk—a branch of trade much developed in Como—and an international exhibition of the machinery, preparation, and process of working the same. Italian and foreign electricians are invited to a Congress, which will be held for the purpose of discussing the progress and applications of electricity. Como is a flourishing city on the main line of St. Gothard, and forty kilometres from Milan. It is pleasantly situated at the foot of the Rhaetian Alps, and on the shores of the most beautiful lake of Lombardy, to which it gives its name. An electrical exhibition ought to succeed in Italy, where the abundant hydraulic power greatly facilitates electric works. The application of electricity to the manufacture of silk must be of interest in Como, where the silk-works are of ancient date, and rapid progress is being made, though the industry is indebted to foreign countries for the machinery and implements. We are informed that foreign inventions will be greatly valued at the

exhibition, and will be well placed. For the encouragement of exhibitors, the city of Como has decided to give a sum of 10,000 francs in prizes for new inventions in the field of electricity.

THE title of the evening lecture which Prof. W. J. Sollas, F.R.S., will deliver at Bristol on September 9, at the meeting of the British Association, will be "Funafuti, the Study of a Coral Island." Mr. Herbert Jackson has chosen "Phosphorescence" as the subject of his evening discourse on September 12. Mr. W. Whitaker, F.R.S., will be the chairman of the conference of delegates of corresponding societies. Subscriptions to the local fund being raised for the expenses of the meeting now amount to 3665*l.*, and it is hoped that this will be increased to at least 4000*l.*

OUR Paris contemporary, the *Revue Générale des Sciences*, has arranged with the Orient Steam Navigation Company, Limited, for the *Lusitania* to make a special cruise to Norway and the North Cape from July 15 to August 10. The boat will leave Dunkerque on the former date and proceed to Bergen, from which place it will go up the coast to the North Cape, calling at Trondhjem, Tromsoe, Hammerfest, and other places of interest. After viewing the midnight sun, the party will leave the North Cape on July 25, and will be taken down to Christiania, visiting many places on the way. Prof. J. Thoulet, professor of mineralogy and oceanography at the University of Nancy, and Baron Jules de Guerne, general secretary of the Société Nationale d'Acclimatation de France, will accompany the tourists, and will give short lectures, with lantern illustrations, on the various features of interest in the places visited. The programme is an attractive one, and provides a pleasant and instructive means of spending a holiday.

A VALUABLE circular (No. 18), dealing with the physics of timber, has just been issued by Prof. B. E. Fernow, Chief of the Division of Forestry of the U.S. Department of Agriculture. The paper is given exceptional importance by the development of a formula worked out by Mr. S. T. Neely, showing how the strength of beams can be determined from the compression strength. In testing timber to obtain its various coefficients of strength, the test which is at once the simplest, most expedient, satisfactory and trustworthy is the "compression endwise test," which is made by crushing a specimen parallel to the fibres. All other tests are either mechanically less easily performed, or else, as in the case of cross-bending, the stresses are complex, and the unit coefficient can be expressed only by depending upon a doubtful theoretical formula. It is, therefore, of great practical value to have a relation between the cross-bending strength—the most important coefficient for the engineer—and the compression strength, and this is what Mr. Neely has found. His discovery is expressed in the following conclusion :—"The strength of beams at elastic limit is equal to the strength of the material in compression, and the strength of beams at rupture can be directly calculated from the compression strength; the relation of compression strength to the breaking load of a beam is capable of mathematical expression." This enunciation is of far-reaching importance, and a comparison if calculated with observed results given in the circular is convincing as to the efficiency of the formula. It is to be hoped that other and similarly successful scientific investigations into the physics of timber will be made in the U.S. Division of Forestry.

THE mysterious phenomenon known as "Barisal Guns" or "Mist-poeffers" forms the subject of a useful paper by Dr. A. Cancani in the last *Bollettino* (vol. iii. No. 9) of the Italian Seismological Society. The observations on which his discussion is founded are collected from places in or near the inland province of Umbria, where the noises are known as "marina," it being the popular belief that they come from the sea. The sound is quite distinct and easily recognised; it is longer than that of a cannon-shot, and, though more prolonged and dull, it is not unlike distant thunder. It invariably seems to come from a distance and from the neighbourhood of the horizon, sometimes apparently from the ground, but generally through the air. The weather when the "marina" is heard is calm as a rule, but that it often precedes bad weather is shown by the common saying, "Quando tuona la marina o acqua o vento o strina." The interval between successive detonations is very variable, sometimes being only a few minutes, or even seconds. They appear to be heard at all times of the day and year, the experience of observers differing widely as to the epochs when they are heard most frequently. With regard to the origin of the "marina," Dr. Cancani concludes that they cannot be due to a stormy sea, because "mist-poeffers" are frequently observed when the sea is calm; nor to gusts of wind in mountain gorges, for they are heard on mountain summits and in open plains. If their origin were atmospheric, they would not be confined to certain special regions. Nor can they be connected with artificial noises, for they are heard by night as well as by day, and in countries where the use of explosives is unknown. There remains thus the hypothesis which Dr. Cancani considers the most probable, that of an endogenous origin. To the obvious objections that there should always be a centre of maximum intensity (which is never to be found), and that they are so rarely accompanied by any perceptible tremor, he replies that, in a seismic series, noises are frequently heard without any shock being felt, and of which we are unable to determine the centre.

THE American Academy of Arts and Sciences have decided to award the Rumford Medal to Prof. James E. Keeler, director of the Lick Observatory, "for his application of the spectroscope to astronomical problems, and especially for his investigations of the proper motions of the nebulæ, and the physical constitution of the rings of the planet Saturn, by the use of that instrument."

THE honour of Knight of the Order of the Polar Star has been conferred upon Dr. J. Scott Keltie by the King of Sweden and Norway.

DR. R. KOCH has been consulted by the East African Protectorate as to preventive measures against rinderpest, which is again rampant in the interior. Dr. Macdonald, the principal medical officer, and Veterinary-Captain Haslam, M.D., have visited Zanzibar to represent the Protectorate on this and other infectious diseases. Dr. Haslam will proceed to the seat of the disease, and direct preventive measures.

WE learn from the *British Medical Journal* that the monument to Pasteur, which is to be erected in Paris in the space in front of the Pantheon, is now almost completed. M. Falguière, the sculptor, has introduced certain modifications into his original design, in which Pasteur was simply represented as overcoming Death, which was in the act of flight. Now a group of a mother with her child, thanking Pasteur, has been added on the right, while behind the central figure Fame is shown crowning him with laurels. The international subscription to the memorial now amounts to nearly 13,000*l.*

THE Local Government Board, acting under the recommendations of recent Commissions as to the cultivation in glycerine of vaccine lymph before such is applied to the human body, has (says the *Times*) leased a large laboratory and several office rooms at the British Institute of Preventive Medicine, on the Thames Embankment, for the purpose of cultivating the lymph. The bacteriological expert who has been appointed to take chief control of the new laboratory is Dr. F. Blaxall, lecturer on bacteriology at Westminster Hospital. He will have

an assistant, who has already been nominated, and an efficient staff. The calves from which the vaccine lymph is taken will be kept for the present at the Government calf establishment near the Foundling Hospital, and the lymph will be taken thence to the Thames Embankment in its pure state to be prepared and stored in glycerine.

WE regret to announce that Mr. Henry Perigal, the treasurer of the Royal Meteorological Society, died on Monday at the advanced age of ninety-seven years. Mr. Perigal was the author of various works on astronomy, bicycloidal and other curves, kinematics and the laws of motion, probable mode of constructing the Pyramids, &c. He was a constant attendant at the meetings of various London scientific societies until within two years of his death. He was a Fellow of the Royal Astronomical, Royal Microscopical, and Royal Meteorological Societies, as well as a member of several other scientific associations.

THE *Times* announces the death of the Rev. Percival Frost, F.R.S., on Sunday last, in his eighty-first year. Born at Hull, he was educated at Beverley, Oakham and Cambridge, where he was second wrangler and first Smith's prizeman in 1839, Fellow of St. John's College from that year until 1841, mathematical lecturer at Jesus College from 1847 to 1859, mathematical lecturer at King's College, Cambridge, from 1859 to 1889. He had been a Fellow of King's College since 1882, and was elected a Fellow of the Royal Society in 1883. Dr. Frost was the author of treatises on "Curve Tracing," "Solid Geometry," "The First Three Sections of 'Newton's Principles,'" as also of numerous papers published in various mathematical journals.

SIR ROBERT RAWLINSON, K.C.B., eminent by his works in civil and sanitary engineering, died on Tuesday, May 31, at the age of eighty-eight. He was a vice-president of the Society of Arts, and from 1849 to 1888 was chief engineering inspector of the Local Government Board. He took a foremost part in the development of sanitary science, and as a member of the Army Sanitary Commission in the Crimea was able to vindicate the soundness of his sanitary teaching. The beneficial results obtained by the Commission led to increased attention being paid to sanitary requirements, and thus brought about a very great reduction in the annual mortality of the British Army. Sir Robert Rawlinson acted as chairman of the Royal Commission on the Pollution of Rivers in 1866, and also served on the Commission which inquired into the sanitary condition of Dublin in 1879. He became a member of the Institution of Civil Engineers in 1866, and president in 1894. At one period he took a considerable part in the proceedings of that body, discussing mostly questions connected with drainage and water supply, of which his official position gave him a wide experience.

IT has already been announced that the autumn meeting of the Iron and Steel Institute will take place at Stockholm on Friday and Saturday, August 26 and 27 next. Particulars of the special transport arrangements, which have been made for the convenience of members attending the meeting, have now been issued. A special steamer, of over 3000 tons, chartered by Dr. H. S. Lunn and Mr. Woolrich Perowne, will leave Newcastle-on-Tyne on Wednesday, August 17, and will proceed by way of the Baltic Canal, Kiel and Wisby to Stockholm, where she will lie, and serve as a floating hotel, from Thursday, August 25, to Sunday, August 28. The return journey will be by way of Copenhagen, Gothenburg and Christiania. Dr. Lunn and Mr. Perowne have also arranged for the S.S. *St. Sunniva*, a one-thousand ton boat, to leave Leith on Saturday, August 20, proceeding by way of Christiania to Stockholm, where she will lie on Friday, Saturday and Sunday, August 26, 27 and 28, proceeding from Stockholm to St. Petersburg, and returning by way of Copenhagen and the Baltic Canal. The Orient Steam Navigation Company, Limited, have re-arranged the itinerary of their pleasure cruise No. 3 to the Baltic, so as to bring their S.S. *Lusitania* (3912 tons) to Stockholm on Thursday, August 25, and to keep her there until Sunday, August 28. The itinerary includes visits to Copenhagen, Wisby, Stockholm, Kronstadt, St. Petersburg, Kiel, and the Baltic Canal. The Great Eastern Railway Company has promised to afford special facilities to members travelling by the Continental route. The arrangements which are being made by the Local Reception Committee for the instruction and pleasure of the members, and the ladies accompanying them, are making satisfactory progress, and the detailed programme will be issued in due course.

IN view of the forthcoming conference of representatives of Sea Fishery Committees convened by the Board of Trade, a preliminary meeting of the representatives was held on Tuesday at the Guildhall, Westminster, to obtain a consensus of opinion on the subjects which are to be considered. It was resolved that a deputation should urge on the Government the need of legislation to protect immature sea fish and the enlargement of the powers of Sea Fishery Committees. A resolution was also carried in favour of the formation of an association of Fishery Committees.

THE Belgian Government having decided to offer a premium of 50,000 francs to the inventor of a paste for matches which will be free from white phosphorus and which will ignite on cloth or any other surface, a Ministerial decree has been issued determining the conditions. The competition will be international in character, and will remain open until January 1, 1899. Communications on the subject are to be addressed to M. Woeste, the president of the Commission appointed to adjudicate, at 2 Rue Laterale, Brussels.

HERR N. A. MÖLLER, in Eberswalde, has sent us a communication in which he states that he has undertaken a labour of love which will not be easy unless he is helped by many who are in the position to assist him. Fritz Müller, the naturalist, an old friend of his, died in Brazil, and Herr Möller wishes to raise a monument to his name by publishing a work which will contain an account of his life, character, method of work, his most important letters, and if possible his most valuable scientific writings. With this intention Herr Möller requests all those of our readers who possess any manuscripts, letters, &c., which may be found useful in such a biography, to forward them to him in Eberswalde, where they will be taken the greatest care of and returned when finished with.

A SYLLABUS prepared by Mr. R. De C. Ward, containing an outline of requirements in meteorology, intended for use in preparing students for admission to Harvard College and the Lawrence Scientific School, affords evidence that careful and systematic work in meteorology is given more encouragement in the United States than it receives here. The scheme of work indicated in the syllabus will train the student to scientific methods of investigation, and will make him to some extent a thinker and investigator on his own account.

