THURSDAY, JULY 30, 1903.

A MODERN PHYSICIST.

Scientific Papers of Lord Rayleigh. Vols. ii., iii. and iv., 1881–1901. Pp. xiv+598; xii+596; xiv+604. (Cambridge: University Press.)

TO review these volumes in an ordinary sense is an impossible task. Fortunately it is quite unnecessary. Lord Rayleigh's work in its many phases is so well known that a brief notification of the fact that his papers have been collected and published by the Cambridge University Press is almost all that is called for. Every physicist will realise that his library is incomplete without these four splendid volumes, the first of which has already been noticed, and that he will find in their pages the details of many of the most striking advances in his subject during the past twenty years.

Lord Rayleigh succeeded Maxwell as professor of physics at Cambridge in 1879. The first volume under notice opens with his classical work in the Cavendish Laboratory on the electric units; the latter pages of vol. iv. deal with his experimental verification of Boyle's law for pressures down to the hundredth of a millimetre. A list of the papers—272 in number in the four volumes—would cover the whole range of physics, and each contains a contribution of real value to natural knowledge.

During his tenure of the Cambridge chair, Lord Rayleigh undertook the determination of the three fundamental units of electrical science, the ohm, the ampere, and the volt.

"It is generally felt," he writes in the first paper (*Proc.* Roy. Soc., 1881), "that considerable uncertainty still attaches to the real value of the ohm or British Association unit of resistance. The ohm was constructed to represent 10^9 C.G.S. units of resistance, but according to Kohlrausch it is nearly 2 per cent. too great, and according to Rowland nearly 1 per cent. too small."

The ohm, thanks to the work of Lord Rayleigh and those who have followed in his steps, is now known to some few parts in ten thousand.

It is much the same with the ampere and the volt; more recent work has shown that possibly some small change is required in the numbers given by Lord Rayleigh to represent the electrochemical equivalent of silver and the electromotive force of a Clark cell, but the change will be very small. His work made the Clark cell a practical standard, and every electrician now knows its value. The H form of cell is first described on p. 315 of the second volume of the papers.

But this series of papers did not exhaust his experimental work at Cambridge; the researches on the value of the ohm would have been incomplete without the determination of the specific resistance of mercury (Article 81) by Mrs. Sidgwick and himself. The experiments on the rotation of the plane of polarisation of light in a magnetic field were planned at first in the hope of utilising the results in the measurement of an electric current, and though this hope was not realised, they remain as the standard determination of Verdet's constant. A second paper on the Clark cell is dated 1886.

A short paper (No. 92) from the *Philosophical Magazine*, vol. xiv., 1882, will serve as an example of Lord Rayleigh's work as a critic. It is a comparison of the methods for the determination of resistances in absolute measure, and affords a most valuable *résumé* of the methods employed.

Resistance being on the electromagnetic system of the dimensions of a velocity, the measurement of a length and a time are necessary; the principal length involved is nearly always the mean radius of a coil, and the presumption is in favour of the method which involves only a single linear measurement.

The paper exhibits in a marked degree Lord Rayleigh's great capacity for seeing distinctly the essential point of an experiment or a measurement, and keeping that clearly in view throughout. This, indeed, is the distinguishing feature of his experimental work, a main factor in his success. Those who knew the Cavendish Laboratory when the electrical measurements were going on, or have since visited the laboratory at Terling, from which no less important work is continually being published, have sometimes been surprised at the makeshift character of much of the apparatus. Contrivances of wood and wire and wax do duty where most men would use apparatus elaborated with a quite unnecessary care; but in Lord Rayleigh's case, while the essential instrument on which the accuracy of the result really depends is as perfect as the skill of the workman can make it, and, in addition, has been thought out in all its details so as to fit it best for the purpose immediately in view, for the rest the arrangement which comes first to hand is utilised without regard to appearances.

In addition to the fundamental measurements already referred to, the Cambridge years were marked by a series of optical papers of great value. Among these may be mentioned the article on optics for the ninth edition of the "Encyclopædia Britannica," in which the theory of the resolving power of an optical instrument is given in a simple manner.

The papers already mentioned are contained in vol. ii. of the collected works. Those in vol. iii., written after Lord Rayleigh had resigned the Cambridge chair, differ somewhat in character, but are no less interesting. The article on the wave theory of light from the "Encyclopædia Britannica," and the papers on the relative densities of hydrogen and oxygen, and the composition of water, Articles 146, 153, 187, are perhaps the most important.

Attention may also be directed to a series of papers on capillary questions, while Article 191, on the physics of media that are composed of free and perfectly elastic molecules in a state of motion, has a special interest. Waterston had communicated to the Royal Society in 1845 a paper with the above title, which remained unpublished until 1892, when Lord Rayleigh's attention was directed to it, and the paper was printed in the *Phil. Trans.* with an introduction by himself. Waterston was the first to introduce into the kinetic theory the notion that heat and temperature are to be measured by the kinetic energy of the moving particles. From

this he deduces the law of Dalton and Gay Lussac, and he further establishes, though in an incomplete manner, the law that in mixed gases the mean kinetic energy is the same for the different sets of molecules present, from which Avogadro's law and Graham's law of diffusion follow at once. The memoir also contains the first calculation of molecular velocity, and points out the relation of this velocity to the velocity of sound.

The papers on the relative densities of hydrogen and oxygen find a fitting sequel in some of the earlier papers of the fourth volume, the first of which is on the density of nitrogen, Article 197. This begins:—

"I am much puzzled by some recent results as to the density of nitrogen, and shall be obliged if any of your chemical readers"—the article is a letter to this Journal, NATURE, vol. xlvi. pp. 512, 513, 1892—"can offer suggestions as to the cause. According to two methods of preparation I obtain quite distinct values. The relative difference, amounting to about 1/1000 part[1] is small in itself, but it lies entirely outside the errors of experiment, and can only be attributed to a variation in the character of the gas."

And the paper concludes:—

"Is it possible that the difference is independent of impurity, the nitrogen being to some extent in a different (dissociated) state?"

The matter is again referred to in the Royal Society paper, No. 201, on the density of the principal gases, published in the *Proceedings* of 1893, and in detail in Article 210. On an anomaly encountered in determinations of the density of nitrogen gas (*Proc.* Roy. Soc., 1894), when it appeared that while the weight of nitrogen derived from the air required to fill a certain globe under standard conditions was 2·3102 grammes, when the nitrogen was obtained as a chemical product from other sources than the air the weight was 2·2990 grammes, a difference of 11 milligrammes, or one-half per cent. The question was answered satisfactorily by the paper which appears as No. 214, "Argon, a New Constituent of the Atmosphere," by Lord Rayleigh, Sec.R.S., and Prof. William Ramsay, F.R.S. (*Phil. Trans.*, clxxxvi., A, 1895), and an interesting account of the discovery is contained in the Royal Institution lecture on argon, which forms Article 215.

The *Phil. Trans.* paper contains the account of the means used to separate from the nitrogen of the air the new dense gas the presence of which Lord Rayleigh had discovered, as a residual, by the accuracy of his weighings.

A number of further papers dealing with argon and some of the other new gases are contained in this volume. One of the latest is on the verification of Boyle's law for low pressures. There is also much valuable optical work, specially, perhaps, Article 198, on the intensity of light reflected from water and mercury at nearly perpendicular incidence, and many important investigations of a mathematical character on the electromagnetic theory of light. Among these may be noted Article 227, on the passage of waves through apertures in plane screens, and Article 230, on the incidence of aërial and electric waves on small obstacles.

[1] The difference ultimately found was 1/200.

Perhaps enough has been written to convey to readers who are not professed students of physics the width of range and the power of Lord Rayleigh's work, and to unite them with those who look to him as their leader and master in thanking him for collecting his papers in these four volumes, and rendering them accessible to all.

It is almost needless to add that the University Press has done its part admirably, and fully deserves the thanks of students of nature for its share in the work.

Within a few years the Cambridge Press has published the collected works of Adams, Cayley, Maxwell, Stokes, Tait, Kelvin, Reynolds, and Rayleigh, men whose names will ever make the Cambridge school of mathematics and physics of the last half of the nineteenth century famous in the history of science.

MICRO-ORGANISMS IN THE ARTS AND MANUFACTURES.

Technical Mycology: the Utilisation of Micro-organisms in the Arts and Manufactures. By Dr. Lafar. Translated by C. T. C. Salter. Vol. ii. *Eumycetic Fermentation*, Part i. Pp. viii+189. (London: C. Griffin and Co., Ltd., 1903.)

THE first volume of Mr. Salter's translation of Dr. Lafar's "Technical Mycology," which made its appearance some four or five years ago, opened up to the general reader a very wide and interesting field, the utilisation of micro-organisms in the arts and manufactures. This volume dealt with schizomycetic fermentation, and to the uninitiated who had not looked into the scheme of the whole work, it appeared as though almost the last word must have been said on fungi and fermentation.

The first part of the second volume, the advent of which has been eagerly awaited, has now come to hand, and we may say at once that in many ways it is equal to the first volume and that, not only have we the results of the author's own experience and observations, but a *résumé* of the results of others well brought up to date. This volume deals with the eumycetic fermentation and opens with a series of chapters on the rudiments of the general morphology and physiology of the Eumycetes, chapters of as great interest to the general biologist as to the bacteriologist and fungologist. A short description of the structure of the Eumycetes is given, the method of spore formation, the development of the mycelium from the spore, the gemmating mycelium, and the various methods of reproduction—fructification by sporangia, zygospores, conidia, or by the formation of oidia and gemmæ without the intervention of conidiophores. The author refers the reader for more detailed accounts of structure and function to the early text-books provided by Zopf, De Bary, and Brefeld, but supplements these works by carefully written chapters on certain parts of the subject on which much work has been done since the appearance of these text-books. He describes the researches which have been carried out on the celluloses, chitin, hemicelluloses, and other carbohydrates of which these fungi are composed, dis-

cusses the position of their colouring matter and ascribes the waterproof character of certain cell membranes to the deposition of excreted fatty or waxy substances, pointing out that this waterproof character is of importance biologically,

"since it prevents the penetration of toxic substances from the surrounding aqueous medium, and thereby also opposes the attempts of the mycologist to kill such fungi by means of aqueous toxic solutions."

A chapter is devoted to the mineral nutrient matter utilised by the Eumycetes, the author indicating that certain substances which are not absolutely necessary for the nutrition of these organisms may still, as in the case of nickel, cobalt, and manganese, like iron, exert a stimulative action on the growth of fungi. Sulphur, selenium, and silicon may also be found in the protoplasm of these fungi, but phosphorus appears to be a most important element in their composition, and, although arsenic does not take the place of the phosphorus in the Eumycetes, certain of these organisms appear to have the power of converting arsenious acid into volatile compounds having an odour of garlic. These organisms have, therefore, been used for the purpose of indicating the presence of arsenic in cases where, by the ordinary Marsh's tests, only a doubtful reaction has been obtained. The influence of light on the development of the Eumycetes is discussed, and it appears that although strong light interferes with their development, moderate illumination interferes very little with their activity. Chemotropism is discussed somewhat fragmentarily; this remark applies also to the diastatic enzymes and the enzymes capable of decomposing fat; the enzymes of yeast, however, are described more fully in the later part of the work.

The special part of the book consists of two sections, one devoted to the fermentation set up by Zygomycetes, the other to a preliminary consideration of yeast-fermentation. The first of these sections is interesting to the technologist from the fact that it deals with Calmette's *Amylomyces Rouxii* or *Mucor Rouxii*, derived from the Chinese yeast-balls used in the preparation of rice spirit. This produces a powerful diastatic enzyme which first produces glucose, and this, in the absence of oxygen, is converted by yeast ferment into alcohol. For a full account of the Amylomyces process the reader may be referred to the description of the use of the Mucoreæ in the spirit industry.

The latter half of part i. of vol. ii. is devoted entirely to yeasts, especially the forms, structure, and chemical composition of the yeast-cell, and anyone who studies this will be amply repaid by obtaining a knowledge of the principles and mechanism of fermentation such as can be obtained elsewhere only by the study of bulky treatises, though now and again one is a little disappointed that the author has not elaborated his descriptions somewhat more fully, this remark applying specially to the chapter on the chemistry of the yeast-cell. The sketch given is so interesting that one would have welcomed a somewhat more detailed account of this part of the work.

After reading this work one feels the truth of Hansen's statement that none of the text-books and manuals giving a summary of larger or smaller sections of technical microbiology has treated the subject of this extensive field from so comprehensive a point of view as that of Dr. Lafar. In preparing the work, the author has exhibited not only many sided discernment and enthusiasm for his task, but also great courage and endurance. Certainly, this part of the second volume

"will be welcomed not only by those for whom it is primarily intended, viz., technical chemists, chemists dealing with food stuffs, fermentation and agriculture, pharmacists, and agriculturists, but many another worker will derive benefit from its pages for his lectures and researches."

We can cordially recommend this section of Dr. Lafar's work as an excellent supplement to the first volume, which has already been reviewed in our columns.

We are glad to learn that the translators have made arrangements with the German publishers to obtain advance proofs of the German work in order that the concluding sections may appear as soon as possible. This portion of the work fully maintains the interest aroused by the first volume, and the translators are to be congratulated on the fact that they have been able to give so accurately not only the substance, but the spirit of the German work.

G. SIMS WOODHEAD.

VISUAL PURPLE.

Abhandlungen zur Physiologie der Gesichtsempfindungen. By J. von Kries. Heft. i., 1897, pp. vi+198; Heft. ii., 1902, pp. 197. (Leipzig: Johann Ambrosius Barth.)

THIS is a collection of papers reprinted from the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane.* The papers are the work of von Kries and his school, and deal chiefly with visual purple and its functions. They give an account of one of the most important of recent advances in our knowledge of the physiology of sensation.

The discovery of visual purple in 1876 aroused great hopes, which seemed to be frustrated when it was found that the substance was absent from the *fovea*, the place of most distinct vision, and physiologists soon settled down to the view that a substance absent from this situation could have little to do with the production of visual sensations.

In the early days, however, Kühne suggested that the great instability of visual purple made it probable that it was a substance for the perception of feeble light, and Parinaud in France later advanced the same idea. It has been reserved for von Kries to develop fully Kühne's idea.

According to von Kries, visual purple is a substance which supplies the retinal basis for vision at low luminosities, and the accumulation of this substance is accountable for the great increase in sensitiveness of the dark-adapted eye—a thousand-fold increase according to some computations.

The change in the relative brightness of different colours with varying illumination, first pointed out by Purkinje, finds a ready explanation on this view.

Hering had shown that this phenomenon is a function of the condition of dark-adaptation produced by feeble illumination rather than a function of the feeble illumination itself, and von Kries shows that the changes of relative brightness are readily explicable if we suppose that, as the eye becomes more and more dark-adapted, there comes into play a new factor which has no influence, or no appreciable influence, at ordinary luminosities. Speaking roughly, the blue end of the spectrum becomes relatively brighter, and it is this end of the spectrum which has the greater action on visual purple.

In pronounced dark-adaptation the spectrum is seen as a colourless band of light, and the curve of luminosity of the spectrum in this condition shows a close correspondence with the curve representing the degree of action of different parts of the spectrum on visual purple. The spectrum is shortened at the red end; it is brightest in the green, and the diminution of brightness towards each end is much more gradual on the blue than on the red side of the maximum.

Visual purple also furnishes an explanation of an anomaly of colour vision which has long puzzled physiologists. A colour-equation which is good for one luminosity is not good for all luminosities, and von Kries shows that the mixed light which becomes relatively brighter at low luminosities is that which has the greater action on visual purple.

The absence of visual purple from the *fovea centralis* provides a ready method of putting the theory to the test. If dark-adaptation with its influence on colour-brightness and colour-equations be due to visual purple, the *fovea* should not share in the increased sensitiveness of the dark-adapted eye, nor should this region show any change in colour-brightness or in colour matches in different conditions of adaptation.

There seems to be no doubt that the *fovea* responds in favour of the theory. There is some difference of opinion as to whether this region fails entirely to show alteration of sensitiveness, but it is generally agreed that any increase which occurs is insignificant compared with that of the surrounding region of the retina. Very careful observations by Nagel and others seem also to show conclusively that Purkinje's phenomenon and the alteration of colour-matches are absent if the stimulation of the retina be strictly limited to the foveal region. The features of colour vision which are believed to depend on visual purple are absent just when, according to the theory, they should be absent.

One of the most interesting developments of the theory is that in which the condition of total colour-blindness is regarded as vision dependent chiefly, or exclusively, on the visual purple of the rods. Hering was the first to show that the curve of luminosity of the spectrum in most cases of total colour-blindness corresponds with great exactness to the curve of luminosity of the normal dark-adapted eye, and von Kries shows that there are other points of close resemblance between the two conditions.

If visual purple be the basis of monochromatic vision, there ought to be a central blind spot, and in several cases which have been examined from this point of view by quite independent observers, this has been found to be the case. Again, the behaviour of the *fovea* is in favour of the theory. The evidence here, however, is not unanimous. Hess has failed to demonstrate the existence of a central scotoma in several cases, but our knowledge of the exact distribution of rods and cones in the human *fovea* is based on very few examinations, and it is possible that there are wide individual variations, and that in some people an area devoid of rods may be absent, or so small that it is impossible to demonstrate its presence. The diffusion of visual purple into the rod-free area is also possible in some cases, but it seems more probable, from a study of the evidence as a whole, that there are two kinds of total colour-blindness, and that in only one of these is it probable that visual purple is the only sensitive substance in the retina.

Several of the papers in the "Abhandlungen" deal with the recurrent image, or "ghost" of Bidwell, which is believed by von Kries to be a "visual purple" phenomenon. This part of von Kries's work has been much attacked, and recent work seems to show that the recurrent image is a much more complex phenomenon than has usually been supposed. It is probable that visual purple is only the basis of one of the elements of the complex.

The comparative evidence is in favour of the theory, visual purple being abundant in nearly all vertebrates the habits of which are nocturnal or which live underground.

It has only been possible here to give the briefest sketch of the views of von Kries and his co-workers. The "Abhandlungen" should be consulted for the elaborate investigations and detailed arguments in support of their views. W. H. R. RIVERS.

OUR BOOK SHELF.

Botanische Forschungen des Alexanderzuges. By Dr. H. Bretzl. Pp. xii+412. (Leipzig: Teubner, 1903.) Price 12 marks.

THE criticism passed by Sachs in his "History of Botany" on the writings of the ancient classical writers, including Theophrastus, seems to have been unnecessarily severe where he passes over their "corrupt texts" with a brief mention. At that time the study of geographical and ecological botany had not received the stimulus which was mainly induced by the appearance of Schimper's master work, "Die Pflanzengeographie." It would hardly be going too far to say that it required the development of this branch of the subject to admit of the full appreciation of Theophrastus's work. For the essential feature of Theophrastus's "Plant Geography," and this book is the main source of information concerning Alexander's expedition, is the painting of a series of word pictures, illustrations of types of vegetation, in which, while correct morphological ideas could hardly be looked for, the descriptions, in their accuracy of observation and power of expression, are not often excelled by those due to present-day writers. As might be expected, some of the accounts are difficult of explanation, and discrepancies arise which have demanded considerable skill and enthusiasm on the part of Dr. Bretzl to clear up. Others are more obvious; thus the paragraph which begins:—

"ὑποβέβρωται δὲ ταῦτα τὰ δένδρα πάντα κατὰ μέσον ὑπὸ τῆς θαλάττης καὶ ἔστηκεν ὑπὸ τῶν ῥιζῶν ὥσπερ πολύπους" calls up very definitely the picture of a mangrove swamp.

Even more striking is the description of a mimosa which grew near Memphis:—"ὅταν δέ τις ἅψηται τῶν κλωνίων ὥσπερ ἀφαναινόμενα τὰ φύλλα συμπίπτειν φασίν, εἶτα μετά τινα χρόνον ἀναβιώσκεσθαι πάλιν καὶ θάλλειν."

Here the difficulty arises with regard to the species which is denoted, but special investigation by Dr. Schweinfurth elicited the information that in the vicinity there grows *Mimosa asperata*, a plant the sensitivity of which is almost unknown to botanists. Another graphic description is that of the banyan, συκῆ Ἰνδική, with the allusion to the roots developed from the branches, which are roots because they are lighter in colour and *leafless*. But the book contains many similar points of interest, and Dr. Bretzl has furnished abundant proof of the accuracy of perception and faculty of discernment possessed by some of the ancient Greeks.

The sources of information are to be traced to the memoirs of certain of Alexander's retinue. These manuscripts, which were deposited in Babylon, have unfortunately been lost; but they were apparently available to Theophrastus, who has worked up the material with truly remarkable intuition. Between the writings of Theophrastus and those of other authors, notably Pliny, Dr. Bretzl draws a sharp line of distinction, the distinction, in fact, between the original thinker and the annotator.

Practical Plane and Solid Geometry for Elementary Students. By Joseph Harrison. Pp. xiii + 250. (London: Macmillan and Co., Ltd., 1903.) Price 2*s*. 6*d*.

THIS little book will be found very useful for the teaching of the fundamental principles of geometry to young students. The most important properties of triangles and other plane figures are illustrated by means of accurate drawing and numerical calculation, and thus appeal more readily to the understanding and memory than if the beginner were made acquainted with them by means of the severe and tedious logic of Euclid. The great advantage of such a book as this is that it prepares the mind of the beginner for methods of accurate logical demonstration at a later stage in his studies. The very large number of numerical exercises requiring calculation and the use of instruments should suffice to give the student a very firm knowledge of all the important part of elementary geometry; and for this reason the book can be confidently recommended to teachers.

The first ten chapters are of this useful kind; then follow some chapters on the nature of vectors and their addition, including some properties of uniplanar forces acting on a particle the necessity for which may, perhaps, be doubted. In these chapters we meet with a little careless writing which, doubtless, will be corrected in the next edition. Thus, the first sentence (or what should be a sentence) on p. 118 reminds us of Mr. Skae's item in "The Jumping Frog": a verb is missing and no assertion is made. The use of the expression "in *tandem*, or *follow-my-leader*" to indicate cyclic order in the sides of a triangle is of doubtful propriety; but such trifles constitute, of course, no serious objection.

The notation l_{θ} for the magnitude and direction of a vector (p. 130) is distinctly useful in the composition of vectors. Chapter xiii., on concurrent forces, will, of course, be omitted by the beginner whose aim is to acquire only a knowledge of the elements of geometry; and it scarcely belongs to the subject.

The remaining five chapters deal with geometrical drawing in three dimensions, and they constitute a very good introduction to the subject, the figures being very numerous, and accompanied by a large number of numerical examples.

Die Aluminium-Industrie. By Dr. F. Wintelen. Pp. xi + 108. (Braunschweig: Friedrich Vieweg und Sohn, 1903.) Price 6 marks.

THIS very interesting monograph upon the aluminium industry commences with a short historical introduction, in which we learn that Davy, so far back as 1808, after he had discovered sodium and potassium, endeavoured to prepare aluminium by electrolysing alumina. In this he was not successful, and it fell to the lot of Wöhler in 1827 first to prepare the metal by purely chemical methods. Bunsen, however, was able in 1854 to obtain it by electrolysing its chloride. In a table on p. 5 the variation in the price of the metal is traced since 1854, when it was merely a chemical curiosity. Its value in that year was 120*l*. per kilo, and even in 1889 it cost 2*l*.; but with the improvements of the electrical methods, the price rapidly dropped, until in 1901 it ranged from 2*s*. to 2*s*. 6*d*. per kilo. Following the historical portion of the work, a very full account of the physical and chemical properties of the metal is given. It is not until we reach p. 22 that the present methods of obtaining the metal are gone into, but here the thoroughness of the treatment leaves nothing to be desired. In the first place a careful account of the preparation of the outgoing materials used in the manufacture is given. This part of the work is of very considerable value. Everyone is aware that bauxite and cryolite are the substances used for preparing aluminium, and those who have studied the subject know that these substances cannot, as a rule, be employed without being first purified. In this book the methods of purification are described in detail, and methods of analysis are also set forth. Page 54 is headed "carbon electrodes"; these are employed both for the anode and kathode, in consequence of impurities introduced into the bath when other electrodes are used. The author gives details of the manufacture of these carbon electrodes—ten pages are devoted to this. Some useful diagrams illustrating the way in which the electrodes become corroded during the electrolysis are also given.

The last few pages of the monograph are devoted to the "working up of the metal"; one of the most interesting points being the method for welding the metal which is employed by Heräus, of Hanau. It consists in heating aluminium sheets with a hydrogen flame to a temperature of about 400°. The edges are then pressed together, and after being worked for some time with the hammer, they weld together in such a manner that tubes made in this way can hardly be distinguished from seamless ones.

This monograph is one of the most interesting and useful which we have had the pleasure of reading for a long time. The facts are well arranged, and although there are 108 pages devoted to the single subject of the aluminium industry, we do not consider that the work suffers from prolixity; we wish this could be said of many German monographs which have lately been published. F. M. P.

Die Konstitution des Kamphers und seiner wichtigsten Derivate. By Ossian Aschan. Pp. xi + 117. (Braunschweig: Friedrich Vieweg und Sohn, 1903.) Price 3.50 marks.

THE chemistry of camphor and its derivatives has occupied the attention of chemists for many years, and has now become so specialised that it is almost impossible for the ordinary chemist to keep up with the immense amount of research published in the journals devoted to chemistry. The monograph by Prof. Aschan is accordingly very welcome, and will be found useful not only by the non-camphor chemist, but also

by the camphor specialist. The treatment of the subject is purely theoretical, and in that respect differs from the valuable paper "On the Constitution of Camphor" read at the British Association in 1900 by Dr. Lapworth.

A short introduction is followed by a chapter giving a *résumé* of the various camphor formulæ arranged in historical order, starting from that proposed by Victor Meyer in 1870 and coming down to that of Schryver in 1898. This history of camphor formulæ is an interesting example of evolution. The formula proposed by Bredt in 1893, and now generally accepted, seems best to explain the constitution of camphor and its numerous derivatives, and is the one adopted by the author.

In the third chapter the practical data on which the constitution of camphor rests are recorded under twelve heads, such as "camphor is a ketone," it "contains the group $.CH_2.CO$," "camphor and camphoric acid are saturated compounds," &c., all of which conditions are fulfilled by the Bredt formula. In this connection, to the researches of Brühl on the refractive index might have been added those of Perkin on the magnetic rotation, as confirming the bridged ring structure of camphor. The inconsistencies of other formulæ with the above-mentioned facts are briefly pointed out in the fourth chapter. The degradation products are next treated, and the monograph finishes with a discussion of the constitution of camphene and bornylene.

The clear manner in which Prof. Aschan indicates how some of the many seemingly inexplicable reactions probably take place is worthy of comment. The difficulty of excluding unimportant details and including all that is important in such a monograph as the one under notice has been overcome by the author with great success. J. E. M.

Theorie der Bewegungsübertragung. By Richard Manno. Pp. iv + 102. (Leipzig: Engelmann, 1903.)

IN laying down the fundamental notions of mechanics there has been divergence of opinion concerning the definition of force. There is the distinction between cause and effect, between statics and dynamics. The older school has regarded force as the cause of motion, modern theorists prefer to define and measure force by the effect only. Herr Manno attempts to construct a system of mechanics by regarding force as neither cause nor effect, but as the phenomenon of motion itself, and further, in order to get rid of the notion of action at a distance, every instance of force is supposed to be due to impact, so that motion is transferred from body to body by a succession of intervening impacts. Accordingly the attempt is made to develop the theory of impulsive forces from the simple cases of direct and oblique impact. Naturally, in this view, some divergence is found from the ordinarily accepted theory. The proportionality of cause and effect as implied in the "second law of motion" obviously fails when the momentum of a striking body is regarded as producing the momentum of a struck body.

It must be confessed that the author's theory, when its meaning is disentangled from the mass of verbiage with which it is swathed, does not seem to smooth the way towards a clear apprehension of the principles of mechanics. His leading idea seems to be that purely theoretical conceptions, such as action at a distance, must be discarded, and that all the terms used must represent observable phenomena. The author probably has in his mind the subject of a discussion recently appearing in NATURE, as is evidenced by sundry physiological allusions, and his objection to the technical meaning of "work" when applied to living organisms R. W. H. T. H.

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.*]

On a Map that will Solve Problems in the Use of the Globes.

IN mapping an extensive region of the earth in separate sheets, there are great advantages in dividing the region into belts by parallels of latitude, and modifying the law of representation in passing from each belt to the next. This plan is illustrated by the accompanying sketch, which represents a region extending from the equator to the North Pole, and covering 80° of longitude.

The map consists of nine sheets, each covering 10° from north to south, and 80° from east to west. The meridians are indicated at every tenth degree, and are straight lines, all of the same length, at right angles to the parallels of latitude, which are arcs of circles. The two parallels which bound each sheet are on the same scale as the meridians, so

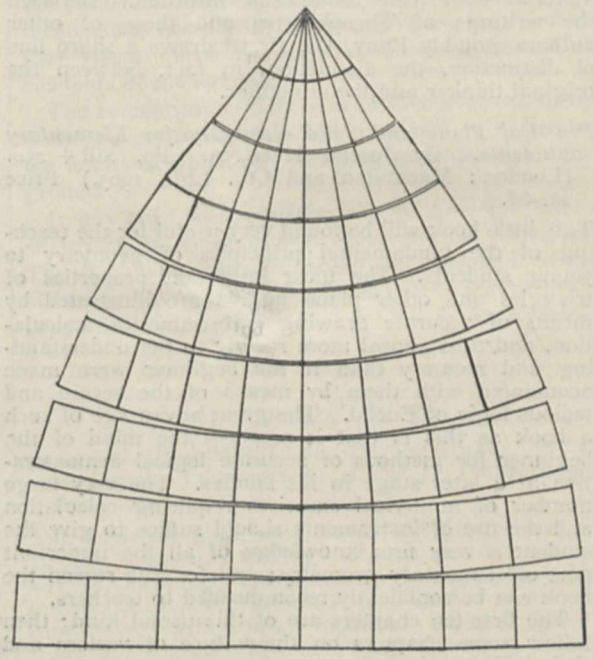

FIG. 1.

that the four sides of each of the seventy-two compartments of the map are precisely equal to the lengths which they represent on a spherical globe; and no difference is made between extreme and central meridians, all longitudes being treated alike. The intermediate meridians and parallels will be at right angles, as well as those shown, and the meridians will be of correct length. The intermediate parallels will be a trifle too short, the defect amounting, in the case of the middle parallel of each sheet, to rather less than 1 part in 250, a difference too small to be detected by the eye.

In examining on the map the borderland of two sheets, the two sheets are to be placed in contact at any point on the parallel common to both, and then, on rolling the edge of one sheet against that of the other, the whole border region from end to end will pass in review. All the successive meridians, when they are brought in turn to the point of contact, will be seen as straight lines crossing the point of contact, and the same will be true for the two portions of any oblique line which crosses the boundary.

If we want to trace a great-circle route from one place to another, we have merely to roll the sheets into such positions that the points of contact lie in a straight line

drawn from one place to the other. This straight line will represent the great-circle route.

I have put this matter to experimental test by constructing (on the scale of a 20-inch globe) eighteen cards, consisting of two sets of duplicates, and the accompanying figure is a reduced copy of one set.

As all meridians are treated alike, one card can be shifted 10°, 20°, 30°, &c., east or west relative to another, and this is necessary when the difference of longitude of the two places exceeds 80°. The second set of cards can either be used for the southern hemisphere or for increasing the range of longitude to 160°. I can thus measure the great-circle distance from London to Shanghai (the route passing 1½ degrees north of St. Petersburg), or from Yokohama to San Francisco, or from Land's End to Cape Horn. For measuring the distances I use a card scale divided into degrees of the same length as the degrees of the meridian.

The process above described also serves for finding the position of the sun in the sky at a given hour of the day, and by obvious modifications of it, most of the problems set forth in books on the use of the globes can be solved. In dealing with a spherical triangle, two of the sides are represented by polar distances, the included angle by difference of longitude, and the third side by the divided scale.

J. D. EVERETT.

Action of Tesla Coil on Radiometer.

THE following phenomena, observed while experimenting with a small Tesla coil, will, I believe, interest some of your readers. Not having access to the necessary literature, I am not in a position to find out whether they are new or already known.

The knobs of the Tesla coil were placed in contact with, or just close to, the bulb of a Crookes's radiometer, and the coil set at work. When the brush discharge fell upon the bulb, the blackened surfaces of the vanes first retreated, as they do under the influence of radiant heat, but soon the direction of rotation changed, and the blackened surfaces moved forward, the motion continuing as long as the brush discharge fell upon the bulb.

At the same time, inside the bulb, were seen diverging from the glass sides close to the knobs two cones of pale blue light, which, falling on the opposite sides of the bulb, caused a yellowish-green fluorescence. On the fluorescent parts the shadows of the rotating cones were clearly visible, the shadow on one side being always more intense than on the other side. When the direction of the current in the charging Ruhmkorff was reversed, the shadows exchanged places, but no change in the direction of rotation of the vanes was noticed.