IN our issue of April 8, 1897 (vol. lv. p. 542), we drew attention to an important investigation by Dr. O. Pettersson, with the object of showing that certain relations existed between the behaviour of the Gulf Stream and the subsequent general character of the weather over Europe, the results of which were based upon observations made during about twenty years at three stations on the Norwegian coast. In the *Meteorologische Zeitschrift* for March last, Dr. W. Meinhardus, of Berlin, continues the investigation in an article entitled, "On some

Meteorological Relations between the North Atlantic Ocean and Europe during the Winter Half-year," based upon a much longer series of observations. The results confirm those of Dr. Pettersson in a very satisfactory way, and show that a good idea of the temperature over a large area may be predicted with a considerable probability of success, and that, generally speaking, a high (or low) temperature of the Gulf Stream on the Norwegian coast in the first part of the winter (November to January) is usually followed by a high (or low) air-temperature in Central Europe in the latter part of the winter (February to March) and the early spring (March and April). It will be seen that the investigation refers entirely to the winter months.

MR. H. PARKER gives, in the *Ceylon Observer* of May 12, a detailed account of the abnormal rainfall of 31·72 inches in twenty-four hours, experienced at Nedunkeni, in the Northern Province of Ceylon, last December, and already briefly described by a correspondent in these columns (p. 78). Nedunkeni, eleven miles down the southern road to Mullaittivu, and 122 feet above sea-level, is a small village a little to the east of the dividing ridge of North-Central Ceylon, and though itself in the catchment area of the eastern Per Aru, which flows through Tannir Murippu Tank, it is only a little to the south-west of the point where three separate drainages meet. Forest, containing a thick growth of high trees, extends over the neighbourhood, and more especially for many miles from the south to the east. For about three years a rain-gauge has been established in the grounds of the dispensary in the village, and its records are regularly transmitted to the Public Works Office, and are published among the rainfall returns. Although the mean annual rainfall at Nedunkeni is probably little more than 50 inches, the fall for last December was 67·07 inches, and of this amount 31·72 inches were measured at 9.30 a.m. on December 16 as the rainfall of the preceding twenty-four hours. From an examination of the position of the rain-gauge, and the testimonies of the observers, Mr. Parker concludes that most probably the actual rainfall was in excess of the recorded amount.

WEATHER influences on farm and garden crops are discussed in an interesting address by Mr. Edward Mawley, published in the *Quarterly Journal* of the Royal Meteorological Society (April). After giving a short sketch of the climate of the British Isles as a whole, Mr. Mawley considers separately some of the effects produced on vegetation in this country by varying temperatures, by scanty and heavy rains, by sunshine and by wind; and afterwards treats of the leading farm and garden crops, and their special requirements with regard to atmospheric conditions. The paper should be of service in showing how intimate the connection is between meteorology, agriculture and horticulture.

MR. T. MELLARD READE informs us that a very large boulder of gypsum has been uncovered by the excavations in the brickworks of Mr. Ed. Peters, Cooks Lane, Great Crosby, near Liverpool. It is embedded in and completely surrounded by a thick bed of brown boulder clay, the bottom of the boulder being about 17 feet below the surface of the ground. The boulder measures 11 feet by 6 feet by 6 feet extreme dimensions, and weighs about 13 tons. "Small pieces of gypsum and plates of selenite are," adds Mr. Reade, "not uncommon in our boulder clays; but this individual boulder not only far surpasses in size any drift fragments of gypsum hitherto found, but is actually the largest boulder of any sort that I have seen taken out of the boulder clay, or recorded from it in the neighbourhood of Liverpool."

IT is known that a function of two variables $x$ and $y$ may have a maximum or minimum value along every straight line passing through a certain point O without the function necessarily being itself a maximum or minimum at that point. A simple proof that the same cannot be the case if the function is a maximum at O, not only for all *straight* lines, but also for all continuous lines through O, is given by Signor G. Vivanti in the *Atti de Lincei*, vii. 8.

THE Royal Academy of Sciences of Naples has hitherto been supposed to have originated about the year 1732, but from a communication published in its *Rendiconto*, by Prof. Federico Amodeo, we learn that the foundation of the Academy has been traced back thirty-four years earlier. In 1698, under the Viceroy, Luigi della Cerda, Duke of Medinacoeli, there was founded, in Naples, a literary and scientific society called the Palatine Academy; this society appears to have been overlooked by historians, owing to the fact that no published writings of its members had come before their notice. Prof. Amodeo has now succeeded in discovering a number of printed papers, notably two scientific works of the mathematician Antonio Monforte, affording abundant proof of the existence and activity of this, the parent of the present Academy, which thus dates from the year 1698.

PROF. P. DE HEEN continues his researches on so-called "infra-electric" radiations in the current number of the *Bulletin de l'Académie royale de Belgique*. The author is led to the conclusions that every source of disturbance in the ether gives rise not only to known radiations, but also to other rays vibrating in a different manner. These rays have the same properties as Röntgen rays in the matter of their action on dielectrics, charged conductors and electric fields, and differ from them in the matter of wave-length. They are absorbed so much more readily than ordinary light waves, that any such rays which emanate from the sun are completely sifted out by our atmosphere. In accordance with M. Perrin's views, the discharge of a conductor by these rays is chiefly due to their action on the lines of force. Lastly, an electric field is found to behave towards infra-electric rays as an opaque medium.

AN extremely simple commutator for converting an alternating current into a direct one is investigated by Signor A. Dina (of Zürich) in the *Rendiconti del R. Istituto Lombardo*, xxxi 9. From the experiments of Prof. Grätz (of Munich) and Herr Pollak (of Frankfort), it appears that an aluminium element capable of evolving oxygen at the anode produces a remarkable weakening of the current, and if the electromotive force is less than 22 volts, practically no current flows; but if the pole in question is made the kathode, no perceptible change in the current takes place, the electromotive force of the element being less than 1 volt. Hence it is easy, by arranging such elements in series, to obtain a combination which will only allow currents to pass in one direction, and which will resist any required electromotive force in the opposite direction. From experiments now described, the present writer concludes that the action of the elements is similar to that of a condenser, the aluminium becoming coated with a film of oxide which plays the part of dielectric. Signor Dina has not succeeded so far in putting the method to any practical use, though Herr Pollak claims to have done so.

A SERIES of experiments on the action of opaque tubes on Röntgen rays passing down them is described by Prof. Villari (*Atti dei Lincei*, vii. 8, and *Rendiconto dell' Accademia di Napoli*, iv. 3, 4). In a series of previous experiments, Prof. Villari found that in traversing a long tube opaque to them, these rays lose a large part of their power of discharging an electrified conductor at the end of the tube. This effect the author now attributes to the action of the tube in cutting off lateral rays, which, by their action on the surrounding air, would accelerate the discharge. In the matter of photographic action, Prof. Villari finds no difference between rays which have passed

through a tube and those which have not, and he concludes that Röntgen rays are neither reflected nor diffused by the walls of the tube, and that the transmitted rays are probably in no way modified by its presence.

MR. ERNEST HOSE communicates to the *Sarawak Gazette* for May some observations on an encounter between a python and wild pigs in the jungle at Tambak. A young pig had been seized by a large python, and the cries of distress summoned about twenty of the herd to an attack. They gored the python savagely with their tusks, and so harassed and lacerated it as to force it to relinquish its prey. The python was ultimately killed by Mr. Hose.

AN interesting note on Chinese antiquities is given in the consular report on Shashih (C. 8648–108 of 1898), just issued. Shashih contains a pagoda dating, it is said, from the ninth century, and there are other remains. There are distinct traces of the town having been at one time fortified, the earth nucleus of a wall and six brick gateways being still visible. The place is one of considerable interest to the archæologist and student of ethnography. All round Chingchou, which is about two miles from the north-west extremity of Shashih, are mounds, earthworks, look-out terraces, &c., the remains of ancient cities and fortresses, which mark the sites of successive capitals and strongholds of the ancient kings of Ch'u and their local successors from the very dawn of authentic history. These remains are not described in the report, but it is stated that the traditions attached to them cluster round the capture of the capital of Ch'u by the Prince of Ch'in in 278 B.C., its destruction as an independent kingdom half a century later, the part it played in the wars of the second and third centuries A.D., and the momentary revival of independence in the tenth century as the principality of Nan P'ing.

ANOTHER report on China, very important for commercial purposes, "Trade of Central and Southern China" (C. 8649–29 of 1898), contains some geographical and other notes of interest, together with maps. K'uei Fu is interesting as one of the oldest sites of Chinese occupation in these parts, dating from the beginning of our era. Geographically it marks the point of junction of the limestone mountains, athwart which the Yang-tze has forced a way in 100 miles of rapids and gorges, and the red sandstone formation of Ssŭ-ch'uan. A mile beyond Tzŭ-t'ung-chen there is a once-renowned Buddhist temple, and still noteworthy for its gigantic figure of Buddha, about 80 feet high, 5 feet across the toes of one foot, cut in high relief out of the solid rock and overlooking a bad rapid in the river, over which it is thought to have a sort of divine superintendence. Though cut in A.D. 1126, it is still in excellent preservation, and evidently much respected. The temple on the bluff behind the image was once on a grand scale, but it has been allowed to fall into utter ruin. In the region beyond this is the plain of Sui-ning, composed of solid alluvium 30 feet deep. There are frequent little temples to the god of the soil, usually of solid stone, the image being enclosed by open fretwork, so that the god cannot see out. The city of Ch'êng-tu is defended by huge walls and gates. The first wall was built in the third century B.C., shortly after the Chinese reduced the old aboriginal state of Shu, and began to colonise this country; the present wall was built in 1784, and is really a magnificent structure, and in almost perfect preservation. Opposite the city of Chia-ting has been cut in high relief a huge figure of Maitreya Buddha, no less than 380 feet high. Between Hêng-chiang and Lao-wa-t'an is the territory of the independent people Lolo, a race akin to the Thibetans, and perhaps the Burmese, who peopled these parts before the Chinese, and whom the latter have never subdued, although they have been attempting the enterprise for nearly 2000 years. The eastern part of the Red Basin was early peopled by the Chinese race, and in the third century A.D. Ch'êng-tu was the capital of the western of the three kingdoms into which China was then divided. At the end of the Ming dynasty (1640) the inhabitants were destroyed in one of those social cataclysms that have occurred with much regularity every few hundred years in Chinese history. When order was restored by the present dynasty, the province was colonised chiefly from Hupei and Hunan on the east. Altogether this is a most interesting report; and though intended for trade, the ethnographer and geographer will obtain many useful notes therefrom.

UNDER the title of "The Adulteration of Dairy Produce," Mr. R. Hedger Wallace has brought together a mass of statistics relative to the quality of the articles which come under the above head. The author's original paper was read before the Royal Scottish Society of Arts in Edinburgh, and it constitutes a formidable indictment against the conduct of dairying both at home and abroad. The butter we import is apparently frequently shamefully adulterated. The reputed pure Normandy and Brittany butters, we are told, for example, have been found to contain as much as from 30 to 40 per cent. of margarine; and not only is this latter material employed to swell the volume of first-class butter exported to this country from these districts, but butter of inferior quality is imported from Central France, Italy, and even Australia, to be *blended* and forwarded to us as the best Normandy and Brittany butter. Another plan consists in importing Belgian butter, which enjoys a by no means high reputation, and then shipping it from Calais to England as Normandy butter, whilst Australian butter is also *worked up* to sell in London under the Isigny mark, a noted brand of Normandy butter. In the space of a little over two years it appears that of the samples of butter taken at port of entry into this country and analysed, 10½ per cent. of the Dutch samples were adulterated, 2 per cent. of the Danish, 19 per cent. of the German, 5½ per cent. of the Norwegian, and 7 per cent. of the Russian. Unfortunately such adulteration is not confined to our friends across the Channel, and the practice of working up butters, as it is called, is carried on at home as well. It is clear that such extensive adulteration, as Mr. Wallace assures us goes on in the butter trade, ought to be energetically dealt with by our public authorities. Another important matter discussed by the author is the use of antiseptics or preservatives to milk, technically known as "drugging" the milk. We know that the addition of chemicals to milk as preservatives is prohibited in France on the grounds of unwholesomeness; cannot we induce responsible officials in this country to bring this matter to the notice of the Government, and have such treatment of milk included under the head of adulterants? The New York law on dairy products, passed in 1893, enacts, among other things, "that milk is adulterated to which has been added, or into which has been introduced any foreign substance whatever." Surely it is time steps were initiated, if not by authorities responsible for the purity of our food supplies, then by the public themselves, to put a stop to so reprehensible a practice.

As contributions to our knowledge of the Flora of India, we have received reprints of the tenth portion of the materials for a Flora of the Malayan Peninsula by Dr. George King, and of a paper on some new Malayan orchids by Dr. G. King and Mr. R. Pantling.

IN the *Kew Bulletin* No. 132, Mr. George Massee has a note on the obscure disease which is often very destructive to young fruit trees, known as "slime-flux." Mr. Massee attributes the injury to the combined attacks of a Schizomycete, *Micrococcus dendroporthes*, and of the aquatic condition of a fungus *Torula monilioides*. The *Micrococcus* is the active agent in producing fermentation, but can enter the tissues of the plant only through injuries in the bark.