On examining the fluorescent parts with a screen of potassium platinocyanide, the same effects were noticed as with the X-ray tubes.

Similar effects were obtained on repeating the experiments with two incandescent lamps in the laboratory. The larger of these, an old Swan lamp, fluoresced green, and the smaller new one, supplied with the Tesla coil by the manufacturer, fluoresced blue. But in both cases, though somewhat feeble, the same X-ray effects were observed.

To study further the cause of the motion of the vanes of the radiometer, the experiment was repeated with a Crookes's tube containing a freely suspended wheel with transparent mica waves. In this case it was found possible to alter the direction of rotation of the wheel by adjusting the positions of the knobs of the Tesla coil relatively to the sides of the tube and the wheel inside it.

P. L. NARASU.

Christian College, Madras, June 18.

Tides at Port Darwin.

ALONG the north-west coast of Australia the tidal wave, flowing in from the Indian Ocean, produces at most places a large rise and fall. At Port Darwin the mean spring range is about 24 feet, but the range is sometimes as much as 30 feet. A tide gauge of Lord Kelvin's pattern was set up here by the South Australian Government some few years ago, and good records are available up to 1897, since when it has been dismantled, waiting the building of a new jetty. Captain Inglis, the harbour-master at Port Adelaide, and the writer selected the last good records available for a whole year's tides, the records beginning January 1, 1896, and subjected them to a harmonic analysis, with the results given in the table below. The records show a very marked diurnal inequality, especially at the low waters. In the year examined the greatest difference in height between the two high waters occurred in January and December, and amounted to 4 feet 9 inches. In April, however, there was a difference in height of the two low waters of as much as 10 feet. The analysis shows the existence at Port Darwin of a remarkably large annual tide, the water on this account standing nearly two feet higher at the end of summer than it does at the end of winter. At first sight this seems very remarkable, especially when we find that at Kupang, on the island of Timor, to the north, according to Van der Stok, the solar annual tide has a semi-range of only 2·3 centimetres. The tide appears to be a purely meteorological effect due to the conformation of the harbour and the direction of the prevailing winds. The harbour opens towards the N.W., and, as will be seen from a perusal of the wind charts given in Van der Stok's work, "Wind and Weather, Currents, Tides and Tidal Streams in the East Indian Archipelago," the winds during the summer blow with great persistency from the N.W., tending to pile the water up in the harbour, while in the winter time the prevailing winds are S.E., with, of course, an opposite effect. This is further assisted by the variations of atmospheric pressure. The average barometer readings exhibit a remarkably regular annual fluctuation, as is shown by the following results. The averages are from readings taken at regular intervals of three hours for twenty years, ending 1901 :—

	Mean Readings for 20 years.	Mean Readings for 1896.
January	29·765	29·757
February	29·769	29·759
March	29·814	29·808
April	29·863	29·849
May	29·917	29·973
June	29·945	29·966
July	29·966	29·969
August	29·956	30·005
September	29·931	29·978
October	29·892	29·948
November	29·841	29·868
December	29·793	29·854

Results of Harmonic Analysis of Records of Tide Gauge at Port Darwin (Latitude 12° 23′ S., Longitude 130° 37′ E.) for the year beginning noon, January 1, 1896.

Component.	Amplitude.	Phase (K).	Component.	Amplitude.	K.
	Feet.	°		Feet.	°
S_1	0·16	169	Q	0·34	324
S_2	3·44	193	μ	0·39	110
S_4	0·05	127	P	0·44	1
S_6	0·01	184	K_1	1·91	336
M_1	0·05	315	T	0·24	166
M_2	6·56	144	R	0·83	97
M_3	0·05	26	K_2	1·02	204
M_4	0·13	279	2SM	0·17	13
M_6	0·06	167	MS	0·16	30
N	0·40	121	*Sa*	0·97	76
L	0·41	216	*Ssa*	0·54	58
ν	0·96	161	*Msf*	0·47	29
O	1·14	313	*Mf*	0·128	333
J	0·14	197	*Mm*	0·045	284

The University, Adelaide. R. W. CHAPMAN.

Spirals in Nature and Art.

I HAVE to thank you for a very kind notice of my little essay on spirals, and I venture to trouble you further on the subject, because your last paragraph, criticising my attribution of spiral curves in flight to Leonardo, gives me an opportunity of making a correction to which, I feel sure, your courtesy to a distinguished scientific writer will enable me to give publicity. It appears that, in pp. 153 to 155 of my study of spirals, and in the figures 45 and 46 therein included, I have unconsciously done an injustice to the original researches on flight published by Dr. J. Bell Pettigrew, M.D., LL.D., F.R.S., Chandos professor of medicine and anatomy at the University of St. Andrew's, who, I now find, has been steadily engaged on the problem of flight since 1867, and has apparently published many papers and memoirs on the subject in the *Proceedings* of the Royal Institution of Great Britain, the *Transactions* of the Linnean Society and of the Royal Society of Edinburgh, and elsewhere.

My figure 45, which you acutely ascribe to its right author, is of very little importance to my argument, and only a side-issue in my essay, but it is right to say that it is Dr. Pettigrew's original figure, and should have been acknowledged as such in my pages. Had I known of this, I think I need hardly assure you that this acknowledgment would have been inserted, and that Dr. Pettigrew's own explanation of the figure would have been substituted for what he would justly stigmatise as the incorrect explanation given in my text. I have also to add that Prof. Marey's photograph of a flying pigeon, which I attributed to the only source I knew, was really an illustration of the alternate and opposite rise and fall of the body and the wings of a bird in flight, a principle first described and figured by Dr. Pettigrew in his memoir on "The Physiology of Wings" (*Trans.* Roy. Soc. Edin., 1870), and acknowledged by Prof. Marey as a previous discovery.

THEODORE ANDREA COOK.

Distribution of Calostoma.

IN December, 1891, I found in a pit near Port Katsura, a few miles off this place, a species of Calostoma in abundance, and this year I see the same fungus now and then occurring here. I send you some specimens of it herewith, in the hope that some mycologist of your acquaintance may determine it in my behalf. Of all the species given in Mr. Massee's monograph of the genus in the *Annals of Botany*, vol. ii. 1888, it seems most near *C. Ravenelii*, Mass.

If my memory deceives me not, Mr. Massee, in the same paper, divided the genus Calostoma into two groups, the so-called eastern group, growing in Asia and the adjacent islands, with globose spores, and the western group, the habitats of which are America and Australia, with elliptical spores. Now the Japanese species in question has its spores oblong-elliptical, which fact would seem to necessitate such a naming of the groups as eastern and western to be modified more or less. KUMAGUSU MINAKATA.

Mount Nachi, Kii, Japan, June 5.

THE specimens of fungi from Japan belong to *Calostoma Ravenelii*, Mass., agreeing in every essential point with the type of that species preserved in the herbarium at Kew.

In the monograph referred to in the letter accompanying the specimens, the form of the spores was not made a basis of classification, but the fact was simply pointed out that eastern species possessed globose spores, whereas in all known western species the spores were elliptical.

The fact of a North American species occurring in Japan, while very interesting, will not cause surprise to botanists, considering the intimate relationship between the phanerogamic flora of the two countries. GEO. MASSEE.

School Geometry Reform.

IN your issue of June 25, Mr. R. W. H. T. Hudson criticises the fact that, in my "Elementary Geometry," I give three meanings of the word angle, the third being what may be called the "sector of plane space" meaning.

He considers that, even if not wrong, it is undesirable in a school book. It seems to me that the one essential point which requires attention in introducing a new subject to boys and girls is to attach a clear, definite meaning to the terms employed, and that, if there be any terms such as this word "angle," of which many people have confused notions owing to the bringing together and blurring of two or three distinct meanings, then those meanings should be carefully dissected.

Mr. Hudson quotes with approval the French writers who, while stating that an angle is a simple undefinable idea, incidentally give "inclinaison mutuelle" as a synonym; personally, I am adverse to the word "inclination," it seems to mean a "leaning *towards* one another," whereas an angle is a "leaning *away* from one another," if it be a leaning at all. I have endeavoured to express this idea in my second meaning, viz. the "wideness" of the opening between two radii drawn from a point.

That the space-sector meaning is implied in nineteenth century Euclids is indisputable, *e.g.* in iii. 20 we have "Case i., when the *centre is within* the angle"—how could the centre lie within a "mutual inclination" or within "an amount of turning"? Again, "a solid angle is . . . made by . . . plane angles . . . *meeting at one point*"—how can "mutual inclinations" meet? I doubt even if a "mutual inclination" is more capable of being bisected than is any other abstract quality, say, for example, gratitude.

Mr. Hudson speaks of the *axiom*, "whole is greater than its part": surely this is no axiom at all; it is a *definition*, whether of "a part" or of "greater than" I would not venture to say.

Whether my position be right or wrong, it is surely preferable to the attitude which makes geometry the "science of the undefinable."

I am grateful to your reviewer for the suggestion that angles should be quoted in decimals of a degree rather than to the nearest ten minutes, and will adopt the suggestion as soon as possible.

FRANK R. BARRELL.

University College, Bristol, July 6.

The Moon's Phases and Thunderstorms.

IN connection with the note in NATURE (July 9, p. 232), it is interesting to compare the results of Prof. W. H. Pickering with those obtained by Schiaparelli in 1868, from the discussion of observations made in Vigevano (north Italy) for thirty-eight years (1827–1864) by Dr. Siro Serafini.

"Sebbene i numeri della seconda colonna presentino delle grandi irregolarita nel loro andamento, sembra tuttavia indubitato, che nella prima metà della lunazione i temporali debbano in generale essere meno frequenti che nella seconda. Facendo la somma di 5 in 5 per veder meglio la legge di progressione, si vede che il minimum cade verso il 5° giorno della lunazione, il maximum verso il 24°. E la proporzione della frequenza minima alla massima è quella di 101 : 153, ciò è quasi esattamente di 2 : 3."

Translated into English, the quotation reads as follows:—"Although the figures of the second column show great irregularities in their proceeding, it seems nevertheless undoubted that in the first half of a lunation thunderstorms may be, generally speaking, less frequent than in the second. Adding 5 by 5 in order to see better the law of progression, one remarks that the *minimum* falls towards the 5th day of the lunation and the maximum towards the 24th. The ratio of the least frequency to the greatest is that of 101 : 153, or almost exactly of 2 : 3." (Clima di Vigevano: Milano Vallardi, 1868, p. 81.)

The conclusion is thus exactly the reverse of what Prof. W. H. Pickering has found.

OTTAVIO ZANOTTI BIANCO.

THE NEW MAMMOTH AT ST. PETERSBURG.

THE new mammoth just mounted for exhibition in the Zoological Museum at St. Petersburg, is a triumph of the taxidermist's art. The frozen skin has been cleaned, softened, and prepared. The skeleton, and as many of the surrounding soft tissues as possible, have been carefully removed from its interior and preserved separately. The animal has been actually stuffed like a modern quadruped, and placed in the attitude in which it originally died. The skin of the head and the ears are artificial, copied from the famous old specimen obtained a century ago by Adams. A model of the base of the proboscis has also been added. The skin of the trunk and limbs, however, is nearly complete, only embellished in parts by the addition of a little wool and hair from other specimens; and some deficiencies are covered by the surrounding mount, which represents the morass into which the animal slipped. The well-preserved tail is especially noteworthy, and bears a large tassel of long black hair at its tip. The animal is a young male of rather small size.

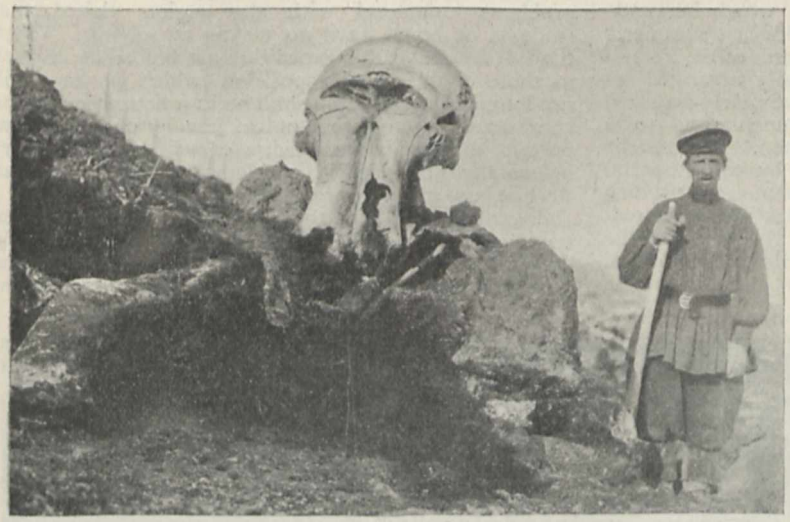

FIG. 1.—Front view of Mammoth in frozen earth on the banks of the Beresowka, Jakutsk, showing the bent fore limbs widely spread. From photograph by Dr. O. Herz.

The hopelessly-struggling aspect of this mammoth is very striking, and reproduces exactly the attitude of the carcase as it lay buried in the Siberian tundra. In fact, the chief value of the specimen depends upon the circumstance that it was scientifically disinterred, photographed at various stages in the excavation, and carefully preserved by the best modern methods. Great credit is due to Dr. Otto Herz, the leader of the expedition organised by the St. Petersburg Imperial Academy of Sciences, who undertook the arduous task of securing the carcase and transporting it to the Russian capital. His are the only photographs hitherto obtained of a mammoth buried in the tundra, and they throw important new light on the question of the conditions under which these large quadrupeds were destroyed and entombed. Some of Dr. Herz's photographs have lately been presented by Dr. Salensky to the British Museum, and two of them are reproduced in the accompanying figures.

The carcase in question was exposed by a landslip on the bank of the River Beresowka, an affluent of the Kolyma, in the Government of Jakutsk, in latitude 67° 32′ N. The head was entirely uncovered, so that the foxes and other carnivores ate its soft parts, while the inhabitants of a neighbouring village removed a tusk. The Governor of Jakutsk, however, succeeded in keeping the remainder of the specimen undisturbed until the arrival of the expedition from the Academy. It was buried partly in ice, partly in frozen sand and gravel, and there was a sufficient covering of earth to prevent its naturally thawing.

According to the general report published by Dr. Herz,[1] he began to excavate the specimen from the front. In this manner he soon discovered the two fore limbs spread widely apart, and sharply bent at the wrist, as shown in the first photograph (Fig. 1). Proceeding backwards on the left side, he unexpectedly met with the hind foot almost at once, and it gradually became evident that the hind limbs were completely turned forwards beneath the body, as shown in the second photograph (Fig. 2). Dr. Herz then removed the skull, and found the well-preserved tongue hanging out of the mandible. He also noticed that the mouth was filled with grass, which had been cropped, but not chewed and swallowed. Further examination of the carcase showed that the cavity of the chest was filled with clotted blood. It is therefore natural to conclude that the animal was entrapped by falling into a hole, and suddenly died from the bursting of a blood-vessel near the heart while making an effort to extricate itself. As shown by the recent researches

FIG. 2.—Left and partly posterior view of the same specimen, showing the bent left fore limb and the left hind limb turned forwards beneath the body. From photograph by Dr. O. Herz.

1 "Berichte des Leiters der von der kaiserlichen Akademie der Wissenschaften zur Ausgrabung eines Mammuth-kadavers an die Kolyma-Beresowka ausgesandten Expedition" (St. Petersburg Academy of Sciences, 1902).

of Dr. Tolmatschow,[1] the ice surrounding the carcase was not that of a lake or river, but evidently formed from snow. It is thus quite likely that the mammoth was quietly browsing on grassland which formed the thin covering of a glacier, and fell into a crevasse which was obscured by the loose earth. On this subject, however, much more information may shortly be expected, when Mr. Ssewastianow publishes an account of the geological researches which he made in the neighbourhood of the Beresowka last summer.

The director of the Zoological Museum of St. Petersburg, Dr. W. Salensky, has not only arranged an admirable and unique exhibition of the newly-acquired mammoth, but has also devoted much time to a scientific investigation of the specimen. The results of his researches will be published by the Imperial Academy of Sciences in a series of memoirs, of which the first, dealing with the skeleton, has just appeared. In this work, he not only describes the parts of the new animal, but also refers to the rich collection of remains of the Siberian mammoth already in the museum under his direction. The first instalment, illustrated with twenty-five fine plates of bones and teeth, is unfortunately written only in the Russian language. We venture to express the hope that, when his work is completed, Dr. Salensky will make it more generally accessible by appending a copious abstract in one of the languages with which most naturalists are familiar. A. S. W.