THE additions to the Zoological Society's Gardens during the past week include a Servaline Cat (*Felis servalina*), a Serval (*Felis serval*) from Uganda, presented by Mr. Francis G. Hall; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mr. P. G. Dupuch; two Golden Eagles (*Aquila chrysætus*), European, presented by Edgar Baxter; a Yellow-billed Sheathbill (*Chionis alba*), captured at sea, presented by Captain H. W. Schlemann; a Bean Goose (*Anser secetum*), European, presented by Mr. W. H. St. Quintin; two Egyptian Kites (*Milvus ægyptius*) from Congoland, presented by the Rev. R. H. C. Graham; a Common Viper (*Vipera berus*) from Cornwall, presented by the Rev. John Harris; a Burchell's Zebra (*Equus burchelli*, ♂) from South Africa, deposited; two Black Hornbills (*Lophoceros nasutus*) from West Africa, a Yarrell's Curassow (*Crax carunculata*) from South-east Brazil, a Guan Ortalida from South America, a Double-ringed Turtle Dove (*Turtur bitorquatus*) from Java, purchased; an English Bull (*Bos taurus*) born in the Gardens.

*Erratum.*—In the classification of Bacteria given in the review of Prof. Migula's work on "Systematic Bacteriology," which appeared in last week's NATURE, the term "genus" should be substituted for "species."

## *OUR ASTRONOMICAL COLUMN.*

THE COMPANION TO PROCYON.—As is well known Prof. Schaeberle discovered in November 1896 a companion to Procyon, which he suggested would prove the theoretical companion predicted by Bessel. This difficult object—difficult on account of its nearness to Procyon, not by reason of its faintness—has been satisfactorily observed at the Yerkes Observatory, thus confirming Prof. Schaeberle's measures, the motion of the object, and its suggested identity with Bessel's companion. We have now the following measures:

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| 1896, November | ... | P = 318·8 | ... | D = 4·59 |
| 1897, October | ... | P = 324·1 | ... | D = 4·70 |
| 1898, March | ... | P = 326·0 | ... | D = 4·83 |

Prof. Barnard, who reports the observation, says that when the seeing is good, the companion star is a very conspicuous object and easy to measure with the bright star in the field unobscured. It was estimated to be one magnitude fainter than the old companion, which is of about the twelfth magnitude. This description, however, scarcely agrees with that of Prof. Schaeberle, who states that he made a measure of the star in November 1897, ten minutes before sunrise, and when looking along the outside of the telescope Procyon was no longer visible in the sky. This would imply that the comes was brighter than the thirteenth magnitude, and therefore more observations may be anticipated.

THE LIVERPOOL OBSERVATORY.—We have received the annual report of the director of the Liverpool Observatory, and are glad to see that he is making some attempt to break away from the mere meteorological observations, which have so long held sway at this observatory. The present attempt is a very small one, consisting merely in the observation of the Right Ascension of some of the circumpolar stars that Prof. Auwers has suggested should be continuously observed, with the view of affording more frequent opportunities, and more accurate determinations of the azimuthal error of transit instruments. Cometary observations have always formed a part of the routine work of this observatory, since the appointment of the present director. These are still being actively prosecuted, when the brightness of the comet permits. We notice also that the observatory is taking some part in the inquiries that are now going on in seismometry and the physics of the earth's crust.

SUNSPOT PERIODS AND NATURAL PHENOMENA.—In an article entitled "Le Soleil et la Nature" in the *Bulletin de la Société Astronomique de France* for June, M. Camille Flammarion brings together some very interesting data concerning the connection between the sunspot period and the yearly return of swallows, cuckoos and nightingales, and the flowering of chestnuts and lilacs. The observations have been extended over several years. In the case of the chestnuts and lilacs, M. Flammarion himself commenced the series in the year 1871, and not only observed the same trees every year when they began to bud, but employed the same scale of observation from the first; the observations are thus homogeneous throughout. In the remarkable series of figures accompanying the article, M. Flammarion has grouped together the observations of three years, and plotted curves which undoubtedly suggest a connection between one another, and with that representing the number of spots on the sun. Further, when spots are most numerous migratory birds return to any one place earlier in the year than usual, and when spots are at a minimum they do not come back until a much later date. In the case of swallows this is very remarkable, as observations of their time of return have been made since 1853, a period of forty-five years. The curve has a period of about eleven years, and the times of the maxima and minima correspond well with those of the sunspot curve.

Another curious fact M. Flammarion points out is that the curves showing the temperature of the months of March and April and the mean temperature of the year are nearly identical for the period covered by the years 1876-97.

DOUBLE AND MULTIPLE SOUTHERN STARS.—On April 28 of this year we noted in this column that Dr. T. J. J. See had published in the *Astronomical Journal*, Nos. 431-432, some details of his plan of double and multiple southern stars, and the first part of a catalogue of new double stars. In the current numbers of the *Astro. Nachr.* (Nos. 3495-6) he publishes a further catalogue containing the measures of those systems made at the Lowell Observatory during the past year and four months. In many instances these measures are the first that have ever been made, and on that account a great part of the accompanying results possess a degree of interest equal to that of the first measures of new double stars. Messrs. W. A. Cogshall and S. L. Boothroyd have ably assisted Dr. See in this work.

## *THE ROYAL OBSERVATORY, GREENWICH.*

ON Saturday last (June 4) the Astronomer Royal presented his annual report to the Board of Visitors of the Royal Observatory, Greenwich. As usual the numerous guests numbered among them many astronomers and other men of science; and the weather, though at times threatening, proved sufficiently fine to allow the buildings and instruments to be comfortably inspected. The following brief *résumé* is taken from the report:—

*Buildings.*

The buildings on the south side of the grounds, which form part of the new physical observatory, are now approaching completion, having been delayed somewhat by a failure in the supply of terra-cotta. Up to the present time the construction of the magnetic pavilion has not been commenced, although provision has been made for it and a good site selected. It is hoped that this will no longer be delayed, for the amount of iron recently used in the construction of the new physical observatory has a very decided effect on all the magnetic instruments in the old buildings. For some months past we have noticed a scaffolding outside the dome of the 28-inch. This we read was put up in February last in preparation for erecting a balcony round the building, but the plans were subsequently reconsidered and modified, and the work in consequence delayed. The electric light and telephone communication has been extended to the new buildings, and a new accumulator house is being constructed in the basement on the north-east side of the physical observatory to replace the shed in which they are now located.

*Transit Circle.*

A diagram on the wall of the transit room showed a curve which had been plotted, the points in the curve representing the number of R.A. observations and circle readings for each year from 1877. A glance at this curve showed that the number of transit observations during the more recent years has increased by leaps and bounds, and where in place of the usual 4000 observations per year in 1877-80, the number now has reached the figure 11,000. This year the transits, counting separate limbs as one observation, amount to 11,441, excluding determinations of collimation error 297 and level error 651. The circle readings were 10,626. The correction for the R.D. discordance

for 1897 has been found to be very small, amounting to $+0''\cdot068 + 0''\cdot104 \sin$ L.D. The colatitude of the transit circle obtained from 800 stars in 1897 was 38° 31′ 21″·69, differing by −0″·21 from the adopted value.

The mean error of the moon's tabular place (computed from Hansen's lunar tables with Newcomb's corrections) is −0ˢ·142 in R.A. and +0″·27 in N.P.D. deduced from 95 observations. These are equivalent to an error of −1″·97 in longitude and +0″·16 in ecliptic north polar distance.

*The New Altazimuth.*

The axis of this instrument has been considerably stiffened, and modifications in the friction rollers have been made to relieve the weight of the instrument on its bearings. Changes have also been made in the illumination of the field and microscopes. In December last the instrument was brought into working order; but regular observations have only recently been commenced, as the determination of division errors, and other observations necessary to test the stability of the instrument, occupied several months' work.

The observations on the whole show satisfactory stability in the instrument, the collimation, level, and azimuth being steady. Long series of observations of the nadir point have been made to test the stability of the microscopes and of the instrument generally for zenith distance observations. Discordances were found in the results given by the two circles, which, after a considerable time had been spent, were traced to the wheel carrying one of the sets of microscopes, which was found to have worked loose. This was remedied recently, and the accordance in the results from the two circles appears now to be satisfactory. But large changes in the readings of the individual microscopes are found on turning the instrument into different azimuths, which, however, would not affect the observations, as the microscopes come back to sensibly the same readings for the same azimuth. As, however, this implies a displacement of the microscopes relatively to the circles when the instrument is turned, Mr. Simms is considering whether the supports of the microscopes and pivots can be stiffened.

*Thompson Equatorial.*

Photographic tests with the 26-inch object-glass, varying the distance between the two lenses, show that the images were never good when away from the centre of the field. The glasses were, therefore, sent back to Sir Howard Grubb for alteration, and have only just been returned. A few trial photographs show that the "coma" is now corrected, but that a slight refiguring is still required. This, we are told, is being now done by Sir Howard Grubb at the observatory.

The 30-inch Cassegrain, mounted on the other end of the declination axis, has been employed for obtaining photographs of the moon, star clusters, and star fields. These have all been obtained at the secondary focus, the focal length of the mirror being somewhat longer than that for which the tube was designed, making it impracticable to take photographs with it at the primary focus. Dr. Common proposes to supply another mirror of the correct focal length, 11 feet 3 inches.

The photographic spectroscope has been completed, and is mounted at the back of the cell of the 30-inch mirror, but the diagonal prism to reflect the rays from the Cassegrain telescope into the collimator has not yet been mounted and adjusted.

*The 28-inch Refractor.*

This instrument was in use for micrometric measurements from 1897 May 11 to 1898 May 10, with the exception of about seven weeks, from August 5 to September 23, when it was used for photography, the crown lens being reversed. During the year 273 double stars have been measured, each star being measured on the average on two nights; the distance between the components of these stars is less than 1″ o in 156 cases, and in 63 less than 0″·5.

From August 5 to September 25, 1897, the instrument was used with the crown lens in the photographic position. During this period 110 measurable images of 17 double stars were obtained on dry collodion plates. The closest of these pairs were:—

| | Magnitudes. | Distance. |
|---|---|---|
| | | ″ |
| Σ 2881 ... ... ... | 7·7 and 8·2 | 1·6 |
| Σ 2723 ... ... ... | 6·4 ,, 8·2 | 1·5 |
| Σ 2900 ... ... ... | 6·0 ,, 9·2 | 1·5 |
| Σ 2799 ... ... ... | 6·6 ,, 6·6 | 1·3 |

*Astrographic Equatorial.*

The following statement shows the progress made with the photo-mapping of the heavens:—

| | For the Chart (Exposure 40m.) | For the Catalogue (Exposures 6m., 3m., and 20s.) |
|---|---|---|
| Number of photographs taken | 363 | 147 |
| ,, successful plates | 285 | 118 |
| ,, field photographed successfully ... ... ... | 283 | 110 |
| Total number of successful fields reported 1897 May 10 | 551 | 814 |
| Number of photographs, previously considered successful, rejected during the year ... | 6 | 15 |
| Total number of successful fields obtained to 1898 May 10 ... | 828 | 909 |
| Number still to be taken ... | 321 | 240 |

An important but unsatisfactory discovery has been made by an examination of all the plates on the shelves. This has shown that 166 catalogue plates out of 909—that is, nearly one-fifth of the total number—and 90 chart plates out of 828 have deteriorated owing, probably, to the effect of damp in the building in which they have to be stored pending the completion of the new physical observatory. There is difficulty in warming this building adequately, and the books, as well as the photographs stored there, have suffered from damp. The film has, in some cases, left the glass, and in the others shows signs of doing so. Of the 166 damaged catalogue plates, 57 have been completely measured, 23 partially measured, and 86 are not measured.

The importance of making duplicates as soon as possible of all negatives in such a work as this cannot be underrated. Positives on glass of all the 90 damaged chart plates were taken, and these are uninjured.

Of the fields still required, 197 are within 10° of the Pole, and no photographs of this part of the sky have yet been taken, the work being purposely deferred till near the epoch 1900. It is proposed to begin taking these now, and the settings of the scales for the guiding stars are partly computed.

*Spectroscopic and Heliographic Observations.*

No spectroscopic observations have been made during the last twelve months.

With the Dallmeyer photo-heliograph photographs of the sun have been secured on 191 days, 355 of these being selected for preservation, besides nine photographs with double images of the sun for the determination of zero of position. With the Thompson 9-inch photo-heliograph twenty-two photographs were taken on twelve days. Photographs to supplement the Greenwich series have been received from India and Mauritius up to 1898 February 22.

For the year 1897 Greenwich photographs have been selected for measurement on 183 days, and photographs from India and Mauritius (filling up the gaps in the series) on 181 days, making a total of 364 days out of 365 on which photographs are available. The importance of utilising the clear sky of India and Mauritius for obtaining the photographs can hardly be better demonstrated than by the figures given above, which show that on only one day out of the whole year a photograph record of the sun's disc was not secured.