THE ETHNOLOGY OF THE MALAY PENINSULA.[2]

THE scientific results of the Skeat expedition of 1899 to Siam and the Malay Peninsula have not yet been published, but a secondary result of that expedition was the return of Mr. Nelson Annandale to the same district in 1901. Sir William Turner suggested to Mr. Annandale that he should obtain measurements of the people of the Siamese Malay States, and the Edinburgh University gave him a grant for that purpose from the Moray Fund. Mr. H. C. Robinson joined Mr. Annandale, and together they made a most successful expedition, the results of which are now beginning to appear with praiseworthy promptitude, a result that is rendered possible through private munificence in Liverpool. The association of this expedition with the University of Liverpool augurs well for the spirit of that young institution, and we hope tnat it may continue to foster field work in ethnology.

The present fasciculus contains a general account of the appearance and mode of life of the Semang and Sakai tribes of the Malay Peninsula, of the coast people of Trang, and of the Malays of Perak, and detailed studies of the external physical characteristics of these tribes, together with some valuable osteological observations. So far the authors have presented us with a considerable body of data which are at once available to students for comparative purposes, but they reserve comparisons and discussions until the final part. We look forward with great interest to the fulfilment of this promise, as there are several important ethnological problems connected with the region visited that students at home have no means of solving. When the full results of this expedition are before us, as well as those of the Skeat expedition (which we hope will not long be delayed), we shall be in a better position to reconstruct the anthropological history of a very important district, a knowledge of which is necessary before the ethnological problems of the Indonesian Archipelago can be unravelled.

A general sketch of the main results, from a racial point of view, will be found in the authors' paper in the current number of the *Journal* of the Anthropological Institute, but for the facts on which they are based the student must have recourse to the "Fasciculi Malayenses." Only part i. of this series has yet been published, and as no forecast is given of what is to be expected, one cannot say very much about the accounts of the social life of the jungle tribes, as subsequent parts may render the criticism void. It is safe to say that the physical anthropology is well done, and will prove of permanent value, to which the excellent illustrations of natives materially assist. The characteristic decoration, clothing, implements, habitations, and other details of the several tribes, which an intelligent traveller can readily observe, are carefully noted, and some curious engraved designs and patterns on dart cases, combs, and other objects are figured and partially described. There is an interesting chapter by Mr. Annandale on the beliefs and customs of the Patani fishermen. These Malays have various animal cults, but they certainly do not present any features of true clan totemism. This is followed by the first part of an essay on religion and magic among the Malays of the

FIG. 1.—Semang (Semán) shelter, with kitchen (occupied by married couple); Grit, Upper Perak.

1. "Bodeneis vom Fluss Beresowka (Nord-ost Sibiriens)," (*Verhandl. k. russ. min. Ges.*, vol. xl. pp. 415-452, pls. v-viii, 1903.)

2. "Fasciculi Malayenses: Anthropology." Part i. (London: Longmans, Green and Co., 1903.) Price 15s. net.

Patani States, in which souls and ghosts are dealt with; a consideration of ghosts and spirits unconnected with material bodies will be published in another part.

The work is admirably printed, and the illustrations are excellent. This first part reflects great credit on the University Press of Liverpool.

ELECTROCHEMISTRY IN AMERICA.

THE third meeting of the American Electrochemical Society took place in New York on April 18. Three meetings may seem rather a small number for a society which has been in existence for more than eighteen months, but the society, which has members from all parts of the United States, only meets once in six months, and the meetings assume the form of a congress, which lasts several days. This style of meeting, which might be compared to the annual meeting of the Society of Chemical Industry, in which members from all parts of the country meet together each year in a different town, partly for work and partly for social intercourse, has certain obvious advantages, in that country as well as town members are able to attend; there is, however, one disadvantage, and that is that papers are only published once in six months. The transactions of the society are also only published once in six months, hence they contain the concentration of six months' work.

The presidential address of Dr. Joseph W. Richards, an abridgment of which is printed below, contains several points of considerable interest. One thing which will strike British electrochemists is that although the Americans have made great progress in the industrial applications of electrochemistry, yet they have to admit that they owe their present position in a large measure to foreign trained electrochemists. Dr. Richards mourns that they are vastly behind the Germans in the number of their chairs and laboratories of electrochemistry. How much more, then, should we in this country mourn—*we have not a single chair devoted to the teaching of electrochemistry*, and there are only two or three laboratories in the whole kingdom.

It is often said that, having very little water power in this country, we can never expect to compete industrially with other countries in electrochemical processes. Dr. Richards remarks that although all countries have not Niagaras, they have gas-engines, and he points out some of the sources of gas supply. Finally his remarks upon the value of literature, *good, sound literature*, are worth consideration. Where is the British electrochemical literature to be found?

To live is to progress, and to progress is to live. A science which does not progress petrifies. The science of electrochemistry has progressed so magnificently in the last decade that a mere catalogue of its achievements would be a monumental compilation. Abler and better-informed pens than mine have given to us recently, in presidential addresses and in careful reviews, the detailed history of this progress. I do not intend to attempt that task anew this evening; my theme is an analysis of the *conditions which make for progress*, and which I hope to make clear in all their bearings on electrochemical science.

I place discovery of new facts in electrochemical science as the corner-stone of progress in our science. Given a freshly-flowing current of new electrochemical facts, and all the other elements of progress have a chance to exist. No less certain than this is the location of the birthplace and the identity of the sponsors of these newly-born facts. The birthplaces are chemical, electrical and physical laboratories; the sponsors are the investigators, the searchers after truth—the professors, students, employees, private investigators, and all who with the insatiable thirst for more knowledge are pushing back the thick curtain of the unknown which hems us in so closely on every side. The elect among these workers, the highly-favoured few, are the professors of electrochemistry provided with well-equipped electrochemical laboratories. They are in the position to do or to direct the most valuable investigations, and are also under the moral obligation to publish freely to the world all that they discover. The giants of the electrochemical fraternity are in this class: Davy, Faraday, Bunsen, Arrhenius, van 't Hoff, Ostwald, Nernst, Moissan. The labours of such workers, given to the world in their publications, form the *body* of electrochemical science, and their thoughts—its *soul*. Such are the heroes of science; men who work for the work's sake, who sacrifice time, money, and often health, to increase the boundaries of our knowledge, and then keep nothing back.

The German-speaking countries count up alone at their universities and technical schools fifteen chairs of electrochemistry and twelve electrochemical laboratories. These, we all know it, have been the source of the greater part of the advance of electrochemical science in the last ten years. The whole industrial electrochemical world is debtor to the European electrochemical laboratories and their workers, and how can that debt be requited? Surely not by selfishly using all the facts and holding fast all the material benefits. Not only common gratitude but also self-interest unite in recommending to the captains of electrochemical industry that more such laboratories be built and more such chairs endowed; money thus spent will be seed which will return many fold its value to the industry. America has boasted that it is "The Electrochemical Centre of the World." It may be so, in the development of electrochemical industries, in the amount of power used and material products turned out; but is it not a fair question to ask "Where are the professors of electrochemistry at our universities and how many electrochemical laboratories are at their command?" Are we not out of comparison with Germany in that respect—but I trust not hopelessly so? Our present flourishing condition industrially is largely due to our foreign-trained electrochemists and our imported literature. Shall we not, through shame at contributing so little ourselves to that literature, soon begin to establish chairs of electrochemistry and build well-equipped laboratories to go with them? Then our boast might begin to be more than the empty boast of a successful money-maker; then we may begin to be an *illuminating* centre radiating knowledge to the rest of the world.

In place of professors and professional laboratories, however, America is blessed with another class of investigators who are no less industrious in acquiring facts, and to whom a large part of our commercial success is directly ascribable; I refer to the small army of patient investigators in the laboratories of our industrial plants, who are searching over ground not yet explored and accumulating facts of value in their special industrial lines. The expense of such work is borne by the corporation for which they labour, and the work itself is in reality an investment made in the hope of yielding financial reward.

By means of facts, correlating, discussing and deducing therefrom, we arrive at a knowledge of the laws of science, the rules governing its various phenomena and according to which its manifestations invariably proceed. Such deductions are the goal of pure science; they contain no element of speculation, hypothesis or theory, and represent man's deepest insight into the phenomena of nature.

The indefatigable Faraday discovered our first fundamental laws. Ohm and Joule added to them, and numerous later investigators have contributed, but we must not make the mistake of thinking that there remains very little more in the nature of generalisations to be discovered; we could not make a greater mistake. If facts are being discovered, the recognition of unforeseen generalisations and the establishing of new laws are bound to follow, and thus the science reaches its highest consummation.

Such discoveries are usually the privileges and the perquisites of the experimenter and investigator, if so be that he is likewise a thinker. He gets the facts at first hand, and has the first chance to deduce new laws. The electro-

chemist not blessed with laboratory facilities has, however, free entrance to this field. He may be only a student, a looker-on at what others are doing, a reader of the newly-discovered and recorded facts, but if he is at the same time a thinker, a compiler, an analyst with the power of collating, dissecting and deducing, he may in the seclusion of his study discover laws which escape the observation of others less studious, and thus render a service of the highest value to the science.

As soon as facts accumulate and laws are discerned, the man of science inevitably begins to reflect on the why and the wherefore. He commences to search for relations, to imagine connections and dependencies, and to make pictures of the mechanism of the phenomena. It was thus that Dalton imagined the atomic theory to account for the fact of chemical combination in simple multiple proportions, that Arrhenius hit upon the dissociation theory to account for the increase of molecular conductivity with increasing dilution, that Nernst worked out the solution-pressure theory to explain the generation of current in the galvanic cell. Thus there are theories and theories, some poor, some good, and some almost perfect in their applicability, since, *granting their premises*, they give an explanation satisfactory to the mind of all observed phenomena.

Such theories are not only allowable, but necessary. We must have them, much as an artisan must have a working drawing of the machine he will construct; the drawing is but paper and ink, which never moves or works, but it guides the workman in putting his ideas into realities. So theories help us to handle mental conceptions as if they were concrete things, and thus to imagine and discover relations and generalisations which would otherwise be beyond our mental grasp.

The danger to the development of a science comes when a theory, by being believed too implicitly and by not being open to constant revision, becomes a strait-jacket for the growing science. Like a "creed outworn," it stifles criticism, warps the judgment, engenders blindness and bias in its adherents and undue hostility and acrimony in its opposers. We should be slow in revising our theories, or in discrediting a theory which has done us good service in its day, just as we are conservative in correcting our "confessions of faith" or indulgent and sympathetic with the weaknesses of a faithful old servant; but, after all, when a theory has come to be considered so firmly fixed as to be above criticism, or so certainly true as to be above the possibility of revision, or so well-established as to thunder its excommunications on those who dare to think or believe otherwise—such a theory had better be placed at once in the museum of scientific petrifactions, where it properly belongs, and where it can do no further harm.

If science is progressing, theories must progress too; they will be outgrown, much light will give way to more light, imperfect pictures of phenomena founded on crude assumptions must be replaced by better pictures corresponding more accurately to the newer and the larger truth, and then progress begins anew.

All theories have been of some use in their day; they have helped men to grasp concretely evanescent immaterial phenomena, they have very often been splendid guides to further experiment and new discoveries, they have at times been so helpful that many have mistakenly thought them infallible, and lastly, they have been stepping-stones to better theories. One great hindrance to scientific progress is the common human weakness of becoming partisans of a theory. Who is not familiar with the well-meaning theoriser whose mental vision is so biased that he refuses or is incompetent to give a fair reception to new facts and theories; or who has not met the egotistical speculator who experiments and makes researches not to discover truth, but to prove his pet theory? Thus the warmest friends of a theory are often its worst enemies, and by their blind partisanship lay obstacles in the path of scientific progress instead of being the leaders which they might be.

To make a specific application of these remarks, who has not felt that the most effective blows dealt the present theory of electrolytic dissociation have come from the excessive zeal of its warmest adherents? There are scientific zealots as well as religious bigots, and the one does as much harm to the progress of true science as the other does to the development of pure religion.

The fundamental conceptions of any and every theory must always be open to correction and revision, and thus progress will be rendered easy. If new facts appear which contradict our theories, let us welcome them, like loyal lovers of the truth should. The theory of electrolytic dissociation is being saved by being modified and revised, it is being transformed into a more perfect mirror of the truth as we now conceive it, and thus only is it retaining its usefulness and aiding in scientific progress.

Power alone is apt to be regarded as the first desideratum for the success of electrochemical processes, but knowledge, thinking power and industry are more primary factors. Given these, crude materials to work with will be found on every hand, and power sufficient will be created if it is not to be found.

A few words, however, about this question of the necessary cheap power. This item in manufacturing cost is of variable importance in electrochemical processes; in some it may form three-quarters of the total cost of the process, in others perhaps only one-quarter. The former are frequently compelled to move to the cheapest power, in order to exist at all, while such as the latter may take into account many other considerations, and find it cheaper for them to locate at more expensive powers. Niagara Falls is the most accessible of our great water powers, and has therefore drawn into its fold the majority of our electrochemical industries. But another source of surplus power is distributed over a large part of our country, in a condition at present as undeveloped as was Niagara power when Columbus touched our shores. I refer to the surplus power from blast-furnaces, obtainable by using gas-engines. Every blast-furnace burns its gases to heat its blast and to raise steam for its power. The two-thirds of its gases used for the latter purpose generate just about the power needed for the blowing-engines, pumps, hoists, &c., an amount equal on an average to 2500 horse-power for a furnace making 500 tons of iron per day. If the gas thus used was used in gas-engines, there would be an average surplus power, over and above all the requirements of the furnace itself, of 10,000 horse-power. The gas-engine plant needed to produce this power does not cost more than 50 dollars per horse-power investment, which compares favourably with the cost of developing water-powers, which vary from 25 dollars to 100 dollars per horse-power. It is thus deducible that there are scattered over the United States, in some of our most flourishing industrial centres, undeveloped powers which aggregate more than 1,000,000 horse-power, which can be developed at no more cost than the average water-power, can be generated just at the spots where they can be most favourably utilised, and without any more drain on our natural resources than the harnessing of a new water-power—for not a pound of coal more would have to be burnt than is used at present.

Other possible sources of power are the waste surplus gases from by-product coking ovens, and the utilisation of gas-producers, using cheap, almost waste, coal, in connection with gas-engines. Power therefore is available in immense quantities in places and in countries not blessed with Niagaras in their midst, and the industrial development of such sources will be one of the most marked industrial movements of the next ten years.

And now, let us inquire, how is this increasing development of power and its increasing application to industrial purposes best promoted by the electrochemists themselves. Undoubtedly, it is by the intimate and cordial cooperation of theoretical with practical electrochemists. This is attained by many agencies, but the most potent are research companies and our Electrochemical Society.

Such organisations as research companies, formed explicitly to combine research with practical application, are novelties in the industrial world which have originated with, and are almost peculiar to, electrochemistry. They invent, investigate and develop electrochemical process, and furnish facilities to would-be experimenters whose ideas might otherwise remain still-born. Such companies deserve the hearty support of all electrochemists, for they are injecting new life into the industry. May we have more such, scattered all over our land to nurse and develop quickly into active being the many electrochemical processes which *are to be*.

The factors which promote increasing applications of

electrochemistry are therefore cheap and accessible power, experimentation on a semi-industrial scale, men with heads full of ideas and inventiveness in applying them to the industrial needs of the country, more research companies and a further cultivation of the beneficent results of our society meetings.

By thus doing, cheap raw materials will be converted by the electrochemist into valuable products with constantly increasing ease and constantly decreasing cost, and thus electrochemistry will achieve its great *raison d'être* by increasingly ministering to the needs, the comforts and the pleasures of life, and thus it will become an increasingly important factor in social progress.

No modern science can progress if it adopts the mediæval practice of the alchemists, and carefully guards its wisdom for the exclusive use of the initiated. Widespread dissemination of the literature of our science, not only among our own fraternity, but among educated people in general, and even down to the rising generation of expectant men of science, is as necessary to our progress as is the recruiting of the human family to the preservation of the race.

The literature of our science consists of transactions, journals, treatises, monographs and text-books. Without these, and without the constant extension, improvement and dissemination of the same, our science would soon be dead indeed.