There has been but little change in the mean daily spotted area of the sun for the period covered by the report as compared with the preceding one. The progress towards minimum has shown itself rather in the increase of days when the sun was wholly free from spots, than in the poverty of the displays of spots on the days when the sun's surface was disturbed.

It will be remembered that about the time of the recent eclipse in January there were several, comparatively speaking, large spots on the solar disc, considering that the minimum period was so near at hand.

The remark made regarding the deterioration of the astrographic plates applies also to many of the solar photographs, an examination having shown that some of those stored in the new library and in the museum of the physical observatory, both gelatine and wet collodion, have suffered from damp, spots of mildew being found on the film, though much more frequently the mildew is confined to the uncoated side of the glass.

*Magnetic Observations.*

Fortunately for the magnetic records secured at the observatory, the proposed electric tram-line in the neighbourhood of the Deptford Cattle Market has been successfully opposed. That this would have seriously damaged the records there can be absolutely no doubt, since it would have been only 1¼ miles from the observatory: even now small agitations, due to the running of trains on the South London Electric Railway, 4½ miles from the observatory, can be clearly traced from the year 1890 on the horizontal and vertical force sheets, synchronising with the disturbances in the earth current registers.

The principal results for the magnetic elements for 1897 are as follows:—

Mean declination ... ... .. ... 16° 50′·4 West.
Mean horizontal force by the Gibson instrument in the library ... { 3·9877 (in British units). 1·8387 (in metric units).
Mean dip ... ... ... ... { 67° 5′·5 (by 9-inch needles). 67° 6′·8 (by 6-inch needles). 67° 7′·1 (by 3-inch needles).

These results are to a certain extent affected by the iron in the new physical observatory and in the new altazimuth pavilion. To eliminate this effect as far as circumstances would allow, observations have been made during the past year on the site selected for the new magnetic pavilion in Greenwich Park, which is presumably free from any disturbing effect of iron. The horizontal force has been observed monthly on this site with the two deflection instruments (Gibson and Elliott), the declination occasionally with the Elliott instrument, and a dip with a Kew dip circle (Dover 74).

It appears from these observations that the declination at the observatory has been increased by 3′ to 4′ through the introduction of iron.

The mean horizontal force obtained with the Gibson instrument in the park is 1·8366 in metric units. In the same units we have also the following differences:—

| | | |
|---|---|---|
| Gibson in library—Gibson in park | ... | + 0·0021 |
| Elliott in library—Elliott in park ... | ... | + 0·0084 |
| Elliott in its usual position in library—Elliott on Gibson pier ... ... | ... | + 0·0060 |
| Gibson in park—Elliott in park ... | ... | + 0·0010 |

All the magnetic disturbances during 1897 were of a comparatively trifling nature.

*Meteorological Observations.*

The mean temperature of the year 1897 was 50°·3, being 0°·9 above the average for the fifty years 1841–1890.

During the twelve months ending 1898 April 30, the highest daily temperature in the shade recorded on the open stand was 90°·2 on June 24. The highest reading recorded in the Stevenson screen was 87°·4 on the same day. The monthly mean temperatures were in excess of their corresponding averages in every month with the exception of May, September, and March. In January the excess amounted to 5°, the mean temperature for that month being 43°·6. In the preceding fifty-seven years there is one instance only of a higher mean temperature occurring in January, viz. in 1884, when it was 43°·9. A mean value equal to the present January value (43°·6) was also recorded in two other years (1875 and 1890). The winter of 1897–1898 was remarkably mild throughout, and the temperature of the air fell to freezing point (or below) on twenty-nine days only—ten of these occurring in March and seven in December. The lowest temperature recorded during the winter was 23°·3 on December 24. [The lowest temperature recorded in January was 30°·0.] The mean temperature for the five months 1897 October to 1898 February, was 44°·6, being 2°·4 in excess of the average value. During the whole period of fifty-seven years (1841 to 1897) this value has only been exceeded three times, viz. in the winter of 1876–1877, when the mean for the five months was 45°·8, in the winter of 1845–1846, when it was 44°·8, and in the winter of 1865–1866, when it was 44°·7. A mean value of 44°·6 (the same as that for the present year) was also recorded in the winter of 1848–1849, and in that of 1868–1869.

The number of hours of bright sunshine recorded during the twelve months ending 1898 April 30, by the Campbell-Stokes instrument, was 1529 out of the 4454 hours during which the sun was above the horizon, so that the mean proportion of sunshine for the year was 0·343, constant sunshine being represented by 1.

An interesting comparison is made between the results as given by the new and the old ball of the sunshine recorder for 1897. With the former 1542·6 hours were registered throughout the year, while with the latter only 1268·4 hours, the excess with the new ball amounting to 274·2 hours during the twelve months.

The rainfall for the year ending 1898 April 30 was 17·33 inches, being 7·21 inches less than the fifty years' average. The number of rainy days was only 149. This is a very small annual rainfall; the three smallest falls during the preceding fifty years being 16·38 inches in 1864, 17·61 inches in 1867, and 17·70 inches in 1858.

*Personnel.*

No change of any importance has been made with regard to the staff during the past twelve months, Mr. Dyson continuing to take special charge of the astronomical department, and Mr. Cowell the astro-physical department, in which is included the magnetic and meteorological branch.

## GUTTA PERCHA.

IN a recent course of three lectures[1] delivered before the Society of Arts, and subsequently revised and reprinted from the *Journal* of the Society, with additional illustrations and appendices in the form of a bulky pamphlet, Dr. Obach dealt very fully with the history, origin, treatment and properties of gutta percha.

In the first lecture the early history, botanical derivation and geographical distribution of this substance were related, and the analyses of various commercial "brands," as well as exhaustive statistics of the annual imports and exports of the material were given.

In the second lecture the mechanical cleaning processes and chemical washing and hardening processes were described and illustrated, and also the different methods of extraction of gutta percha from removable parts of the trees, such as twigs and leaves, explained. This lecture concluded with an enumeration of the various *natural* substitutes for gutta percha which have been proposed at various times, including the interesting material known as *balata*.

The third lecture dealt with the mechanical and electrical properties of gutta percha and its application for various technical purposes, also its behaviour towards water, oxygen and ozone. In conclusion the *artificial* substitutes for gutta percha were briefly discussed.

The following is a short report on those parts of the third lecture which we think may be more especially interesting to the readers of NATURE.

In order to simplify matters, Dr. Obach selected from the numerous sorts of gutta percha which make their appearance on the Singapore market twelve different "brands," which may be considered as typical; they are distinguished by the name of the locality whence they are derived. For direct comparison and easy reference these twelve materials were divided into four groups, each group comprising materials more particularly related to each other. The groups were designated as "Genuine," "Soondie," "White," and "Mixed."

It was explained that cleaned gutta percha consists essentially of two constituents, viz. a hydrocarbon termed pure gutta (G) having the composition $C_{10}H_{16}$, and being therefore isomeric with oil of turpentine, and a resin (R) containing more or less oxygen, and consisting principally of two substances named Albane $C_{10}H_{16}O$, and Fluavile $C_{20}H_{32}O$. Besides these proximate components there is also a variable amount of extraneous matter present in every commercial gutta percha, even after the most scrupulous cleaning, which consists of finely-ground bark, wood fibres, vegetable colouring matter, grit, &c., summarily termed dirt (D), and of water (W).

Dr. Obach has found that the physical and mechanical properties of the various sorts of gutta percha depend almost exclusively on the relative proportion of gutta and resin, *i.e.* the ratio $\frac{G}{R}$, whereas the electrical properties depend chiefly on the nature of the gutta and, to a lesser extent, upon that of the

[1] "Cantor Lectures on Gutta Percha," by Dr. Eugene F. A. Obach, F.I.C., F.C.S., M.I.E.E.

resins, but also very largely upon the amount and the character of the impurities contained in the material.

The specific gravity of cleaned gutta percha of average composition is very nearly the same as that of water, but that of individual brands deviates considerably from it, some being about 3 per cent. lighter, and others about 2 per cent. heavier, as will be seen from Table I., which gives the specific gravities for eleven definite brands and an average material obtained by mixing a number of different cleaned materials in the masticator. The table also gives for comparison the specific gravities of balata, of gutta percha extracted from leaves with petroleum spirit by Dr. Obach's patent process, and also of pure Para-caoutchouc.

The exceptionally low specific gravity of the gutta percha from leaves is to be attributed to the fact that it consists almost entirely of pure gutta.

TABLE I.—*Specific Gravity of Cleaned Gutta Percha.* (2·2 mm. sheet.)

| Group | Name of brand | Spec. grav. at 15° C. | Ratio $\frac{G}{R}$ |
|---|---|---|---|
| I. Genuine | Pahang ... ... | 0·9858 | 3·9 |
| | Banjer red ... ... | 0·9868 | 4·0 |
| | Bulongan red ... | 0·9911 | 3·4 |
| II. Soondie | Bagan ... ... | 0·9709 | 1·44 |
| | Kotaringin ... ... | 0·9729 | 1·30 |
| | Serapong ... ... | 0·9767 | 1·38 |
| III. White | Bulongan ... ... | 1·0093 | 1·57 |
| | Mixed ... ... | 1·0186 | 1·14 |
| | Padang ... ... | 0·9911 | 1·40 |
| IV. Mixed | Padang reboiled ... | 0·9960 | 1·18 |
| | Sarawak mixed ... | 0·9912 | 1·20 |
| | Mixed after cleaning | 1·0022 | 1·75 |
| V. Various | Balata ... ... | 0·9731 | 1·16 |
| | G.P. from leaves ... | 0·9625 | 51·90* |
| | Para-caoutchouc ... | 0·9275 | — |

* Not 5·19, as erroneously stated in the *Journal* and Reprint.

The absorption of water by gutta percha was ascertained by immersing strips of the cleaned material in water and weighing them at regular intervals for about eighteen weeks. The results of these tests made on representative materials of the four groups which have been mentioned, and on gutta obtained from leaves, on balata and caoutchouc, are graphically shown in Fig. 1.

The curves shown on the left of the diagram (Fig. 1) represent the average results obtained for the different brands composing the various groups or "classes," as well as the results for gutta percha extracted from leaves, for balata, and also for pure Para-caoutchouc; but the curves on the right of the diagram were indirectly obtained by calculation and represent the absorption, which would have taken place if each specimen tested had entirely consisted of the kind of gutta which is characteristic of it. The reason for this reduction of the results to "pure gutta" is that the water is exclusively absorbed by this component and not by the resin, which has been found impervious to it.

It will be seen from the diagram, that it is the group of "genuine" materials which absorbed the most water, both before and after the reduction to "pure gutta"; whereas of the materials as such, it is the "white" sorts which are the least permeable to water, and of the "pure guttas" that of the material extracted from leaves.

Pure Para-caoutchouc, as is generally known, has a considerably greater absorptive power for water than even the most permeable kind of gutta percha.

The temperature at which gutta percha becomes plastic, a physical property of practical importance, depends almost entirely upon the relative proportion of gutta and resin. The great difference existing in that respect between the different sorts was demonstrated in the lecture by an experiment illustrated in diagram (Fig. 2).

The apparatus consists of a frame, *f*, holding three strips of gutta percha, 1, 2, 3, under the tension of springs $S_1$ $S_2$ $S_3$, the frame is lowered into a beaker of water, V, and the latter slowly heated, the arrangement being such that an electric current is established, and an alarum, A, sounded as soon as a strip becomes sufficiently soft to allow the spring to pull it apart. The three materials employed contained 2½, 38 and 60 per cent. of resin, and the temperatures at which they softened were found to be 55°, 48° and 42° C. respectively.

Another physical property, viz. the time required by gutta percha to harden or set again on cooling, after having previously been softened by heat, also depends mainly on the relative percentage of gutta and resin, as was pointed out by the lecturer.

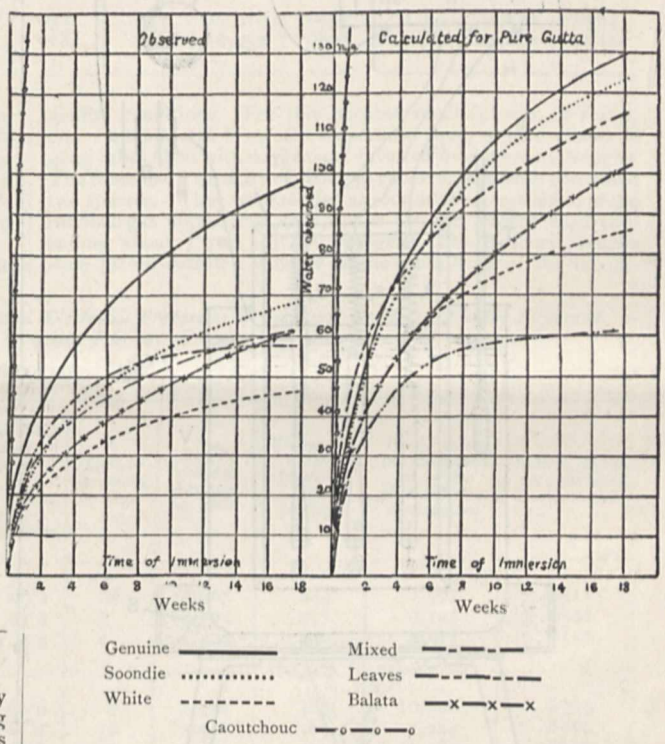


FIG. 1.—Absorption of water by different "classes" of gutta percha. (Thickness of sheet 2·2 mm.; area, 1 sq. dm.; weight, 10 g.)

The mechanical properties of gutta percha, of which the tensile strength is the principal one, are in their turn also greatly affected by the percentage of resin.

The important electrical properties of gutta percha chiefly depend on the nature of the gutta, and, to a lesser extent, on that of the resin, but only slightly on the relative proportion of these two components.

The insulating property of gutta percha was stated to have been first observed by Dr. Werner von Siemens in 1846. Faraday also noticed it shortly afterwards, and called attention to it in March 1848.

Dr. Obach showed the two principal electrical properties by means of an electroscope arranged as shown in Fig. 3. The instrument was provided with a flat brass disc, P, at the top, and below it two pith rods, *p*, *p*, were suspended on either side of a fixed strip of brass, *m*. When a piece of gutta percha tissue was spread over the brass disc and the electroscope charged by means of the brass knob, *k*, at the side, the pith rods diverged and remained stationary. If the fingers were now placed on the covered disc, the rods slightly converged and then again

remained stationary. On withdrawing the hand, the rods took up their former diverged position.

This simple experiment demonstrated at once the excellent insulating property of gutta percha and its inductive capacity. Its insulating power was shown by the fact, that the tissue formed an efficient screen between the hand and the brass disc of the electroscope, to prevent the latter from being discharged. Its inductive capacity was shown by the temporary fall of the pith rods, indicating the "binding" of the charge on them when the tissue was touched by the hand.

*Per se* the insulation of gutta percha should be as high as possible, and the inductive capacity as low as possible; but whereas the latter property is mostly associated with other good qualities of the material, such is not always the case with a high insulation.

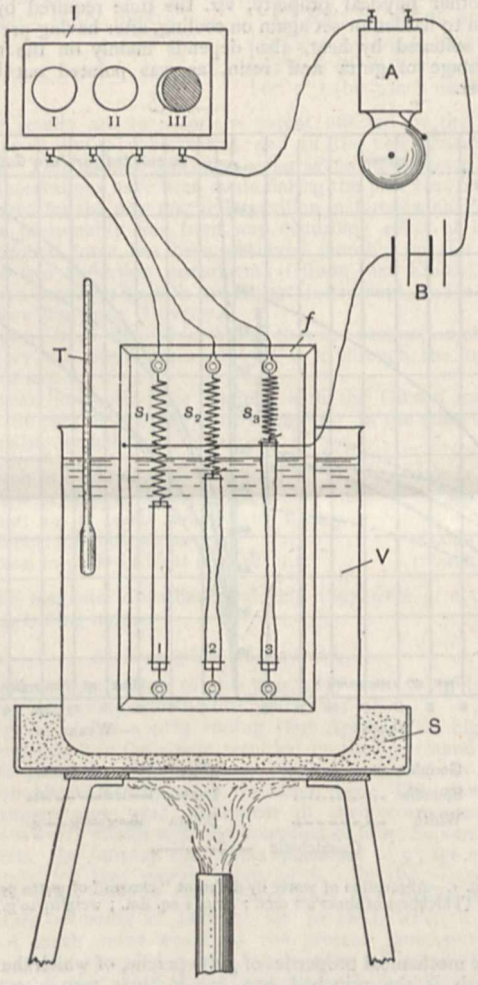


FIG. 2.—Softening temperature of gutta percha.

Faraday apparently had some difficulty in 1848 in obtaining gutta percha having a sufficiently good insulation. He found that this was due to an excessive amount of water contained in the commercial material. This is an important matter, and experiments were shown by Dr. Obach to demonstrate the effect of different percentages of water on the insulating power of gutta percha. The electroscope was charged until the rods fully diverged. Strips of gutta percha, containing approximately 15, 10, 5 and 2½ per cent. of water, were then successively brought into contact with the brass knob, the finger being held against the other side of the strip. When the strip containing 15 per cent. of water was brought into contact with the knob, the pith rods slowly converged, and did not regain their former position on removing the strip, which showed that the charge had been dissipated. On repeating the experiment with the next strip, containing 10 per cent., the charge disappeared much more slowly; the strip containing 5 per cent. of water was next tried, and this was found to be an almost perfect insulator and practically equal to the best strip with 2½ per cent. of water. It must be mentioned however, that different sorts of gutta percha behave differently in this respect. The specific insulation and inductive capacity of various specimens of gutta percha are given in a table in comparison with other materials, such as paraffin wax, colophony, ebonite, &c., but space does not permit us to reproduce this interesting table here. The figures show how greatly the electrical data vary for different kinds of gutta percha. For instance, the insulation resistance per cube knot was only 382 megohms for an otherwise excellent specimen of gutta percha, and 139,300 megohms for a specimen of considerably inferior description. Gutta percha extracted from leaves has usually a comparatively high insulation, exceeding that of paraffin wax, colophony and ebonite, but the insulation resistance of pure vulcanised caoutchouc is higher still, approaching the maximum obtained with ordinary gutta percha. The specific inductive capacity also varies greatly, the lowest values per cube knot

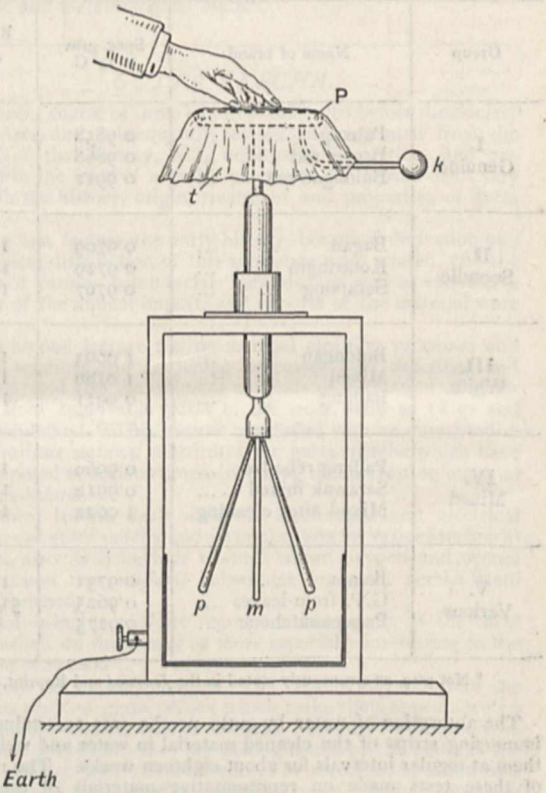


FIG. 3.—Insulation and electrostatic capacity of gutta percha.

being ·0466 and the highest ·0801 microfarad. In this respect the gutta obtained from leaves by Dr. Obach's process compares favourably with any ordinary gutta percha. Pure Para-caoutchouc also has a very low inductive capacity, viz. ·0446 mfd., which is lower than that of the best gutta percha, but paraffin wax is lower still, viz. only ·0411 mfd. Water, on the other hand, has the highest known inductive capacity of any substance, *i.e.* 1·348 microfarad per cube knot. The significance of this will be seen on comparing the values in Table II., which gives the insulation and inductive capacity of several "brands" of gutta percha, each with a high and low percentage of water.

The dielectric strength of insulating materials is another property, which is daily becoming more important. From tests made on gutta percha-covered cores of submarine cables, it has been found that a thickness of ⅛ inch of this dielectric is pierced by about 40,000 volts, and one of $\frac{1}{10}$ inch by about 28,000 volts.

The next table (III.), which is abstracted from a large table in the *Journal*, contains the chemical composition and the physical, mechanical and electrical properties of the first grades of the twelve principal brands of gutta percha.

The figures show how largely the physical and mechanical properties depend on the relative proportion of gutta and resin, *i.e.* the ratio $\frac{G}{R}$. The temperatures given as those at which the material softens and at which it becomes pliable, have only a relative value, as they apply to the particular method of testing here employed, but for comparative purposes they are most valuable.

TABLE II.—*Insulation and Induction per Cube Knot with Low and High Percentage of Water.*

(Abstracted from larger table.)

| Percentage of water. | I. Genuine. (Pahang) | | | II. Soondie. (Bagan.) | | | III. White. (Banjer.) | | | IV. Mixed. (Sarawak.) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water p.c. | Insul. megs. | Induct. mfds. | Water. p.c. | Insul. megs. | Induct. mfds. | Water. p.c. | Insul. megs. | Induct. mfds. | Water. p.c. | Insul megs. | Induct. mfds. |
| Low | 1·5 | 6,173 | ·0523 | 1·7 | 7,950 | ·0521 | 0·6 | 10,410 | ·0555 | 1·1 | 24,250 | ·0564 |
| High | 6·3 | 5,480 | ·0675 | 7·3 | 4,350 | ·0682 | 7·1 | 6,454 | ·0898 | 7·0 | 24,250 | ·0718 |

The softening temperature is determined as follows:—A thin sheet of the gutta percha to be tested is very slowly heated in a water bath, and a small stud from time to time brought to bear upon it with a definite pressure. As soon as the stud leaves a permanent impression on the surface of the sheet, the temperature of the water is noted and recorded as the "softening temperature."

The temperature at which the material becomes pliable is thus determined:—A strip of the material of definite dimensions is held vertically in a bath of water; the upper end of the strip is attached to a cord, passing over a pulley and carrying a known weight, the strip being thus subjected to a constant tension. The temperature of the water at the moment when the weight is able to pull the strip asunder, is taken as that of "pliability."

The "time of hardening" is that taken by the material, heated to the temperature of pliability, to become sufficiently rigid to resist the pressure of the stud in the apparatus used for determining the softening temperature, the water surrounding the strip being maintained at 75° F.

With a view to investigating the action of oxygen on cleaned gutta percha more thoroughly than had hitherto been done, Dr. Obach conducted an exhaustive series of experiments having for their special object a direct comparison of the avidity with which the different "brands" of gutta percha absorbed oxygen under similar conditions. For this purpose small spheres, of 2 cub. cm. contents and 8 sq. cm. superficial area, were enclosed in glass tubes filled with oxygen and inverted over mercury troughs. The tubes had a capacity of about 30 cub. cm., and each contained two spheres. They were refilled as soon as the composition of the residual gas approached that of the air, the oxygen used containing about 7 per cent. of nitrogen. The mercury troughs were placed outside a window on the south front of the laboratory exposed to full sunshine. The experiment extended over twenty-four weeks, and during that period the total amount of bright sunshine amounted to 680 hours.

TABLE III.—*Chemical Composition, Physical, Mechanical and Electrical Properties of the First Grades of Twelve Different "Brands" of Gutta Percha.*

(Abstracted from larger table.)

| | Name of brand | Percentage composition | | | | | Temperat. (° C.) when G.P. becomes | | Time of hardening in mins. | Tensile strength. Lbs. per sq. inch. | Elongation during breaking test per cent. | Insul. resist. per cube knot at 75° F. after 2nd min. in megohms | Induct. capac. per cube knot. in microfarads |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | G | R | D | W | $\frac{G}{R}$ | Soft | Plastic | | | | | |
| I. Genuine | Pahang | 80·0 | 17·7 | 1·4 | 0·9 | 4·52 | 48·8 | 66·1 | 2¾ | 5,067 | 444 | 1,077 | ·0511 |
| | Banjer red | 70·5 | 26·9 | 1·4 | 1·2 | 2·62 | 45·0 | 67·2 | 5 | 4,123 | 417 | 3,723 | ·0542 |
| | Bulong red | 73·4 | 24·2 | 1·4 | 1·0 | 3·03 | 46·1 | 64·4 | 4 | 4,200 | 440 | 4,511 | ·0537 |
| II. Soondei | Bagan | 57·7 | 40·6 | 1·0 | 0·7 | 1·42 | 40·0 | 61·6 | 9 | 2,528 | 383 | 10,800 | ·0523 |
| | Kotaringin | 57·8 | 40·3 | 1·2 | 0·7 | 1·43 | 40·0 | 61·1 | 12 | 2,443 | 383 | 3,284 | ·0541 |
| | Serapong | 57·5 | 41·0 | 1·0 | 0·5 | 1·40 | 41·1 | 60·5 | 12 | 2,466 | 390 | 35,180 | ·0536 |
| III. White | Bulongan | 52·5 | 45 0 | 1·5 | 1·0 | 1·16 | 41·6 | 70·0 | 18 | 2,537 | 420 | 46,380 | ·0581 |
| | Mixed | 52·0 | 46·0 | 1·2 | 0·8 | 1·13 | 42·7 | 78·8 | 19 | 3,180 | 418 | 86,550 | ·0541 |
| | Banjer | 53·6 | 42·9 | 1·7 | 1·8 | 1·25 | 43·3 | 75·0 | 24 | 3,026 | 406 | 45,780 | ·0612 |
| IV. Mixed and Rebd. | Saraw. mix. | 61·3 | 35·1 | 2·0 | 1·6 | 1·75 | 42·7 | 65·0 | 12 | 2,572 | 397 | 12,330 | ·0602 |
| | Pad. rebd. | 50·3 | 45·7 | 1·5 | 2·5 | 1·10 | 36·6 | 61·6 | 63 | 1,465 | 475 | 16,840 | ·0649 |
| | Banca rebd. | 47·1 | 50·5 | 1·3 | 1·1 | 0·93 | 38·8 | 63·3 | 54 | 1,552 | 371 | 71,380 | ·0577 |

*Note.*—Each series of figures in this table represents the average result obtained with a number of individual lots of the particular brand.