The transactions of our societies are the standing record of papers and discussions presented at our meetings. The contents represent the labours of many heads and hands, and the opinions of many minds. As such, they form a permanent record of the latest advances and the best thought in electrochemical lines. They are the reservoirs of information from which the other literature of the science, such as treatises and monographs, is largely compiled. They are of particular value to people who cannot personally attend the meetings which they report. Their value is augmented by being quickly printed and distributed, and the publication committees having that task in their charge should receive the cooperation of all authors in their efforts to prevent the transactions from becoming ancient history before they are issued. We may be pardoned referring with a little pride to the fact that the report of our Niagara meeting was distributed seven weeks from the close of the meeting, and that 25 per cent. of the papers presented at this, our most notable New York meeting, were in print before the meeting began.

The increasing membership of our societies, and the placing of such transactions in scientific and public libraries, are potent means towards interesting and instructing the world in electrochemistry, and recruiting the army of electrochemical workers.

Our text-books, intended to give beginners their first ideas of electrochemistry, should be most carefully written. Nothing sticks so permanently in the mind as a correct idea taken in youth from a good text-book—except an incorrect idea taken from a bad one, and I think that the latter often sticks the hardest. It used to be remarked that every professor elected to a chair of mineralogy in Europe felt himself expected to write a treatise on crystallography—and he generally wrote it; it is, of course, an exaggeration to say that every privat-docent elected to lecture on electrochemistry writes a text-book on the elements of the science, but it is an exaggeration with a grain of truth in it. There are entirely too many imperfect or partisan or downright execrable text-books of this kind; one good one, written by a master, is worth more than all of these poor ones put together. Electrochemistry should also be better presented in the elementary text-books of chemistry and electricity. The interrelation of these subjects is so intimate that the fundamentals of either necessarily include some of the fundamentals of the other, and beginners are wonderfully apt at comprehending the essential fundamental facts if they are skilfully presented. I recall to mind a very complete modern text-book of inorganic chemistry, written by a splendidly-informed chemist, in which the electrochemical part was turned over to an assistant, and, as a consequence, abounds in misstatements. We cannot afford to have our students started wrongly, and it is therefore of the highest importance that our text-books, while being as brief as is necessary, should be as accurate as is possible.

NOTES.

THE monument which was unveiled last month at Bonn, in honour of Prof. Kekulé, stands away from the city and just in front of the building of the chemical laboratories of the University of Bonn, the place in which Kekulé laboured and taught for so many years and with such pronounced and conspicuous success. The statue stands on a granite pedestal, and is life-size and of bronze. On each side of the sculptured figure of Kekulé is a sphynx. The character of the man, simple and unpretentious, yet convincing, is well brought out, and some of his greatest scientific achievements are clearly represented in relief on the pedestal. At the unveiling ceremony many universities and scientific bodies, foreign as well as German, were represented, and so also were numerous firms engaged in the chemical industry.

THE third International Mathematical Congress has been arranged to take place in Heidelberg on August 8–13 of next year. The congress will be divided into six sections, dealing respectively with arithmetic and algebra, analysis, geometry, applied mathematics, history of mathematics, and pædagogics. In addition to the business and sectional meetings, there will be conversaziones, a banquet, and an excursion up the Neckar, and illumination of the Castle. The year 1904 is the centenary of the birth of C. G. J. Jacobi, and the occasion will be celebrated in connection with the congress by the publication of a memorial volume on Jacobi under the authorship of Prof. Königsberger. The secretarial work of the congress is in the hands of Prof. A. Krazer, of Carlsruhe.

THE Anthropological Institute announces that Prof. Karl Pearson, F.R.S., has accepted its invitation to deliver the annual Huxley memorial lecture this year. The lecture will be delivered on Friday, October 16, at 8.30 p.m., in the lecture theatre of Burlington House. Prof. Pearson has chosen for his subject, "On the Inheritance in Man of Moral and Mental Characters, and its Relation to the Inheritance of Physical Characters."

A REUTER message from Strassburg states that the second International Seismological Conference, the object of which is to found an association for the study of seismological phenomena in countries interested in the question, was opened there on July 24. Twenty States were represented. The Statthalter of Alsace-Lorraine, who is patron of the conference, welcomed the delegates in the name of the German Empire.

THE Government has appointed Captain Harry Mackay, a Dundee whaling master, to the command of the *Discovery* relief expedition. The relief ship *Terra Nova* will be manned by an entirely civilian crew, chiefly whalemen. The ship is expected to be ready for sea in about a month, and it has been decided, instead of making a long passage round the Cape, to proceed by the Suez Canal. Arrangements will be made to ensure that, after passing Gibraltar, the *Terra Nova* will be towed by fast vessels of the Royal Navy attached to the Mediterranean and East India stations. The relief ship will proceed to Hobart, where she will be joined by the *Morning*.

THE bust of the late Sir William Flower, prepared for the Flower Memorial Committee by Mr. Thomas Brock, was formally presented to the trustees of the British Museum, at the Natural History Museum, on Saturday last. Dr. P. L. Sclater gave an address in the name of, and on behalf of, the 185 subscribers to the fund.

THE Mackinnon research studentships of the Royal Society have been awarded for the year 1903–4 to Mr. F. Horton for physical research, and to Miss A. L. Embleton for biological research.

THE French Association for the Advancement of Science will hold its thirty-second annual meeting this year at Angers from August 4 to 11, under the presidency of M. Levasseur, Administrator of the Collége de France.

GOVERNOR LANHAM, of Texas, has, *Science* announces, issued a proclamation offering a reward of 10,000*l.* from the State to any person who discovers a practical method for eradicating the cotton boll weevil.

AT an extraordinary general meeting of the members of the Jenner Institute of Preventive Medicine on July 22, a resolution to alter the name of the institute to "The Lister Institute of Preventive Medicine," proposed by Sir Henry Roscoe, seconded by Sir Joseph Fayrer, and supported by Prof. W. J. Simpson, was unanimously adopted. A second meeting will be held on August 7, when the resolution will be submitted for confirmation.

THE council of the Society of Arts attended at Marlborough House on Monday, when the Prince of Wales, as president of the society, presented the society's Albert medal to Sir Charles A. Hartley, "in recognition of his services, extending over forty years, as engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river to the ships of all nations."

AN outline programme has been issued for the autumn meeting of the Iron and Steel Institute to be held at Barrow-in-Furness on September 1–4. The president, Mr. Andrew Carnegie, will deliver a short address, and the papers down for reading include the following:—Alloys of iron and tungsten, Mr. R. A. Hadfield; the restoration of dangerously crystalline steel by heat treatment, Mr. J. E. Stead and Mr. A. Windsor Richards; the influence of silicon on iron, Mr. Thomas Baker; the diffusion of sulphides through steel, Prof. E. D. Campbell; the heat treatment of steel, Mr. W. Campbell; the diseases of steel, Mr. C. H. Ridsdale; carbon in iron, Prof. A. Stansfield.

Science announces that the Bufalini prize of the University of Florence will be awarded at the end of October, 1904. This prize is of the value of 240*l.*, and is awarded once every twenty years. The subject is the value of the experimental method in opposition to the speculative method of scientific research.

AN international exhibition is to be opened at Arras, in the north of France, on May 1, 1904, and remain open until the following October. It is under the patronage of the President of the French Republic, the honorary president of the automobile section being the King of the Belgians. Industrial chemistry is dealt with in one of the classes, and another is devoted to alcohol and its production.

IN reply to a question on the position of wireless telegraphy in the Navy, Mr. Arnold-Forster has stated that all battleships, and a very large number of cruisers, are fitted either with the Marconi system of wireless telegraphy or with modifications of that system. The present average expenditure upon wireless telegraphy is about 20,000*l.* per annum, a considerable portion of this amount being paid to the Marconi Company. An agreement with the Marconi Company is now being concluded, and the use of wireless telegraphy throughout the service will be greatly extended in the future.

SOME additional particulars of the International Congress of Science and Arts to be held at St. Louis next year were published in Monday's *Times*. A body of men of learning from all parts of the world will assemble at St. Louis in connection with the congress, and it is hoped their deliberations will stimulate thought, promote science, and thus form a permanent contribution to the world's progress. An administrative board has been entrusted with the arrangements in connection with this new departure, and Prof. Nicholas Murray Butler, of Columbia University, is at the head of it. The main features of a plan proposed by Prof. Münsterberg, of Harvard University, for the conduct of the proceedings of this section have been adopted.

REUTER reports that on July 22, after a period of explosions, there was a flow of lava from Mount Vesuvius.

THE Museum of Practical Geology, Jermyn Street, will be closed to the general public during the painting of the interior from August 1. The business of the Geological Survey will, however, be carried on as usual, and visitors requiring special information will be admitted to the Museum.

THE Rev. G. W. Rawlings, of Ōsaka, Japan, sends us an interesting example of the pertinacity and strength of Japanese sparrows. A pair of sparrows he found flying about his bedroom one morning had begun to build in a corner of the room, and though the beginnings of the nest were cleared away each morning, the sparrows repeated their attempt three or four successive days. A clothes-brush placed in the corner to keep the birds away was found to have been moved by the sparrows, though it was six inches long and two inches wide.

MR. F. W. BRANSON, of Leeds, sends us an account of some experiments made by him with a mixture of radium and barium chlorides in a dry and in a moist state. When the substance was moistened with water and stirred, its radio-activity was only slightly reduced, though the luminosity instantly disappeared, but it was restored by drying for fifteen minutes at 150° C. When placed in benzene the dried salt retained its phosphorescence. Benzene, however, appeared to diminish somewhat the emission of light rays. Exposure of the dried salt for a few hours to a moist atmosphere caused a total cessation of phosphorescence, but not in a dry atmosphere. No action could be observed on a photographic plate exposed to the radiations from the moistened salt for thirty seconds, whereas the dry salt gave a full image in the same time. A much longer exposure of the moist salt gave a faint impression, about equal in amount to that produced by an equivalent amount of the dried salt, when the latter was covered with a thin paper, opaque to light rays.

AT the beginning of this year Mr. A. E. Shipley directed attention in these columns (vol. lxvii. p. 205) to the widely spread belief that a basil plant (*Ocimum viride*) provided a means of protection against mosquitoes. Observations made by Captain H. D. Larymore at Lokoja, Northern Nigeria, seemed to show that the belief was well founded, but Mr. Shipley pointed out that further experiments were needed upon the subject. The article was reprinted in the *British Medical Journal*, and was referred to by many other periodicals; and in consequence requests for seeds of the plant were received at the Royal Gardens, Kew, from many parts of the world. Sir William Thiselton-Dyer has, however, sent to the *Times* of July 27 a report of experiments made on the basil plant in relation to its effect on mosquitoes by Dr. W. T. Prout, at Freetown, Sierra Leone, and he remarks that it "appears to dispose conclusively of the plant's possessing any real protective value." The conclusions arrived at by Dr. Prout as the result of his experi-

ments are:—(1) Growing plants have little or no effect in driving away mosquitoes, and are not to be relied on as a substitute for the mosquito net. (2) Fresh basil leaves have no prejudicial effect on mosquitoes when placed in close contact with them. (3) The fumes of burnt basil leaves have a stupefying, and eventually a destructive, effect on mosquitoes, but to obtain this action a degree of saturation of the air is necessary which renders it impossible for the individual to remain in the room. It is probable, however, that cones made of powdered basil would, when burnt, have the effect of driving mosquitoes away, and to this extent might be found useful.

A REPORT has been issued by the London County Council upon the manufacture of aërated waters in London. It is recommended that, in view of the large consumption of aërated waters, the premises upon which they are manufactured should be registered and periodically inspected in order to ensure a proper standard as regards sanitary conditions.

WE recently noted in these columns the outbreak of ankylostomiasis (infection with a parasitic worm) which has occurred in the Dalcoath mine, Cornwall, reported upon by Drs. Haldane and Boycott. A report has now been issued by the Home Office on an outbreak of the same disease in the Westphalian colliery district in Germany. A case has also been met with in Scotland by Dr. Stockman. In all probability, therefore, this disease is more widespread than was formerly supposed.

DR. TIMBRELL BULSTRODE'S report upon alleged oyster-borne illness following the mayoral banquets at Winchester and at Southampton has been issued by the medical officer of the Local Government Board. Dr. Bulstrode summarises the facts as follows. Two mayoral banquets were given on the same day in two towns. After both banquets a certain percentage of guests, all of whom had partaken of oysters, were attacked with illness of analogous nature, in some cases with definite enteric fever, in others with gastro-intestinal disturbance only. The oysters supplied to both banquets were from the same source (Emsworth), and the oysters from this source were at the same time and in other places proving themselves competent causes of enteric fever.

IT is reported that Prof. Kossel, of the Imperial Department of Health, Berlin, supports Prof. Koch's view of the non-transmissibility of bovine tuberculosis to man. He stated at a recent meeting of the Berlin Medical Society, that out of all the experiments conducted by the Imperial Board of Health, in two cases only had human tubercle bacilli affected the experimental animals. Prof. Orth, the successor to Virchow in the University of Berlin, on the other hand, states that in his own experiments 10 per cent. of the animals were infected with the tubercle bacillus of human origin. At the recent congress of the Royal Institute of Public Health, Prof. Young, who has collaborated with Prof. Hamilton, of Aberdeen, said that their experiments upon twenty calves left no doubt of the communicability of human tuberculosis to bovines, and Drs. Dean and Todd have proved the same point as regards pigs.

IN a paper entitled "Luftelektrizität und Sonnemtrablung" (Leipzig), Dr. H. Rudolph develops a theory of the origin of atmospheric electricity. We do not think his theory is likely to meet with general acceptance; the reasoning by which he arrives at the laws on which his mathematical investigation is based is, to say the least, by no means convincing. In an appendix the author mentions a method which he has invented for employing a captive balloon to collect from the upper atmosphere the large amount of electrical energy which he believes to be now running to waste, and he complains that the public have not given his scheme the support that it deserves.

THE "spinthariscope" devised by Sir William Crookes to show the scintillations which are produced on a blende screen when a piece of radium nitrate is brought near it, is now made by several scientific instrument makers. Mr. A. C. Cossor, of 54 Farringdon Road, has sent us one of these instruments, which consists of a short brass tube having at one end a blende screen with a speck of radium salt about a millimetre in front of it, and at the other end a simple convex lens. The instrument is very satisfactory, and shows the scintillations wonderfully well; it provides a convenient means of observing the action of radium, and can be recommended as a waistcoat-pocket instrument of scientific value.

WE have received a copy of the observations made at the Batavia Observatory during the year 1901; it contains hourly meteorological values and seismometric records, but the magnetometer was out of action during the year, owing to its removal to Buitenzorg. We are glad to see that the Netherlands Government propose to undertake a magnetic survey of the East Indian Archipelago, extending from longitude 95° to 140°; this will be a valuable addition to the magnetic survey of British India. An appendix to the volume contains a discussion of the anemometric observations for the ten years 1891–1900. This laborious investigation shows that calms largely predominate, especially during the westerly monsoon, from December to April. The direction of the wind during this period is chiefly from the north-western quadrant. From April to November, northerly and north-easterly winds predominate by a large percentage. The greatest horizontal displacement of the air occurs between August and October, during which time easterly trade-winds largely prevail. Another appendix contains valuable electrical and meteorological observations made during the total eclipse of the sun on May 18, 1901, at various stations.

THE *Quarterly Journal* of the Royal Meteorological Society (No. 127, July) contains an important and interesting paper on the prevalence of gales on the coasts of the British Islands during the thirty years 1871–1900, based on the data collected annually in the Meteorological Office for the purpose of testing the accuracy of storm warnings issued. We can only refer here to some of the general results:—the mean annual number of gales experienced on the west coasts is 29·6; of the total number 82 per cent. occur in the winter half-year; on the north coasts the mean number is 25·7, with a percentage of 84 in winter; on the south coasts, mean 19·1, winter percentage 80; on the east coasts, mean 15·6, with 84 per cent. in the winter half year. As regards direction, the mean results show that on the west coasts about 68 per cent. of the gales blew from the Atlantic, or equatorial directions, and about 26 per cent. from the Arctic, or polar directions; on the north coasts about 66 per cent. blew from equatorial, and 30 per cent. from polar quarters; on the south coasts the numbers were respectively 73 and 25 per cent; the results for the east coasts show that less than 53 per cent. blew from equatorial directions, and more than 44 per cent. from polar quarters. The prevalence and direction of gales in each division are plainly illustrated by wind-roses.

AN account of the flora of the north island of Nova Zembla appears in the *Bulletin du jardin impérial botanique* of St. Petersburg. The author, Mr. Palibin, observes that the flowering plants are most closely allied to those found in the Arctic regions of Asiatic Russia, but the algal flora resembles rather that of Spitsbergen.