The smoothed curves, given in Fig. 4, show the average amount of oxygen in cub. cm. absorbed by each of the four different groups of materials and for comparison, also that absorbed by gutta percha obtained from leaves and by balata. As in the case of the experiments on the absorption of water, two sets of curves

are given—one representing the absorption of oxygen by the materials as tested, and the other the absorption calculated for "pure gutta," since here also it is mainly this constituent by which the absorption takes place.

The appendix to the lectures, given in the reprint, contains the results of a complete chemical analysis of the identical specimens of gutta percha used for the determination of the specific gravity and the experiments on the absorption of water and oxygen.

Experiments were also shown to demonstrate the remarkable difference in the behaviour of gutta percha and caoutchouc towards ozone, thin tissue of the former resisting the action of strongly ozonised oxygen for a considerable time, whereas a caoutchouc membrane was pierced by a jet of this gas impinging on it in a few moments. The lecturer also spoke of the applications of gutta percha hardened by extraction of the resin according to his process, proposing it for the use of boats for the arctic regions, on account of its considerably greater strength than that of ordinary gutta percha at very low temperatures, which was demonstrated by experiments.

He also showed that the elasticity of golf balls, as shown by the height of rebound when allowed to drop on a stone slab, depended almost entirely on the percentage of resin in the gutta

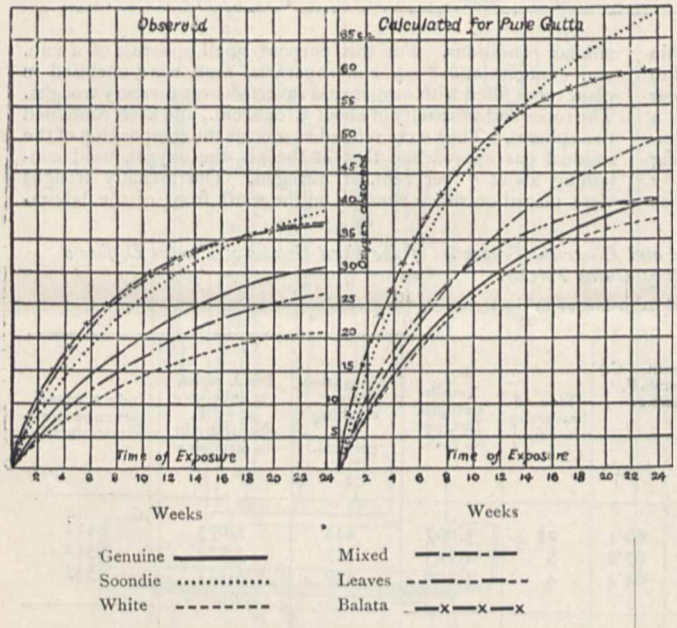


FIG. 4.—Absorption of oxygen by different "classes" of gutta percha. (Two spheres, each 16 mm. diam.)

percha of which they are made; and consequently the treatment by the hardening process is now invariably resorted to, except in the case of gutta percha obtained from leaves by chemical precipitation processes, which consists almost entirely of pure gutta, as has been already mentioned.

## HORN-FEEDING LARVÆ.

SOME few months ago I received a consignment of skulls of antelopes from West Africa, the specimens having been shot by the late Lieut. R. H. McCorquodale, 3rd Dragoon Guards, and on opening the cases I was much struck by the appearance of the horns; all, without exception, were infested by singular thin finger-like protuberances which seemed to grow from the horn, leading me at a first impression to the immediate conclusion that they were some species of fungi; on a nearer inspection I found them to be cocoons, and not having seen anything like them before I looked into what literature I could find on the subject.

As it is, generally speaking, only travellers, or those in touch with travellers, who have the opportunity of seeing the actual cocoons on the horns, a sketch and a few salient points will doubtless be of interest. The skull, that of a Hartebeest, was exhibited at the Linnean Society on January 20 last, and is the original of the sketch; the cocoons are cylindrical and closed at the outer end like the fingers of a glove, extremely tough and composed of a dark grey felt substance, evidently the comminuted fibres of horn, the largest being about three inches in length; these cocoons are formed by the horn-feeding larvæ of the moth known as the *Tinea vastella*, and the following is a description of the insect:—Very pale gilded ochraceous shining. Head ochraceous and tufted above, palpi porrect, pubescent, extending a little beyond the front, much shorter than the breadth of the head, third joint lanceolate, much shorter than the second. Abdomen extending much beyond the hind wings. Legs rather long, hind tibiæ thinly fringed. Wings long, narrow, fringe rather long, fore wings slightly acute, exterior border very oblique, under side and hind wings purplish cinereous, excepting the fringe. Length of the body seven lines, of the wings sixteen lines.

A very interesting point with regard to the habits of this insect, which has not yet been cleared up, but upon which I hope to be able to throw some light, through the observations of

Cocoons ½ natural size. Skull and horns ⅛ natural size.

officers now serving in Africa, is, that it has been asserted to feed on the horns of living animals; and in support of this I will quote the following:—"Dr. Fitzgibbon many years ago while in Gambia stated he was surprised at finding grubs enclosed in cases, which projected from the horns of animals freshly killed, the blood not being yet dry, the carcases of the animals being exhibited in the market place." This statement is recorded in vol. i. of the *Proceedings* of the Dublin Zool. Soc. "In contradiction, Lieut.-Colonel Wenman Coke said he had shot large numbers of various species of horned animals in South Africa. but that he had never seen the horn of a living animal perforated by one of these larvæ, although he had seen many dead horns infested with them. Colonel Coke is most confident that the larvæ never attacks a living animal; he says that had this been the case it could not have escaped his observation; Mr. Truman concurs in expressing great doubt as to the correctness of the theory that the larvæ feed on the horns of living animals." We have the strong evidence of Dr. Fitzgibbon, and might argue that, as the fibrous substance of the horn undergoes little or no change at the death of the animal, there seems no reason why the moth should not deposit its eggs

when the living animal is at rest, nor why the larvæ should not penetrate the horn. I venture to assert as my own opinion, and that of many sportsmen from whom I have made inquiries, that the larvæ does not feed on the horns of living animals; had this been the case, it would not have escaped the observation of some of our "mighty African hunters." Thus Dr. Fitzgibbon's statement stands alone; the question must, however, remain *sub judice*.

The habitat of the moth was generally supposed to be Africa, but Sir George Hampson showed me some specimens which he had collected in various districts in India.

I am indebted to Lord Walsingham, who kindly gave me some very useful notes, he having himself written a few years ago on the subject; also to Mr. P. H. Miller for a very faithful sketch.

W. H. MCCORQUODALE.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

CAMBRIDGE.—In connection with the Congress of Physiology and the Congress of Zoology to be held in Cambridge towards the end of August, the University proposes to confer the honorary degree of Doctor of Science on the following distinguished foreign representatives. For Physiology: Prof. Bowditch, Harvard; Prof. Golgi, Pavia; Prof. Kronecker, Berne; Prof. Kühne, Heildeberg; and Prof. Marey, Paris. For Zoology: Dr. Anton Dohrn, Naples; Prof. Milne-Edwards, Paris; Prof. Haeckel, Jena; Prof. Hubrecht, Utrecht; and Prof. Kowalevsky, St. Petersburg.

The annual report of the Museums Syndicate testifies to the great activity of the science departments and the ever-growing importance and value of the collections acquired by the University. Numerous expeditions have left Cambridge to prosecute researches in far distant lands, and have returned with important and extensive trophies of their work. South America, through Mr. Graham Kerr and Mr. Budgett, has yielded some fine zoological series. The South Pacific fauna has been illustrated by the spoils of Mr. Stanley Gardiner of the Funafuti expedition. Dr. Willey has brought unique contributions from New Britain; and both he and Prof. Flinders Petrie have greatly enriched the magnificent collection of crania under the charge of Prof. Macalister. Other additions are due to Dr. Haddon (Torres Straits), Sir W. L. Buller (Macquarrie Island), Prof. Wiltshire and Mr. H. H. W. Pearson (Ceylon), and many other workers and benefactors.

Mr. Frank Morley, of King's College, the author of numerous works and memoirs in pure mathematics, has been approved for the degree of Sc.D.

The complete list of matriculations for the year has now been published. It appears that 931 students have joined the University in 1898, as compared with 887 in the preceding year.

Dr. Alex. Hill has been re-elected Vice-Chancellor for the ensuing academical year.

Mr. R. Pendlebury, and Mr. A. E. H. Love, F.R.S., Fellows and Lecturers of St. John's College, have been appointed University Lecturers in Mathematics.

A University Lectureship in Chemical Physiology is to be established in connection with Prof. Foster's department, but the University is unable to assign any stipend to the post at present. The lecturer will be remunerated from the students' fees.

Hitherto the same persons have acted as examiners in Anatomy and in Physiology respectively for the Natural Sciences Tripos, Parts i. and ii., and for the Medical examinations. The number of candidates has increased so largely (it is now 310 in physiology, and 252 in anatomy) that the work involved is too much for one pair of examiners. It is accordingly proposed to divide the duty by appointing separate examiners for the Tripos and for the M.B. examinations.

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PROF. E. B. FROST, of Dartmouth College, has been elected professor of astrophysics at Yerkes Observatory; and Prof. E. F. Nichols has been appointed professor of physics in Dartmouth College.

MR. WILLIAM BUTLER DUNCAN, of New York City, has presented to Yale University the Hotel Majestic at New Haven, to be used as a dormitory, and to be called the Duncan Dormitory.

IN replying to questions referring to the Government measures which it is intended to bring forward shortly, Mr. Balfour informed the House of Commons on Monday that the Lord President of the Council would introduce, "in another place," a Bill dealing with the organisation of secondary education, and he hoped the London University Bill would be passed.

ABOUT a year ago the Lords of the Committee of Council on Education decided to make inquiries as to the number of pupils in public and private secondary and other schools (not being public elementary or technical schools) in England, and the teaching staff in such schools. These schools are very various in character, in constitution, and in size; but, broadly speaking, they furnish to the country what is known as secondary or intermediate education in its different grades, and fill the gap between the public elementary schools and the universities or university colleges. They include schools in which educational efficiency is at a minimum, and schools (unfortunately but a small proportion) where rational methods of instruction are followed. The results of the inquiries made through the Education Department have just been published in a Blue Book. The Return represents the first attempt which has been made in this country to give a statistical survey of the schools in the great province of national education which is intermediate between the public elementary schools and institutions of academic rank or for technical training. It shows the various forms of control and ownership under which these schools are carried on, but, as they do not come under any comprehensive system of inspection, no pronouncement can be made as to their educational efficiency or inefficiency. The number of pupils in the 6209 schools comprised in the Return are 291,544; of these 158,502 are boys, and 133,042 are girls. Only 9 per cent. of the boys are more than sixteen years of age, and 11 per cent. of the girls. As to the staff, 32 per cent. of the boys' schools are without graduates on the attached staff, 73·8 per cent. of the girls' schools, and 81·3 per cent. of the mixed schools. From this it will be seen that 61·6 per cent. of all the schools on the Return have only non-graduates on the exclusively attached staff. Of course, this division into schools with graduates and without graduates on the staff only affords a rough criterion as to the character of the instruction, for graduates are not necessarily good teachers, nor are good teachers necessarily graduates. It is, however, time that steps were taken to insist upon all private schools giving public guarantees of their educational efficiency.

## *SOCIETIES AND ACADEMIES.*

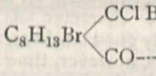
### LONDON.