A SECOND paper by Prof. Vines is published in the *Annals of Botany*, and gives an account of further investigations into the action of proteid-dissolving ferments in plants. Certain divergences appear to exist between the observations of the author and other experimenters; these are traced to the use of different antiseptics, so that it becomes necessary to try several antiseptic substances before formulating any conclusions as to the digestive power of the ferments under consideration.

THE formation of the first tropical experiment station in the British Empire in Ceylon, has already been referred to in these columns. Apart from agricultural experiments and the cultivation of economic products, questions of pure scientific interest will doubtless receive attention. In his report, Mr. Wright, the controller of the station, announces that experimental plots have already been laid out to determine how far the cultivated varieties of cacao plants bearing pure purple or pure white seeds will breed true. Should this be the case, the results produced by crossing will give valuable evidence for testing the Mendelian laws.

AMONG other articles, the *Transactions* of the Manchester Microscopical Society for 1902 contain some interesting observations by Mr. J. Barnes on the microscopic structure of the mountain limestone of Derbyshire. In the first place, it is recorded that the rock contains large numbers of very minute but perfectly formed quartz-crystals, frequently formed round a jaspideous nucleus. Of special interest is the description of a mottled phase of the mountain limestone, in which the dark portions have been produced by the carbonaceous matter contained in foraminifera, with which the rock is crowded.

THE Geological Survey has issued a memoir on the geology of the country around Reading, by the late Mr. J. H. Blake, edited by Mr. H. W. Monckton. The district is a part of the London Basin, with a foundation of Chalk, overlain by Reading Beds, London Clay, Bagshot and Bracklesham Beds, with extensive coverings of plateau and valley drifts. The Reading Beds are of special interest, and many detailed sections of the strata are given, with an analysis, by Dr. W. Pollard, of the mottled clay which is so largely worked for brick- and tile-making. There are also figures of some of the plant-remains which are found in the strata. A list of fossils from the basement-bed of the London Clay is likewise given. Mr. Monckton has contributed many notes relating to the superficial deposits.

SOME interesting facts referring to the cultivation and economic uses of the potato in Germany were recently stated by the American Consul-General in Berlin in connection with a technical exhibition there. In 1901, for every 10,000 inhabitants 160 acres were planted with potatoes, against 98 acres in France, 31 in Great Britain and Ireland, and 34·8 in the United States. The sandy plains of northern and central Germany are well adapted by nature to the cultivation, and elaborate experiments in scientific fertilising and cultivation have increased the production per acre by about 38 per cent. in the last ten years. The result has been that the crop reached the danger point of over-production in 1901, and accordingly there was in that year an enormous increase in potato alcohol, and the market was glutted with raw spirit. In February, 1902, there was an exhibition in Berlin to illustrate and promote the use of denaturised alcohol for technical and industrial purposes, and it has been repeated this year. Besides alcohol, the technical products of the potato are starch, starch syrup, potato flour, dextrin, and starch sugar. The production of these during the last ten years has increased rapidly, as has the export also. Last year the exports of potato flour and starch reached 45,970 tons, or more than double those of 1900, while the export of dextrin was 14,047 tons. The United Kingdom is the largest purchaser of German potato starch, the imports last year being 23,827 tons. The Consul-General adds that the law of 1887 regulating the production and use of untaxed alcohol for technical purposes was one of the wisest and most far-seeing of enactments, for Germany has profited largely by the stimulus thereby given to the cultivation of the potato and to the employment of cheap spirit in the chemistry and the industrial arts.

WE have received a copy of an article published in the Natural History and Scholastic *Abhandlungen* of Leipzig, by Mr. F. Mühlberg, on the object and extent of the instruction in natural science given in the higher middle-schools.

WE have received two further instalments of Messrs. Jordan and Fowler's valuable reviews of Japanese fishes, in course of publication in the *Proceedings* of the U.S. Museum, the one being devoted to the carp group, or cyprinoids, and the other to the cat-fishes, or siluroids. In both groups several new forms are described, some of which have, however, been already referred to in preliminary notices. A new genus of cat-fish receives the name of Fluvidraco, and apparently includes the well-known "yellow dragon" of the rivers of China. In another fasciculus of the same publication Mr. T. Gill discusses the affinities of the opah, or king-fish, and finds that he is not able to accept in their entirety the views on this subject recently published by Mr. G. A. Boulenger. He has some interesting observations on the origin of the name "opah," which appears to have been imported from the west coast of Africa, but does not seem to be the proper native title of the fish to which it is now applied.

THREE other papers from the *Proceedings* of the U.S. Museum are also to hand. In one of these Mr. D. W. Prentiss describes as new an imperfect mink skull from the shell-mounds of Maine. In the second Mr. A. N. Caudell discusses the orthopterous insects of various States, with descriptions of new species; and in the third Mr. J. E. Benedict revises the crustaceans of the genus Lepidopa.

AN issue of the *Circulars and Agricultural Journal* of the Royal Botanic Gardens at Ceylon contains an account, by Mr. E. E. Green, of a recent abnormal and remarkable increase in one district of the numbers of the so-called lobster-caterpillar (*Stauropus alternus*), which affects tea-plants. Until quite recently this caterpillar was so uncommon that good specimens were regarded as prizes by collectors; but latterly it has made its appearance in enormous numbers on certain plantations in the Kalutara district, where it has become a perfect "tea-pest." The reason for this sudden increase has not been ascertained.

ALL that Mr. E. Thompson-Seton writes with regard to the habits and ways of animals is well worth reading, and we are therefore glad to welcome an article from his pen in the Smithsonian Report for 1901 entitled "The National Zoo at Washington, a Study of its Animals in Relation to their Natural Environment." The author describes in some detail the history of the formation of this great and important undertaking, and the prime object which the founders had before them, namely, the preservation of as many of the larger North American animals as possible under conditions assimilating, so far as practicable, to their natural surroundings. In the case of many species, such as the wapiti, the bison, and the pronghorn, the experiment

has, up to the present, been a decided success. There are, however, a number of mammals, inclusive of the bighorn sheep, the true blacktail deer, the mule-deer, the moose, the white goat, and the grizzly bear—all more or less in danger of extermination—which have not yet been established in refuges of their own. This, it is said, is largely due to lack of funds; and the author points out that if the Alaskan brown bear—the largest living member of its kind—be not soon established in the gardens, it will be too late. Many interesting traits in the habits of American mammals are recorded, notably the fact that the prongbuck expands the hairs of its white rump-patch in a disc-like manner when alarmed, after the fashion of the Japanese and Peking deer, the white patch, when thus expanded, forming a conspicuous "recognition mark."

MESSRS. WATTS AND CO. have issued for the Rationalist Press Association, Ltd., a sixpenny edition of a selection of Tyndall's lectures and essays from "Fragments of Science." The famous British Association address at Belfast in 1874 is included, and also the biographical sketch of Tyndall in the "Dictionary of National Biography."

SINCE its publication in 1881, Mr. W. Robinson's delightful book on "The Wild Garden" has been the means of introducing many lovers of plants to new and beautiful aspects of vegetation obtained by placing hardy exotic plants under conditions where they will thrive without further care. The fifth edition has just been issued by Mr. John Murray, and will appeal to a larger circle of readers than that which derived ideas from the original work. The illustrations are all woodcuts by Mr. Alfred Parsons.

THE first part of the fifteenth volume of the *Proceedings* of the Royal Physical Society of Edinburgh, a copy of which has been received, deals with the work of the session 1901–1902. In addition to the opening address by Dr. David Hepburn, vice-president of the society, on some morphological evidences of the evolution of man, the volume contains, amongst others, papers by Mr. Goodchild on the origin of rock-salt and on observations upon the bathymetrical distribution of reef-building corals, and one by Dr. Munro on the prehistoric horses of Europe and their supposed domestication in Palæolithic times.

THE additions to the Zoological Society's Gardens during the past week include a Sooty Mangabey (*Cercocebus fuliginosus*) from West Africa, presented by Mrs. Watkins; a Ring-tailed Lemur (*Lemur catta*) from Madagascar, presented by Mr. H. P. Jaques; a Suricate (*Suricata tetradactyla*) from South Africa, presented by Captain C. P. Harvey; two Kinkajous (*Cercoleptes caudivolvulus*) from South America, presented by Miss C. Wallace Dunlop; a Himalayan Whistling Thrush (*Myiophoneus temminckii*), a Blue-winged Siva (*Siva cyanouroptera*), a Lesser Blue-winged Pitta (*Pitta cyanoptera*) from the Himalayas, presented by Mr. E. W. Harper; a Cardinal Grosbeak (*Cardinalis virginianus*) from North America, presented by Mrs. F. S. Stevenson; a Greek Tortoise (*Testudo graeca*), European, presented by Mrs. F. Bailey; two Wanderoo Monkeys (*Macacus silenus*) from Malabar, a Common Crowned Pigeon (*Goura coronata*), a Sclater's Crowned Pigeon (*Goura sclateri*) from New Guinea, a White-throated Ground Thrush (*Geocichla cyanonotus*), a Bengal Pitta (*Pitta bengalensis*), two Indian Rollers (*Coracias indica*), three Pond Herons (*Ardeola grayi*), five Scarlet-backed Flower-peckers (*Dicaeum cruentatum*), two Two-banded Monitors (*Varanus salvator*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN AUGUST:—

August 2. 8h. 1m. to 11h. 5m. Transit of Jupiter's Sat. III. (Ganymede).
8. 13h. 10m. to 15h. 56m. Transit of Jupiter's Sat. IV. (Callisto).
9. 11h. 27m. to 14h. 32m. Transit of Jupiter's Sat. III. (Ganymede).
10–13. Epoch of the great Perseid meteoric shower (Radiant point 45°+57°).
12. 11h. Venus at maximum brilliancy.
13. 10h. 54m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc =0·236; of Mars = 0·877.
16. 14h. 50m. to 17h. 54m. Transit of Jupiter's Sat. IV. (Callisto).
19. 13h. 16m. to 13h. 46m. Moon occults λ Geminorum (Mag. 3·6).
28. Perihelion Passage of Borrelly's comet (1903 *c*).
29. Mars 1½° south of α Libræ (mag. 2·9).

PHOTOGRAPHS OF COMET 1902 *b*.—Prof. R. H. Curtiss reproduces on their original scale, and minutely describes, some excellent photographs of Perrine's comet (1902 *b*) in the Lick Observatory *Bulletin*, No. 42.

The photographs were secured with the Pierson camera, which has a Dallmeyer objective of 15cm. aperture and 82·6cm. focal length, the Floyd telescope of 12cm. aperture and 200cm. focus serving as a guiding telescope. The nine photographs reproduced show very clearly the remarkable changes which took place in the size and form of the comet's tail.

THE NEW OBSERVATORY FOR BULUWAYO.—The *Buluwayo Observer* for March 21 gives an interesting account of the new observatory which is being founded in that city by the Jesuit mission.

Father Goetz, who obtained brilliant successes at the Paris University, and for eighteen months has been working at the Georgetown (U.S.A.) Observatory, has been appointed director, and has taken with him a fairly complete outfit of instruments for magnetic and meteorological observations. It is proposed that, as the work progresses, other instruments for astronomical work shall be added, and part of the programme for the new observatory is to undertake the mapping and cataloguing of variable stars in the southern hemisphere on similar lines to those followed at Georgetown for the northern variables. For this purpose the mission negotiated for the loan of an equatorial telescope from the Carnegie Institution, but the negotiations have not yet been successful.

The Chartered Company has given two blocks of land for the observatory site, and the Government has granted assistance in the erection of the necessary buildings (*Zambesi Mission Record*, July).

THE SYSTEM OF ϵ HYDRÆ.—In No. 36 of the Lick Observatory *Bulletin* Prof. Aitken gives the details of, and discusses, his observations of the binary system ϵ Hydræ, which, since its discovery by Schiaparelli in 1888, has been observed to possess a rapid motion. The various observations, except those made at Greenwich, are satisfactorily represented by an ellipse having the following approximate elements:—

$$T = 1901{\cdot}1,\ P = 15{\cdot}7 \text{ years},\ e = 0{\cdot}685,\ a = 0''{\cdot}24.$$
$$\Omega = 109°{\cdot}5,\ i = 35{\cdot}5,\ \lambda = 264{\cdot}7,\ n = +22{\cdot}293.$$

The components differ fully two magnitudes in brightness, and their maximum separation is only 0″·25.

There is a third star at a distance of 3″ forming, with the close double, the double star Σ 1273, and the observations show that together they form a ternary system, whilst the spectrograms obtained with the Mills spectrograph, and measured by Dr. H. D. Curtis, show that this third star has a line of sight velocity varying from +45·2 on November 28·02, 1899 (G.M.T.), to +29·1 on November 7·06, 1901, and that the visual and spectrographic binary systems are identical. If this is correct the spectrum observations should show a slow increase in the velocity of recession for the next year or two, and then a nearly uniform velocity until 1912.

WAVE-LENGTHS OF SILICON LINES.—Supplementing his recent work on the wave-length of the magnesium line at λ 4481, Prof. Hartmann has now redetermined the wave-lengths of the two silicon lines at λ 4128 and λ 4131, and has published his results in No. 1, vol. xviii. of the *Astrophysical Journal*.

These two lines, which are of great importance in the discussion of stellar spectra, generally appear broad and hazy in laboratory spectra, but, by photographing the spectrum of Geissler tubes containing silicon tetra-fluoride at low pressure, Prof. Hartmann has obtained them as sharply defined lines, from measurements of which he has obtained 4128·204 and 4131·040 as their respective wave-lengths, these values being based on Kayser's wave-lengths for three iron lines, viz. λ 4118·709, λ 4132·217 and λ 4144·033.

By similar means he has redetermined the wave-length of the carbon line at λ 4267, and gives 4267·301 as its exact value.

THE ECLIPSE OF THE MOON, APRIL 11–12.—In the July number of the *Bulletin de la Société Astronomique de France* a large number of photographs of this eclipse, obtained by various correspondents of the society, are reproduced. The photographs were obtained with many various instruments, and they, together with the remarks accompanying them, emphasise the exceptional density of the earth's shadow during this eclipse.

A METHOD OF APPLYING THE RAYS FROM RADIUM AND THORIUM TO THE TREATMENT OF CONSUMPTION.[1]

THE successful results reported in the treatment of rodent cancer by the rays from radium, and the general germicidal action of the rays, make the discoveries and investigations by Prof. Rutherford of the radio-active emanations of radium and thorium of great possible importance to medical men. The present article deals with the manner in which these emanations can be inhaled into the lungs and be made the means of applying the rays from radium and thorium to the treatment of consumption, in the hope that medical men will be induced to undertake research in this field. The rays from radium and thorium are very similar in kind, but differ greatly in relative degree. Five minutes' application of radium would be about equivalent to ten years' application of the same weight of thorium. Both elements continually and spontaneously produce radio-active emanations, or gases in infinitesimal quantity, beyond the present means of chemical or spectroscopic detection, but endowed with very considerable powers of giving out rays on their own account of exactly similar kind to the rays from radium and thorium themselves. The best condition for the free escape of these emanations, so that they can mingle with the air the patient breathes, occurs with both radium and thorium compounds when they are dissolved in water. In the solid state the emanations are often stored up by the salt and do not escape. Three-quarters of the normal activity of a dry solid radium compound is due to the stored up emanation. This escapes into the air instantly when it is dissolved in water.

If the air containing the emanation is removed and stored in a gas-holder away from the radium, the quantity slowly diminishes, and the radium solution grows a fresh crop as fast as the old disappears. In four days one-half of the emanation removed has disappeared, and one-half has reappeared in the vessel containing the radium solution, provided, of course, that it has been closed air-tight in the interval. After about three weeks the amount of the old emanation remaining is negligibly small; the amount reformed is a practical maximum, the same as was originally obtained on dissolving the solid salt. In the case of thorium one-half of the emanation disappears or is reproduced, as the case may be, in one minute. In five minutes the old emanation has practically all disappeared, and the thorium solution, if kept in a closed bottle, again contains as much as it ever did or can contain. In three weeks for radium, and in five minutes for thorium, an equilibrium in the amount of emanation present is reached, as much disappearing as is reproduced, in the same way as the population of a country remains constant when the number of births in any given time equals the number of deaths.

These considerations regulate the "dosage." The longer a patient breathes through a thorium solution the greater the dose of emanation. With radium, however, once the emanation has all been inhaled, no further effect is produced, and the solution must be left tightly closed to recover its emanation before it can again be advantageously used. Further, in dealing with the thorium emanation, it is essential that the air should reach the patient's lungs within the shortest possible time, say half a minute, after leaving the thorium solution.

The property of the emanations of leaving behind a film of radio-active matter wherever they come into contact, which causes the phenomenon of "excited" or "induced" radio-activity, is important in the present connection, because this excited activity will remain in the air-cells of the lungs after the emanations themselves have been exhaled. This excited activity gradually disappears in the course of time, becoming negligible with thorium after two days, and with radium after three or four hours. The practical effect of this in both cases will be to cause a feebler continued action of the rays on the lungs after the more powerfully radio-active emanations have all been exhaled.

Which emanation will prove the more suited for the present purpose is, of course, a matter for trial, but thorium possesses many compensating advantages which make up for its very feeble radio-activity. It is cheap, and can be procured in any quantity. Unlike radium, the effect of its emanation is proportional to the time of inhalation. Moreover, in dealing with the emanation there is practically no limit to the quantity effectively employable. The radiation from a solid salt, owing to absorption of the rays by the salt itself, is practically confined to a thin surface layer, but with the emanation no such absorption occurs. The emanation from a kilogram or more of thorium salt could be effectively employed on the lungs of a single patient. Thorium nitrate, a very soluble salt, is the most suitable compound to employ, but the free nitric acid present should be neutralised after the salt has been dissolved in water by cautious addition of ammonia with stirring, until precipitation is about to take place. A gas washing bottle, with outlet and inlet tubes ground in, could be used as the inhaler, and this should be filled as full as possible with the moderately concentrated solution. There is not much fear that an hour's daily inhalation of the emanation from 100 grams of dissolved thorium nitrate would produce any ill effect, and both the quantity employed and the time of inhalation could, after due trial, be increased indefinitely. For use with the radium emanation the inlet and outlet tubes should be provided with taps. A few milligrams of the salt, radium bromide, for example, should be placed in the dry bottle, and water drawn in to dissolve it, the taps being then closed. For the first trials, a few bubbles only of the total gas contained in a fairly large bottle should be drawn into the lungs with a deep breath of air, and retained as long as possible before being exhaled. The dose should be only very gradually increased, and the effect on the system very carefully watched, for the radium emanation is an exceedingly powerful agent. Mixed with air it glows brightly in a dark room, and exerts a very rapid oxidising action on carbonaceous matter, and even on mercury. The maximum possible dose for any one quantity of radium solution would be obtained by inhaling the whole gaseous contents of the bottle, a few bubbles at every breath, once every twenty-four hours.

The immunity of these processes from external interference, the simple nature of the treatment proposed, the infinitesimal quantity of the active agents employed, the manner in which the emanations may be inhaled to do their work at the very seat of the disease, leaving behind in their place the excited activity to continue the work in a gentle manner after they have been exhaled, make out a strong case why the attention of medical men should be directed to these new weapons which physics and chemistry have placed at their disposal. Indeed, if nature had designed these phenomena for the purpose proposed, it is difficult to see in what way they could be improved upon.

FREDERICK SODDY.

[1] Abridged from the *British Medical Journal*, July 25.

THE CHEMISTRY OF THE ALBUMINS.

THE composition and constitution of the albumins have hitherto been studied almost exclusively from the analytical point of view, and particularly by the examination of the products of hydrolysis effected by either acids, alkalies, enzymes, or putrefactive bacteria.

Improved methods for the separation of these products, due to Kossel, E. Fischer, and others, have led to the conception of the complex albumin molecule as composed of a large number of simple molecules, consisting to a great extent of monamino- and diamino-acids and related compounds (compare NATURE, vol. lxv. p. 90), united together by some form of condensation, which involves an amino-group, and is probably similar in nature to that which occurs in the formation of the acid amides.

The various members of the vast group of albuminous substances may differ from one another in many ways, but two of the chief points of difference appear to be the variety of these component groups, and the numbers of them contained in a single molecule. Thus a comparatively simple albuminoid substance, such as silk when it is completely hydrolysed, yields, among other products, the monamino-acids, tyrosine, phenylalanine, leucine, alanine (amino-propionic acid), and glycine (aminoacetic acid). Gelatin, on the other hand, which is also comparatively simple in composition, differs markedly from silk by the absence of tyrosine, whilst oxyhæmoglobin, to take another instance, yields tyrosine, but no glycine.

By the incomplete hydrolysis of the fibroin of silk, moreover, Prof. E. Fischer has obtained a substance which appears to be a compound of aminoacetic and amino-propionic acids. The formation of this substance is of great interest, since it probably represents an intermediate stage of the decomposition, and affords strong confirmation of the view of the constitution of the proteid molecule which has just been stated.

Most of the final products of hydrolysis of the albumins are familiar compounds which can readily be prepared by synthetic methods, but very little has hitherto been known of the more complex substances to be obtained by the linking together of several of these molecules. It is in this direction that Prof. Emil Fischer has been working for some time past, and he has contributed to the current number of the *Berichte* an account of the highly important results which have already been attained. The plan of attack consists in endeavouring to build up complex substances from the simple amino-acids by first introducing a second molecule of the same or another acid, and then repeating the process as frequently as possible with each successive product.

The first step was taken some time ago by the production of glycylglycine, $NH_2.CH_2.CO.NH.CH_2.CO_2H$, from glycine anhydride. This substance contains two molecules of glycine united in the typical manner, and is the simplest of the *polypeptides*, as these bodies have been named, because of their assumed similarity to the peptones in structure. To add a third link to the chain is, however, a matter of difficulty, owing to the ease with which the amino-group undergoes change. Two methods have, however, been found by means of which this can be accomplished.

The first of these consists in building up the new aminoacetic molecule by first introducing into the amino-group the chloracetyl radical, $Cl.CH_2.CO.$ (by the action of chloracetyl chloride), and then introducing the amino-group by the action of ammonia, the final product being a crystalline substance having the formula of a diglycylglycine, $NH_2.CH_2.CO.NH.CH_2.CO.NH.CH_2.CO_2H$. A description of the properties and reactions of this substance has, unfortunately, not yet been published.

The other method consists in first of all introducing the group $.CO_2C_2H_5$ into the amino-group of glycylglycine. The resulting compound can then be converted into an acid chloride, which readily reacts with the ester of glycine to form the desired compound containing three glycine molecules. A repetition of this process leads to the addition of a fourth glycine molecule to the chain, the final product which has hitherto been obtained being of the respectable complexity shown by the formula

$$CO_2C_2H_5.NH.CH_2.CO.NH.CH_2.CO.NH.CH_2.CO.NH.CH_2.CO_2C_2H_5$$

(carboxethyl-triglycylglycine ester). This substance is crystalline and is converted by ammonia into a crystalline amide, which gives, with an alkali and a copper salt, the well-known biuret reaction, which is given by all the amides of this series, as well as by the albumins. The group $.CO_2C_2H_5$ combined with the amino-group cannot, so far, be removed from the molecule, so that, until some means of doing this is discovered, this method can scarcely be expected to yield derivatives so closely related to the actual proteids as those obtained by the method first described.

Both methods obviously lend themselves to the production of a great variety of compounds containing different amino-acid groups, and substances of this kind, derived from glycine and leucine, and from glycine and alanine, have already been prepared. It seems probable that by their extended use compounds of the order of complexity of the peptones or albumoses may soon be prepared. The application of both methods is, indeed, still in its infancy, but we can have little doubt that the genius which laid bare the innermost secrets of the sugars will succeed in solving many of the problems which surround the chemistry of the albumins.

ARTHUR HARDEN.

THE ANTARCTIC EXPEDITIONS.

THE report of Captain Scott to the presidents of the Royal and Royal Geographical Societies, which is printed in the July number of the *Geographical Journal*, adds a number of points of geographical interest to those previously published, especially with regard to the great southern ice-barrier, and the nature of the lands discovered by the British expedition; while the map published at the same time, which has had the advantage of revision by Lieut. Shackleton since that officer's arrival, permits the details of the narrative to be followed with much clearness, although it is still to be considered merely provisional.

The voyage down the east coast of Victoria Land brought to light some new features in the configuration of the country. Thus, in about lat. 75° 30′, an enormous floe of the inland-ice was seen to descend into the sea and extend for many miles to seaward, closely resembling the Great Barrier and the barrier formation which entirely fills Lady Newnes Bay. Near the entrance to MacMurdo Strait (between Erebus and Terror Island and the mainland), ice-cliffs, 150 feet high, were again skirted, being evidently the seaward face of the great glacier subsequently explored by Lieut. Armitage. During the voyage eastward along the face of the Great Barrier, soundings for some time showed depths of more than 300 fathoms, the barrier edge being very irregular, and varying from 30 to 215 feet in height. In the neighbourhood of the eastern land discovered by the expedition (King Edward VII. Land) the soundings suddenly became less, varying from 70 to 100 fathoms. The bare patches seen among the snow slopes of the new land, which are evidently the sharp spurs of snow-capped hills, stand at a height of 2000 to 3000 feet. The balloon ascent and sledge expedition made in long. 196° 15′, showed that the surface of the barrier[1] undulated in long waves running W.S.W. and E.N.E. It was noticed that here the ship neither rose nor fell in relation to the ice, thus apparently indicating that the latter is floating.

The winter quarters were established in February, and the magnetic observatory was in readiness for the term-day observations of March 1, all the subsequent term days being kept by Mr. Bernacchi without a break. On May 3 a strong southerly gale brought the first heavy snowfall, also blowing the strait clear of ice to within 200 yards of the ship. Mr. Hodgson was constantly engaged on his biological work, keeping holes open for his nets and fish-traps, and all the officers assisted Lieut. Royds in the night meteorological observations. Auroral displays were infrequent and feeble, but were carefully observed. The winter sledge reconnaissances revealed much of the topography of the neighbourhood, both on the south side of Erebus and Terror Island, and between it and the mainland, where there are three smaller islands, named White,

[1] The whole southern ice-sheet is spoken of throughout as the "barrier," though this term would more naturally apply to its northern face only.

Black, and Brown, from their characteristic aspects; the first being snow-covered, while the two others displayed the bare basaltic rocks of which they are composed. In September and October minimum temperatures of −51° and −57° F. were experienced during two of the journeys.

During a visit to Mount Terror, the eastern slopes of which are terribly wind-swept and bare to the summit, Mr. Skelton made a perilous descent to the sea-ice, and was so fortunate as to discover a breeding-place of the Emperor penguin, obtaining several specimens of the young in down, besides photographs and notes. The attacks of scurvy which occurred about this time, brought about by severe work and exposure, were in reality very slight, and their importance has been much exaggerated, all symptoms quickly disappearing when the diet was restricted to seal-meat. Skua gulls, which were also obtained, were found to be excellent eating.

The southern sledge expedition undertaken by the Commander, with Lieut. Shackleton and Dr. Wilson, was carried out entirely on the surface of the great ice-sheet, it being found impossible to reach the land, though it was sufficiently near to allow of observations as regards the bearing and altitude of the different land-masses, as well as sketches and photographs. A remarkable feature seems to be the fiord-like openings by which it is penetrated at various points, though the intervening volcanic masses rise into magnificent ranges of mountains. These openings had the appearance of straits, nothing being seen behind, though the state of the ice-sheet opposite them showed that ice must be pressing out through them. On approaching the land at the furthest south, the ice-sheet was found to be separated from it by an immense chasm, the ice-foot resembling that seen elsewhere at the sea-margin of the lands, and forming a complete bar to further progress. The return journey was rendered difficult by the nature of the surface and the prevalent mist.

The further details supplied of Lieut. Armitage's western expedition show that, after proceeding up one large glacier, lying between precipitous granite mountains, a ridge was crossed by a pass 4000 feet above the sea to a second glacier, which had a general trend from south-west to north-east. Its right-hand branch was ascended to a range of remarkably bare granite mountains, the ice surface being much crevassed. A line of sticks set up during the ascent showed a maximum motion of 3 feet 8 inches in twenty-three days. On gaining a height of 9000 feet a smooth, open snow-covered plain stretched to the westward, its surface being soft, with successive crusts nine inches or a foot apart. There were no *sastrugi*. The whole horizon to the west was clear and unbroken, and the plain appeared to have a slight fall in this direction. Running streams, 7 feet wide, with occasional pools sometimes a mile in diameter, were seen on the return journey, and *Bergschrunds* 150 feet deep were found at the base of the mountains. Among the other journeys described, those of Dr. Koettlitz for the investigation of the ice and esker-like lines of débris in the neighbourhood of the Black and Brown Islands are of most interest.

An interesting complement to the narrative of the British expedition has been supplied by the report of Dr. von Drygalski, leader of the German expedition in the *Gauss*, which was published as a supplement to the official *Reichsanzeiger* on July 10. It describes the voyage from Kerguelen *viâ* Heard Island to the supposed position of the non-existent Termination Land, the southward advance to a previously unknown land, in the vicinity of which winter quarters were established, the scientific work done at the winter station, and the sledge journeys undertaken during the stay. The *Gauss* was frozen fast in the ice to the north of this land, the pack there remaining stationary owing to the shallowness of the sea over the "Continental Shelf." Only a few miles to the north it appears to be kept constantly in motion by the heavy swell caused by the westerly storms, which would have seriously impeded the scientific work, besides endangering the ship. From the land rose a bare volcanic peak 1200 feet high, which was named the Gaussberg. The *Gauss* was set free on February 8 by a strong easterly wind, but was caught again temporarily in a somewhat lower latitude, the final start northward being made on April 8, when the lengthening nights were already making navigation difficult.

THE STRUCTURE OF SPECTRA.[1]

THIS paper gives a very lucid account of the structure of various types of spectra, special attention being directed to the work on "series" which has been performed during recent years.

After referring to the splendid work performed by Ångström and Rowland in establishing trustworthy tables of standard wave-lengths, the author passes on to the evolution of the definite laws which have been found to govern the distribution of lines in the spectra of many elements, comparing the occurrence of similar definite groupings of lines in the spectrum of a substance to the "harmonics" obtained in acoustics.

In 1863 Mascart found that certain groups of lines of characteristic aspect were reproduced in different parts of the spectrum of the same metal, *e.g.* he found that similar triplets to the "b" group of magnesium were reproduced in the ultra-violet region of the spectrum of that metal. To-day it is known that altogether there are fourteen such groups in the magnesium spectrum, one in the infra-red, the "b" group and twelve in the ultra-violet.

Similarly in the spectrum of sodium there are twelve such "doublets" as that commonly known as D_1 and D_2 in the solar spectrum. If these "triplets" and "doublets" are represented on a scale of wave-lengths, they contract as they approach the ultra-violet, but if they are represented on a scale of frequencies, the groups of the same metal become identical, and are absolutely superimposable. Similar groups have been found for a large number of metals by Kayser and Runge.

The alkaline metals, like sodium, give a series of "doublets," as also do copper and silver, whilst the divalent metals (Mg, Ca, Sr: Zn, Cd, Hg) give triplets, although some of them, *e.g.* Hg, are so mixed up with other groups that at first this arrangement is difficult to recognise. Here then we have a simple law, which should be credited to Rydberg, viz. "In the spectra of a large number of elements there exist groups which are reproduced several times, the interval which separates the individual lines of each group (when represented on a scale of 'frequencies') being exactly the same for all the groups."

For the alkaline metals the length of the interval which separates the doublets varies as the square of the atomic weights, as is shown in the following table:—

Metal	Atomic weights (P)	Length of interval (ν)	$\nu/P^2 \times 10^4$
[2] Li ...	7 ...	— ...	—
Na ...	23 ...	0·17 ...	3·25
K ...	39 ...	0·57 ...	3·81
Rb ...	85 ...	2·34 ...	3·22
Cs ...	133 ...	5·45 ...	3·09

It was then found that these groups arrange themselves in regular series capable of mathematical expression, and in 1885 Balmer found that on plotting the thirteen lines of hydrogen on a curve which had "m" (the number of the line counting in order from "3" in the red to "15" in the ultra-violet) for its abscissa and N (the frequency) for its ordinate, he obtained a perfectly regular curve which could be exactly expressed by the formula

$$N = B/4 - B/m^2,$$

where B was a constant. Later, Messrs. Hales and Deslandres discovered sixteen other hydrogen lines in the spectra of prominences and various stars, and it was found that these also might be represented by the above formula.

The spectra of metals also arrange themselves in similar series, although the relations are not so easily seen at first, because of the overlapping of the other lines. However, the spectrum of potassium may be taken as an example, and we find that on plotting the lines in a similar manner we obtain three such series, known respectively as "the principal," "the first subordinate," and the "second subordinate" series. In each of these series the brightness of the lines decreases as they approach the more

[1] "La Structure des Spectres," by Prof. Ch. Fabry, Marseilles, in the *Revue Générale des Sciences*, No. 5, March 15.