**Linnean Society**, May 5.—Dr. A. Günther, F.R.S., President, in the chair.—Dr. Bernard Renault and Prof. Max Carl Wilhelm von Weber were elected Foreign Members of the Society.—A paper was read by Sir John Lubbock, Bart, M.P., F.R.S., on some Spitsbergen Collembola. Owing to the well-known tolerance of cold by insects belonging to this order, it was, he thought, not surprising that several species should occur in Spitsbergen. Eleven species of *Collembola* had been found in Greenland, as recorded by Meinert (Vidensk. Meddel., 1896, pp. 167–173), and five species were already known from Spitsbergen. He was now able to add two more, one of which was new. This he proposed to call *Isotoma spitsbergenensis*. The second species, *Isotoma quadrioculata*, had been previously met with in Greenland. Both of these were obtained by Mr. Trevor Battye during Sir Martin Conway's expedition to Spitsbergen in 1896.—Miss Ethel Barton, by permission of the President and Council, read a paper on the structure and development of *Soranthera*, a genus of brown Algæ (*Phæophyceæ*) containing a single species, *S. alvoidea*.—Mr. J. T. Cunningham read a paper dealing with the evolution of animal structure, and entitled "The Species, the Sex, and the Individual." The general conclusion arrived at by the author was that adaptation was not produced indirectly by selection from indefinite variations, but directly by the influence of stimulation in modifying the growth of the parts or organs of the body.

**Geological Society**, May 18.—W. Whitaker, F.R.S., President, in the chair.—The garnet-actinolite schists on the southern side of the St. Gothard Pass, by Prof. T. G. Bonney, F.R.S. The author described the field relations and the microscopic structures of a group of schists or gneisses characterised by the frequent presence of conspicuous garnets and actinolites

which are exposed on the southern slopes of the St. Gothard Pass and for some distance west and east, on the northern side of the Val Bedretto. These rocks in the field might be regarded as highly-altered sedimentary strata (as the author once thought) or as a group of igneous rocks (originating possibly in magmatic differentiation) affected by fluxion-movements anterior to consolidation. To the latter view he now inclined, but considered the schistosity and the peculiar minor structures to be the results of crushing (generally without marked shearing) followed by very considerable mineral reconstruction.—On the metamorphism of a series of grits and shales in Northern Anglesey, by Dr. C. Callaway. While mechanical force has been concerned in producing the more intense metamorphism of the lower part of the series, the author was not disposed to advance this as the sole cause of the changes produced.—On a volcanic series in the Malvern Hills, near the Herefordshire Beacon, by H. D. Acland. It is suggested that the rocks may be the volcanic equivalents of the plutonic rocks of the Malvern axis, faulted down and protected by the bend in the axis which occurs in the neighbourhood of the Herefordshire Beacon.

**Chemical Society**, May 19.—Prof. Dewar, President, in the chair.—The following papers were read:—The liquefaction of hydrogen and helium, by J. Dewar. Hydrogen was liquefied by allowing the gas cooled to $-205°$, and under 180 atmos. pressure, to expand; about 1 per cent. of the gas liquefied. Helium was liquefied by cooling in liquid hydrogen.—The action of formaldehyde on amines of the naphthalene series, Part 1, by G. T. Morgan. Formaldehyde acts on β-naphthylamine in alcoholic solution containing hydrochloric acid yielding naphthacridine, and bases of the composition $C_{21}H_{13}N$, $C_{22}H_{16}N_2$, and $C_{23}H_{18}N_2$.—On the constitution of oleic acid and its derivatives, Part 1, by F. G. Edmed. Pelargonic and azelaic acids, as well as two hydroxystearic acids, are formed on oxidising oleic and elaidic acids; the author therefore assigns the constitution $CH_3(CH_2)_7CH:CH(CH_2)_7CO_2H$ to the two latter acids.—Stereoisomeric derivatives of camphor, by T. M. Lowry. On recrystallising dibromochlorocamphor,



its rotatory power changes, indicating the existence of stereoisomerism.

CAMBRIDGE.

**Philosophical Society**, May 16.—Mr. F. Darwin, President, in the chair.—On the figures produced on photographic plates by electric discharges, by Mr. J. A. McClelland. When an electric discharge has passed to the surface of a photographic plate a distinct figure is produced when the plate is developed, and the form of the figure is dependent on the sign of the discharge. The object of the paper is to determine whether these figures are produced by some direct electrical action on the film, or by the light which accompanies the discharge. Figures were taken with the plates in air at various pressures, and as the pressure was diminished the branching lines in the figures became broader and less distinct, as they would if produced by the light of the discharge in the air close to the film. The transparency of various substances was tested, and while no effect was produced through thin slips of ebonite, the effect through glass and mica was quite distinct. The experiments seemed to show that the light of the discharge was chiefly instrumental in producing the figures. The difference in the positive and negative figures is due to the difference in the discharge in air in the two cases.—On a method of facilitating the measurement of temperature by platinum thermometry, by Mr. E. B. H. Wade. Attention is drawn to the inconvenience arising from the fact that equal increments of the resistance of platinum wire do not represent equal increments of the temperature. A form of Wheatstone's Bridge is then described in which the inconvenience disappears. The resistance of the platinum is balanced by that of two resistance boxes in parallel, plugs being transferred from one box to the corresponding places in the other till the balance is obtained. It is shown that when this is done, equal increments of the resistance in one box may be made to represent equal increments in the temperature of the platinum wire. Accuracy is not sacrificed in obtaining the simplification resulting from this method.—The development of *Peripatus novæ-britanniæ*, by Dr. A. Willey. The ova are without yolk, and the nutrition of the embryo is effected by the development of a large trophic vesicle, which occupies the entire dorsum of the embryo, and projects far in front of the embryo as a head-fold and behind as a tail-fold. The trophic vesicle is thus a hollow closed cylinder lined internally by endoderm and externally by ectoderm, the cells of the latter being adapted for absorption of nutriment. The trophic folds were compared with the amniotic folds of insects. The trophic cavity becomes the gastral cavity of the adult, and in the transformation from one to the other the endoderm undergoes certain changes. It secretes a basal membrane and a cuticular membrane simultaneously with a great increase in thickness; and between the two membranes the endoderm contains numerous small and large yolk-like globules, which are probably to be regarded as reserve nutrient matter to tide the embryo over the first few days of its independent life. This late deposition of reserve nutrient matter derived ultimately from the maternal organism, as opposed to foreign ingested matter, is probably of some significance with regard to the question of the lecithality of the ovum. The embryo lies outside on the ventral surface of the trophic vesicle just as an insect embryo lies upon the yolk.—On Röntgen rays and ordinary light, by Mr. C. Godfrey. Prof. J. J. Thomson has shown that the sudden stoppage of an electron gives rise to a thin electric pulse which is propagated through the medium; these pulses he identifies with Röntgen rays. The application of Fourier analysis shows that the assemblage of these pulses is equivalent to a mixture of simple harmonic waves of all wave-lengths; a peculiar feature is that these waves are absent whose lengths are sub-multiples of the thickness of the pulse. Most of the energy is resident in the short waves; but about 1/1000 of the whole energy will be visible light. The pulses suggested by Sir George Stokes as affording an explanation of Röntgen rays differ from Prof. Thomson's in one respect; the integrated displacement through the thickness of the pulse is zero. On this property Sir G. Stokes bases his proof that there will be no diffraction; and it may be seen that these pulses (taken to be of the same thickness as Prof. Thomson's) will have only $10^{-9}$ of this energy in the visible spectrum.—On the possibility of deducing magneto-optic phenomena from a direct modification of an electro-dynamic energy function, by Mr. J. G. Leathem. The method initiated by Maxwell for the explanation of the Faraday effect depended on the direct insertion of a magneto-optic term in the energy. This method was extended by Fitzgerald and others to the explanation of Kerr's effect, namely the modification introduced in the circumstances of optical reflexion by magnetisation of the reflector. A difficulty occurred, however, in satisfying all the interfacial conditions, which virtually showed that such a scheme was not formally self-consistent. The origin of the discrepancy has been traced by Mr. Larmor ("Report on the Action of Magnetism on Light," Brit. Assoc., 1893) to omission to secure what may for shortness be called the electromotive incompressibility of the medium: in the ordinary problem of optical reflexion there is no tendency for this to be disturbed, but when Maxwell's magneto-optic energy terms are included, the reaction against compression introduces what may be termed an electric pressure, which must appear in the equations. It was necessary to compare the modified scheme thus obtained with experimental knowledge: and the calculations given in this paper show that in fact it does not represent the phenomena. The paper is only a summary of the actual calculations, because since they were completed the author has shown ("On the Magneto-optic Phenomena of Iron, Nickel and Cobalt," *Phil. Trans.* 1897), that the other rigorous theory formulated as an alternative by Mr. Larmor (*loc. cit.*), which leads to an analytical scheme practically the same as those advanced on various hypotheses by Fitzgerald, Goldhammer, Basset, Drude, and others, is in much more satisfactory agreement with experiment. This brief history of the subject shows the desirability of the examination of the consequences involved in the former method of explanation; the result is, however, what was to be expected by those who adhere to the more recent formulation (Larmor: "A Dynamical Theory of the Electric and Luminiferous Medium," Part 3, *Phil. Trans.*, 1898) of optical theory, which treats a material medium as free æther pervaded by discrete molecules involving in their constitution electrons considered as nuclei of intrinsic æthereal strain. On such a view a continuous energy function is not the starting-point, and the influence of these discrete nuclei could hardly be conceived to modify the propagation in the intervening æther in so fundamental a manner as an electromotive pressure would demand.—On the solutions of the equation $(\nabla^2+\kappa^2)\psi=0$ in elliptic coordinates and their physical applications, by Mr. R. C.

Maclaurin.—On the interpretation of divergent solutions of the hypergeometric equation, by Mr. W. McF. Orr. The author obtains divergent series satisfying a general hypergeometric equation, and estimates the error involved in choosing a finite number of terms of such a series as a solution of the equation.

EDINBURGH.

**Royal Society**, May 16.—Lord Maclaren in the chair.—Prof. Crum Brown read a paper on the origin of certain of the Phœnician alphabet characters. The idea was to ascertain whether any of them can plausibly be regarded as modifications of others. It was suggested, for example, that *Aleph* was deduced from *Argin* by the addition of a central vertical stroke, *Heth* from *He* and *Tsade* from *Zain* by the addition of a vertical stroke at the left side, *Caph* from *Gimel* and *Samesh* from *Zain* by the addition of a horizontal stroke, *Pe* from *Beth* by opening the loop (or *vice versâ*), *Daleth* from *Tau* by the addition of a diagonal stroke, &c. Attention was called to the risks of being misled by accidental resemblances and to the bearing of such guesses on de Rougé's hypothesis.—Mr. T. C. Baillie read a paper on the thermal conductivity of nickel. The value he obtained by use of Forbes' method was '117. What was believed to be a better value, namely '103, was obtained by a new method, which had the great merit of giving an experimental value of the thermal conductivity directly without requiring the specific heat to be known. A short bar had its one end kept at a steady high temperature as in the Forbes' experiment. To the other end a small cap was attached, through which a steady stream of water was passed. The temperature of the water was taken just as it entered the cap, and just as it left it. The quantity of water passed in a given time being known, the amount of heat lost from the end of the bar to the water was calculated in terms of the specific heat of water. By means of thermometers set at intervals along the bar, the gradient of temperature was indicated, and a good approximation to the value of the gradient at the position occupied by the cap could be calculated. These measured quantities, the gradient and the heat lost, give at once the conductivity. The paper also contained an account of a simple method for determining the thermometer corrections.—Prof. D'Arcy Thompson, in a paper on the crab in mythology, drew attention to the fact that in old coins the crab is always found associated with those deities which are astrologically connected with the zodiac sign *Cancer*, and with animals that give names to constellations which are astronomically related to the constellation Cancer.

PARIS.

**Academy of Sciences**, May 31.—M. Wolf in the chair.—Photographic studies on some parts of the surface of the moon, by MM. Lœwy and Puiseux.—Remarks on the third part of the photographic atlas of the moon, published by the Paris Observatory.—On the preparation and properties of the di-alkylamido-anthraquinones, by MM. A. Haller and A. Guyot. Dimethylamido-benzoylbenzoic acid heated at 180° with strong sulphuric acid gives about one-third of the theoretical yield of dimethylamido-anthraquinone. The yield is more than doubled by starting with the reduction product, dimethylamido-benzoylbenzoic acid, condensing this with sulphuric acid, and oxidising the product with ferric chloride. The corresponding ethyl derivatives were prepared in a similar manner.—On the creation of new articulations between bones normally independent, in the case where the old articulations cannot be reconstituted owing to their having been completely destroyed, by M. Ollier.—Formation in blood serum, under the action of chemical substances, of a material capable of coagulating the bacilli of true tuberculosis, by M. S. Arloing. It has been shown in a previous paper that the blood serum of tuberculised goats contains a substance which is capable of coagulating the tubercle bacilli from a homogeneous culture. It is now shown under that prolonged treatment, by injection of such substances as eucalyptol, guiacol, creosote, and solution of corrosive sublimate, the blood serum acquires the same property, the last-named substance giving the most active serum. The author points out that all these chemical substances have been proposed for the treatment of tuberculosis in man.—On a flying apparatus, by M. Ader. The apparatus described does not belong to the class of aeroplanes, but attempts to reproduce the curves of the wings of birds in flying.—On surfaces of total constant curvature, by M. C. Guichard.—On the form which by the suppression of certain terms becomes a development in complete series, by M. Riquier.—On a method of determining the order of a fringe of high order, by MM. Ch. Fabry and A. Perot. The fringes produced by the interference of the reflections from two parallel silvered plates some three or four centimetres apart are of a very high order. By throwing simultaneously rays of two different known wave-lengths (say red and green), and noting the positions of exact coincidence of a red and green ring, the order can be determined.—On the kathode rays, by M. P. Villard. If the antikathodic wall of a Crookes' tube is covered with cupric oxide glass, cuprous oxide is formed by the action of the rays. This reduction is attributed to hydrogen, furnished by the traces of water given up by the glass. In a tube with mercury electrodes, in which the vacuum was formed by boiling out with mercury, no kathode rays could be formed.—Action of some carbonates upon chromous acetate, by M. G. Baugé.—On the states of equilibrium of a ternary system, lead-tin-bismuth, by M. Georges Charpy. The results are expressed in the form of a curve, Thurston's triangular diagram.—On dimethylpiperazine and some phenolic combinations of this base, by MM. P. Cazeneuve and Moreau.—Heats of neutralisation of phenylphosphoric acid, by M. G. Belugou.—On some halogen derivatives of ethyl-phenyl-ketone, by M. A. Collet. The ketones described were prepared from propionyl and bromopropionyl chlorides, and the halogen benzene derivative by Friedel and Craft's reaction, and include ethyl-*p*-chlorphenyl-ketone, ethyl-*p*-bromophenyl-ketone, bromoethyl-*p*-chlorophenyl-ketone and bromoethyl-*p*-bromophenyl-ketone, together with their oximes, and phenylhydrazones.—On the solipedisation of the Equidæ during recent times, by M. G. Joly. A comparison of the osteology of the horse of the quaternary period with that of the present day shows that the alterations of structure corresponding to increased speed can be readily traced, and are probably still going on.—On *Acinetospora pusilla* and the sexuality of the Tilopteridæ, by M. C. Sauvageau.—On the growth of a green plant, in absolute darkness, by M. R. Bouilhac. The algæ nostoch can be grown in complete absence of light, and has a green colour, although less intense than when grown in sunlight. It is essential that glucose be present in the culture fluid.—On polymorphism, by M. Fred. Wallerant.—Examination of a combustible material by means of the X-rays, by M. H. Couriot. The method affords a ready means of determining the amount of mineral impurity present in a coal.—The artesian basin of the "Oued Rir," and the best means of utilising its irrigation waters, by M. Georges Rolland.—On the distribution of gluten and its immediate principles in the farinaceous nucleus of the wheat grain, by M. E. Fleurent.—Influence of asphyxia upon the amount of carbonic oxide in the blood.—Production of carbon monoxide in the organism, by M. Maurice Nicloux. The carbonic oxide found in the blood would appear not to be derived from the air, but to be a substance formed normally by the organism.—Researches on the ostioles of the cerebro-spinal system, by M. J. J. Andeer.

AMSTERDAM.

**Royal Academy of Sciences**, April 23.—Prof. van de Sande Bakhuyzen in the chair.—Mr. Hamburger on the result of experiments showing that venous propulsive pressure promotes in a high degree the destruction of bacilli anthraces and their spores, which have been introduced under the skin.—Prof. Pekelharing presented a paper by Dr. G. C. J. Vosmaer and himself, entitled "Observations on Sponges," which will be published in the *Transactions* of the Academy.—Prof. Franchimont presented on behalf of Dr. P. van Romburgh a paper for publication in the report of the meeting, entitled "On the occurrence of cinnamic methyl ether in *Alpinia Malaccensis*, Rosc." On distillation with water the rootstocks of this plant yielded about 0·2 per cent. of ethereal oil, specific gravity 1·039 at 27°, exerting a right-handed rotation of 1°·5 in a tube 200 mm. in length. On the temperature being lowered, cinnamic methyl ether crystallised out—the liquid residue seemed to contain terpenes—which substance was not only detected by vapour density and analysis, its melting-point, 36°, and its boiling-point, 159°, but it also saponified, after which the two components, into which it was split up, were detected, cinnamic acid by its melting-point, 133°, and its other properties; methyl alcohol *e.g.* by the formation of the addition product with nitrotrimethylphenylenediamine, which crystallised in orange-coloured needles. Cinnamic methyl ether in chloroform, on being treated with bromine, yielded a dibromic addition product, melting at

116°, consequently phenyl αβ-dibromic propionic methyl ether. The leaves of this plant, too, are rich in methyl cinnamite. This is the first instance of cinnamic methyl ether being found in the vegetable kingdom.—Prof. van Bemmelen made on behalf of Dr. E. A. Klobbie a communication entitled "Qualitative-analytic determination of osmic tetroxide," which will be inserted in the report of the meeting.—Prof. H. A. Lorentz on optical phenomena, depending on the mass and the charge of the ions (II.). The author discussed the question whether the density of the absorbing gas itself and of other gases, with which it is mixed, has any influence on the position of the absorption lines in the spectrum. The formulæ show no appreciable influence, if the absorption is small in a layer of the thickness of one wave-length.

## DIARY OF SOCIETIES.

*THURSDAY*, JUNE 9.

ROYAL SOCIETY, at 4.30.—On a New Constituent of Atmospheric Air: Prof. W. Ramsay, F.R.S., and Morris H. Travers.—Experiments on Aneroid Barometers at Kew Observatory and their Discussion: Dr. C. Chree, F.R.S.—The Nature of the Antagonism between Toxins and Anti-Toxins: Dr. C. J. Martin and Dr. T. Cherry.—Some Differences in the Behaviour of Real Fluids from that of the Mathematical Perfect Fluid: A. Mallock.—On the Heat Dissipated by a Platinum Surface at High Temperatures: J. E. Petavel.

ROYAL INSTITUTION, at 3.—Modern Methods and their Achievements in Bacteriology: Dr. E. E. Klein.

MATHEMATICAL SOCIETY, at 8.—On the General Theory of Anharmonics: Prof. E. O. Lovett.—Point-Groups in a Plane, and their Effect in determining Algebraic Curves: F. S. Macaulay.—On a Regular Rectangular Configuration of Ten Lines: Prof. F. Morley.—On the Calculus of Equivalent Statements (eighth paper): H. MacColl.—On the Conformal Representation of a Pentagon on a Half Plane: Miss M. E. Barwell.—On a Continuous Group defined by any Given Group of Finite Order (second paper): Prof. Burnside, F.R.S.

*FRIDAY*, JUNE 10.

ROYAL INSTITUTION, at 9.—Some Experiments with the Telephone: Lord Rayleigh.

ROYAL ASTRONOMICAL SOCIETY, at 8.—Observations of Phenomena of Jupiter's Satellites in the Year 1897: John Tebbutt.—Occultations of Ceres and Venus: Cambridge Observatory.—Reply to Dr. Rambaut's Note on the Effect of Chromatic Dispersion: David Gill.—Right Ascensions and Declinations of Eight Stars in Aquarius, and their Probable Proper Motions: C. J. Merfield.—Further Researches on the Orbit of γ Lupi: T. J. J. See.—On the Actinic Qualities of Light as affected by different Conditions of Atmosphere: Rev. J. M. Bacon.

PHYSICAL SOCIETY, at 5.—Exhibition of a Model illustrating Dr. Max. Meyer's New Theory of Audition: Prof. S. P. Thompson, F.R.S.—Attenuation of Electric Waves along a Line of Negligible Leakage: Dr. E. H. Barton.—Diffusion Convection: A. Griffiths.

MALACOLOGICAL SOCIETY, at 8.—On the Land Shells of Curaçoa and the Neighbouring Islands: Edgar A. Smith.—On the Anatomy and Synonymy of the Genus of *Mariaella* (Gray): W. M. Webb.—A Note on a New Form of Arionidæ from the Alps in Austria: J. F. Babor.—Descriptions of New Land Shells from Ceylon: E. R. Sykes.—List of the Land and Freshwater Mollusca of South Africa: J. C. Melvill and J. H. Ponsonby.

*SATURDAY*, JUNE 11.

ROYAL INSTITUTION, at 3.—The Temples and Ritual of Asklepios at Epidaurus and Athens: Dr. R. Caton.

GEOLOGISTS' ASSOCIATION (Waterloo Station, S.W.R.), at 1.50.—Excursion to Godalming. Director: T. Leighton.

*TUESDAY*, JUNE 14.

ROYAL HORTICULTURAL SOCIETY.—Lecture on Hybrid Orchids.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Evidence of Lake Dwellings on the Banks of the Costa, near Pickering, North-east Yorkshire, with Illustrative Specimens: Captain the Hon. Cecil Duncombe.—Exhibition of a Large Collection of Stone Implements from Illinois and Ontario, with Descriptive Remarks: Rev. James Oliver Bevan.—On Marriage Laws and Customs of the Cymri: R. B. Holt.

*WEDNESDAY*, JUNE 15.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Frequency of Non-Instrumental Meteorological Phenomena in London with Different Winds from 1763 to 1897: R. C. Mossman.—Progress of the Exploration of the Air by means of Kites at Blue Hill Observatory, Mass., U.S.A.: A. Lawrence Rotch.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—Exhibition of Sponges: B. W. Priest.——At 8.—Report on the Foraminifera of the Malay Archipelago (continuation): F. W. Millett.

*THURSDAY*, JUNE 16.

ROYAL SOCIETY, at 4.30.

LINNEAN SOCIETY, at 8.—Observations on the Seasonal Variations of Elevation in a Branch of Horse-Chestnut Tree: Miller Christy.—On Pantopoda collected by Mr. W. S. Bruce in the Neighbourhood of Franz-Josef Land: G. H. Carpenter.—Morphological Relationships of the Actiniaria and Madreporaria: J. E. Duerden.—On some Fossil Leporines: Dr. C. I. Forsyth Major.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows.—Preparation of a Standard Acid Solution by Direct Absorption of Hydrogen Chloride: Dr. G. T. Moody.—Researches on the Terpenes. III. Halogen Derivatives of Fenchene and their Reactions. IV. On the Oxidation of Fenchene: J. A. Gardner and G. B. Cockburn.

*SATURDAY*, JUNE 18.

GEOLOGISTS' ASSOCIATION (London Bridge, L.B.S.C.), at 12.25.—Excursion to Crowborough. Directors: G. Abbott and R. S. Herries.

## BOOKS, PAMPHLET, SERIALS &c., RECEIVED.

BOOKS.—Dante's Ten Heavens: E. G. Gardner (Constable).—Die Zelle und die Gewebe: Prof. Dr. O. Hertwig, II. (Jena, Fischer).—Lehrbuch der Botanik für Hochschulen: Prof. Strasburger and others, Dritte Verbesserte Auflage (Jena, Fischer).—Th. Thorodssen, Geschichte der Isländischen Geographie, Autorisierte Übersetzung von A. Gebhardt, Zweiter Band (Leipzig, Teubner).—Angling Days: J. Dale (E. Stock).—Essai sur la Classification des Sciences: Prof. E. Goblot (Paris, Alcan).—Automobiles sur Rails: J. Dumont (Paris, Gauthier-Villars).—Ostwald's Klassiker der Exakten Wissenschaften, Nos. 93 to 96 (Leipzig, Engelmann).—Practical Plant Physiology: Prof. W. Detmer, translated by S. A. Moor (Sonnenschein).—Year-Book of the Scientific and Learned Societies of Great Britain and Ireland, 15th Annual Issue (Griffin).—The Heat Efficiency of Steam Boilers: B. Donkin (Griffin).—Introduction to Algebra: Prof. G. Chrystal (Black).

PAMPHLET.—Summary Survey of the Geological Survey Department for the Year 1897 (Ottawa).

SERIALS.—Berichte der Naturforschenden Gesellschaft zu Freiburg i.B., Zehnter Band, 1, 2, 3 Heft (Freiburg i.B.).—Bulletin of the American Mathematical Society, May (N.Y., Macmillan).—Astrophysical Journal, May (Chicago).—Zeitschrift für Physikalische Chemie, xxvi. Band, 1 Heft (Leipzig).—Bulletins de la Société d'Anthropologie de Paris, Tome viii. No. 6 (Paris, Masson).—National Review, June (Arnold).—Scribner's Magazine, June (S. Low).—Strand Magazine, June (Newnes).—Fortnightly Review, June (Chapman).—Engineering Magazine, June (222 Strand).—Transactions of the Royal Society of Edinburgh, Vol. xxxviii. Parts 3 and 4; Vol. xxxix. Part 1 (Edinburgh, Grant).—Proceedings of ditto, Vol. xxii, No. 1 (Edinburgh, Grant).—Meteorological Record, Vol. xvii. No. 67 (Stanford).—Quarterly Journal of the Royal Meteorological Society, April (Stanford).—Geographical Journal, June (Stanford).—Journal of Botany, June (West).—Observatory, June (Taylor).—Atlantic Monthly, June (Gay).

Geological Model of London and Suburbs: J. B. Jordan (Stanford).

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