[2] The "doublets" for lithium have not been observed, but if the law is applicable in this case the interval would only be 0·016, which is too small to be observed.

refrangible end of the spectrum, acting in this respect in a manner analogous to the hydrogen lines. It is found that the potassium curve is exactly similar to the hydrogen, having a horizontal asymptote which corresponds to the limit of the series. Not only is it similar to the hydrogen curve, but by making two displacements parallel to the coordinates it is found to be superimposable, and both curves may be represented by a generalisation of Balmer's formula, due to Rydberg, as follows :—

$$N = A - B/(m+\mu)^2,$$

where A, B and μ are constants, B having sensibly the same value as in Balmer's formula.

It is interesting to compare the curves for the various members of the alkaline metals among themselves, when it is seen that both for the "principal" and the "subordinate" series the limits approach the red end of the spectrum in the order of the atomic weights of the metals, as if the greater masses of the atoms caused the frequencies of the vibrations to become less; this same fact becomes obvious when we consider, similarly, the spectra of the other metals classified into their natural groups.

Prof. Fabry next describes the "satellites" which accompany most lines in the several spectra. For an example he takes the spectrum of mercury, which is composed of triplets forming two series, one the "diffuse" and the other the "sharp" ("first subordinate" and "second subordinate" respectively) series of Rydberg. In the "diffuse" series the first element of each group is composed of four lines, the second of three and the third of two, but in the "sharp" series the elements are apparently single lines; this is probably due, however, to the very close proximity of the satellites in the latter series, and in several cases MM. Fabry and Perot have shown that, with special apparatus having great resolving power, these lines are of a compound nature, and have come to the conclusion, which at least is probably the correct one, that *all* the elements of the secondary series are accompanied by satellites. All these satellites appear to share the common property of varying greatly under different conditions of emission (*e.g.* as temperature, pressure and nature of the electric discharge), and these two observers have shown that, whereas the silver line at λ 547·2, which is a satellite of the line at λ 546·6, appears in the spark spectrum in air, it completely disappears when the spark takes place *in vacuo*. Many metals (*e.g.* Fe, Ni, Mn) produce spectra so complex that, as yet, it has not been possible to classify them, but this may be done when a means of distinguishing analogous rays is discovered and brought into use.

This latter means may be found when the phenomena first observed by Zeeman, and known as the "Zeeman effect," have received a more complete study. This observer found that if the emission took place in a strong magnetic field, each line was split up into a series of lines symmetrically placed as regards the original line, but differently polarised. Taking the spectrum of mercury as an example, we see that the second subordinate series is made up of triplets, or, as shown above, three separate parallel series of lines, which one may call, in this explanation, "a," "b" and "c" respectively. In the magnetic field the members of the "a" series split up into nine separate lines, *four* on each side of the original line, some of which are polarised in the plane of the lines of force, the others in the perpendicular plane, but the corresponding line on each side is similarly polarised. In the "b" series we get lines which are similarly placed as regards the original line, and similarly polarised, but there are only *three* on each side, the second member on each side in the "a" group having disappeared. Similarly in the "c" series only two extraordinary lines are seen, *one* on each side of the original, corresponding to the extreme lines in the "a" series.

To the first workers in this field these lines appeared greatly entangled, but, thanks to the labours of Cornu, Michelson, Preston, and more especially Runge and Paschen, order has been evolved from the chaos, and the study of the "Zeeman effect" will, in the future, form a ready means of recognising and determining series, for it has already been proved that "the various lines which go to make up similar series behave in an identical manner when the emission takes place in a magnetic field, and if one represents each line by its 'frequency,' the various members, in the same magnetic field, resolve themselves into groups which are strictly superimposable." It is also to be hoped, and even expected, that when the work of Humphreys and Mohler, and others, on the displacement of spectral lines under various conditions of pressure, comes to be further developed, similar laws as to the analogous behaviour of lines in their corresponding series will be evolved.

Prof. Fabry concludes his article with a discussion of the relations which exist between the absorption and emission of the same radiations, taking the example of the telluric absorption assigned to atmospheric oxygen in the solar spectrum as an example for discussion. He doubts the coincidence of these absorption bands with emission lines in the spectrum of the gas, although, as he points out, experimental means of proving their non-coincidence have yet to be devised.

CONGRESS OF THE SANITARY INSTITUTE.

THE annual congress of the Sanitary Institute was held at Bradford on July 7–11, under the presidency of the Earl of Stamford.

In his inaugural address Lord Stamford dealt with the history of hygiene, showing how closely the subject was allied to political, social and economic history. In describing broadly the various sanitary questions as they affected the home, factory, and the municipality, the president dealt with the important subject of school hygiene, and pointed out how essential it was that the training schools for teachers should form part of the coordinated system of national education. It should be one of the first requirements in the preparation of the teacher, and also of the inspectors who are appointed to visit the schools, that they should practically understand something of the nature of the child material upon which they are to work, the conditions under which the child can best develop by the teacher's guidance, and the proper use of the appliances provided in modern school buildings.

The sections and conferences to which the papers and discussions of the congress were allotted were presided over by well-known representatives of different sciences connected with hygiene. Prof. Clifford Allbutt, in his address on sanitary science and preventive medicine, brought forward for consideration the question if, within limits, the birth of fewer children under improved conditions may be better in the end than a more voluminous birth-rate of children of which some may be of lower vital capacity, and many less watchfully reared.

Mr. Fitzmaurice, of the London County Council, presided over the section of engineering and architecture, and in connection with some of the large engineering works in which he had been engaged he directed attention to the duty of providing for the medical and sanitary requirements of the large bodies of men temporarily collected for the purpose of carrying out the works, and showed that attention to these requirements was an economic advantage. In works like the Forth Bridge or others in the neighbourhood of large towns the difficulty could be overcome, but in works abroad, such as the Nile reservoir, the problem was a more difficult one, especially as smallpox and typhoid are endemic in the Nile valley, and a large outbreak of either in a camp where 15,000 persons were at times employed would have been disastrous; but by making careful provisions, health conditions were so well maintained that, during the five years the works were going on, there were only four deaths from smallpox and one from typhoid fever. He also dealt with the health aspects of cheap locomotion to the suburbs, and motor traffic.

Prof. Hunter Stewart, in addressing the section of chemistry, physics, and biology, discussed the spread of and immunity from Asiatic cholera, and referred to Great Britain as the most striking instance of acquired immunity. With a sea traffic from India greater than that of any other European Power, and in constant communication with the Mediterranean ports, with no quarantine and cordon regulations such as prevailed on the continent of Europe, this country has, since 1866, known cholera only in the sporadic

form, even though it was raging as an epidemic in France and Spain in 1884–1885. This immunity may be attributed to the great measures for sewage and refuse removal carried out in Britain, which had slowly resulted in such a purification of the soil as to make it unsuitable for conferring virulence on the micro-organism of cholera.

Among the subjects discussed in the sections were the notification of consumption, the several aspects of sewage disposal, construction of hospitals and public baths, and disinfection.

In addition to the sections, eight technical conferences were held dealing with the aspects of hygiene, particularly in reference to the different professions and various classes of the community.

In connection with the congress an exhibition of sanitary apparatus and appliances was arranged, containing exhibits brought by manufacturers from all parts of the country. The visits made to the various municipal undertakings and sanitary works in the neighbourhood served as a valuable object-lesson, illustrating many of the matters discussed in the meetings of the congress.

Among the exhibits at the exhibition, which were carefully examined by a board of expert judges, a special Rogers Field medal was awarded by the institute to the Northern Vacuum Cleaning Company for their apparatus for cleaning carpets, furniture, and house decorations without removing them from the house. The attendance of members and delegates numbered 1550.

E. WHITE WALLIS.

THE MUSEUMS ASSOCIATION.

THE fourteenth annual congress of the Museums Association was held in Aberdeen on July 13–16, and although the place of meeting was so far north, the attendance was exceptionally good, while the programme of business was one of the most varied and useful that has ever been brought before the Association. The president for this year is Dr. F. A. Bather, assistant keeper of geology, British Museum (Natural History), whose presidential address dealt chiefly with art museums. After defining generally the purport and breadth of museums, which he classified into three divisions, (*a*) investigation for the benefit of specialists; (*b*) instruction for the benefit of students; and (*c*) inspiration for the guidance of the general visitor, he entered into a critical survey of the Museum of Fine Art, specially condemning the present system of arranging pictures, and the lack of harmony between the architecture, decoration, and contents of an art gallery.

Mr. James Murray followed with a paper on the Aberdeen Art Gallery, which is about to be greatly extended; then came a paper by Mr. Alex. M. Rodger, "Method of Mounting Fish with Natural Surroundings," which can be commended to all curators who wish to make their museums attractive. Mr. W. P. Pycraft was rather severe on some of the methods of representing birds in a museum, and Mr. E. M. Holmes briefly described a method of preserving the natural colours of dried leaves and flowers for museum specimens, which had stood the test of many years' exposure, while a paper by Mr. H. Bolton treated of the "Re-shelving of Museum Cases." "On Good Form in Natural History Museums" was the title of a paper by Mr. F. Jeffrey Bell; another paper of the same character being "Neglect of Opportunities," by Mr. S. S. Buckman.

In addition to representatives from the leading museums of Britain, there were some foreign representatives who read papers. Dr. Jens Thiis, director of the Nordenfjeldske Kunstindustri-museum, Trondhjem, explained the practical work connected with that museum; Dr. G. Johanson Karlin, of the Kulturhistoriske Museum, Lund, gave some good advice in his paper on the museum system; while Dr. O. Lehmann, of the Altona Museum, advocated the cultivation of the habit of drawing in natural history museums.

Other papers were contributed by Prof. T. D. A. Cockerell, of the New Mexico Normal University; Dr. Anton Fritsch, of the Bohemian Museum, Prag; Mr. B. H. Woodward, of the Perth Museum, Western Australia; and Prof. Wm. M. Ramsay, of Aberdeen, who treated of the archaic art of the north-east of Scotland, and the urgent necessity for the preservation of existing examples of it, while Prof. J. Arthur Thomson, in a convincing paper, showed the need for a faunistic museum for the north of Scotland. All these papers, together with the discussions which they aroused, will be published in due course in the *Museums Journal*. The invitation of the City of Norwich to hold the conference in 1904 in that city was accepted, and Dr. S. F. Harmer, superintendent of the Museum of Zoology, Cambridge, was elected president, Mr. E. Howarth, of the Museum and Art Gallery, Sheffield, being re-elected secretary and editor.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE third reading of the London Education Bill was carried in the House of Commons on July 22, and the second reading passed the House of Lords on July 28. The measure will, therefore, doubtless soon be placed upon the Statute-book.

THE following awards have been made under the research scheme of the Carnegie Trust for the universities of Scotland, in addition to those announced last week:—*Research Scholarships*.—Pathological: Mr. C. T. Andrew, Mr. A. Matheson, Mr. M. Logan Taylor, Mr. S. A. K. Wilson. Economical: Mr. John Young.

MR. PHILIP J. HARTOG has been appointed academic registrar of the University of London in succession to Dr. H. Frank Heath, and Dr. E. R. Edwards secretary to the registrar of the board to promote the extension of university teaching, in succession to Mr. J. Travis Mills. The Drapers' Company has presented to the university the sum of 1000*l*. to be devoted to the assistance of Prof. Karl Pearson in his statistical researches at University College and in the higher work of his department.

THE Technical Instruction Committee of Leeds has decided to give support to the application of the Yorkshire College for the establishment of a university in Leeds, to be entitled Victoria University of Yorkshire, and, in the event of a Charter being granted, to give 4000*l*. per annum towards the university funds, in addition to the 1550*l*. granted from the "whisky" money. The finance committee also approved of the resolution. The *Gazette* of Friday last announces that a petition has been presented to the King in Council praying that a Charter be granted constituting an independent university in Sheffield.

AMONG many questions of educational interest considered in the report for 1902 of the council of the City and Guilds of London Institute is that of the relation between the amount of State aid for university and higher technical education and that of private munificence for the same purpose. The report states, "that State or public aid does not necessarily take the place of private and voluntary effort is shown by the experience of the United States of America. Notwithstanding the increasing revenue available there from the State land grants permanently assigned to education, the activity and munificence of private effort increases rather than diminishes, as shown by the large contributions which are continually being made to the principal universities and higher colleges. In the three months September to November of last year gifts to higher education, amounting in all to nearly five million dollars, equal to about one million sterling, have been publicly recorded." The report also shows that the executive committee of the institute has had under consideration the question of the length of the sessions of work of colleges providing systematic courses of higher instruction. It has been found that the number of weeks in the session at eight of the principal technical colleges in England varies from thirty-one to thirty-three, leaving between four and five months' vacation during the year. Vacations do not necessarily mean holidays, and in most colleges the work of advanced students continues into the vacations; nevertheless, the committee suggests that the length of the formal session might with advantage be increased.

TWENTY-EIGHT senior county scholarships and exhibitions have just been awarded by the London County Council Technical Education Board. The awards are made on the work and promise of the candidates, and most of the scholars will pursue their studies at universities or advanced

technical colleges. Among the awards we notice the following:—Mabel Gardner, who has gained the first science scholarship at Girton College, senior county scholarship of 90*l.* a year for three years. H. H. Mittell, a full senior county scholarship of 90*l.* a year for three years to enable him to proceed to Magdalene College, Cambridge, where he has gained an open scholarship, and to take the mathematical tripos. C. H. Pitt, a senior county scholarship of 90*l.* a year to enable him to proceed to Corpus Christi College, Cambridge, where he has won an open science scholarship. A. E. Baker, an exhibition of 75*l.* a year for two years in the first instance, in order to enable him to proceed to Trinity College, Cambridge, where he has obtained an exhibition and subsizarship, and to take the natural sciences tripos. W. H. Norris, an exhibition of 70*l.* a year for three years to enable him to proceed to Corpus Christi College, where he has gained an open science scholarship. J. W. Kuhrt, a free place at the London School of Economics and Political Science, together with an exhibition of 50*l.* a year for two years, in order to enable him to take the B.Sc. examination of the London University in economics. B. P. Williams, an exhibition of 50*l.* a year for two years, together with a free place at the college to enable him to take the B.Sc. degree in engineering. P. A. Houseman, an exhibition of 40*l.* a year for three years to assist him to proceed to Würzburg University for the study of chemistry. H. H. Hodge, an exhibition of 30*l.* for one year in order to enable him to travel on the Continent and study the French language and the French system of education.

THE Board of Education has recently published two sets of regulations, for the session 1903–4, for schools of various grades. One volume deals with secondary day schools, and does not appear to differ in any important respect from that of last year. The other contains regulations for all schools and classes in connection with the Board of Education which have not received attention in previous regulations already published for next year's work, such as evening schools, technical institutions, and schools of art and art classes. A circular letter respecting the latter volume has been issued by the Board, and describes for the benefit of managers of schools the important respects in which the regulations for next session differ from those of previous years. The volume may be said to concern all those institutions in which instruction of a specialised or technical character is given, whether in the day-time or in the evening, as well as evening schools and classes the scope of which may vary almost indefinitely with the attainments and aim of the students. The rule under which the rate of grant payable for science instruction given in the day-time was half the rate payable for such instruction if given in the evening is abolished, and grants for advanced instruction given during the day in technical institutions will now be assessed in accordance with regulations appropriate to the special circumstances of such instruction. The letter also urges the desirability of fixed salaries for teachers of classes of all kinds, and rightly insists that the amount of stipend should be in relation to the qualifications and experience of the teacher and the time given by him to the work of the class, and that cognisance should be taken of the time absorbed in preparing experimental lectures, in travelling, and in the correction of home-work. It is very satisfactory, too, to find that the new regulations definitely require a sufficient preliminary training for students in classes in scientific and technical subjects, and that every encouragement is given to managers to inaugurate a system of "courses of study" rather than one of isolated subjects in no way correlated.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18.—"On the Synthesis of Fats Accompanying Absorption from the Intestine." By Benjamin **Moore**, M.A., D.Sc., Johnston Professor of Biochemistry at University College, Liverpool. Communicated by Prof. C. S. Sherrington, F.R.S.

The fats of the food are changed in the intestine into fatty acids and glycerine, and the fatty acids are then in part combined with alkali to form soaps.

Both soaps and free fatty acids have a very small solubility in water, and it is by the agency of the bile, in which both are much more soluble, that these constituents of the digested fats are made capable of being taken up in soluble form by the absorbing cells of the intestine.

The absorbed fatty constituents are not taken up by the blood stream, but pass by a separate system, namely, the absorbent lacteals of the intestinal area, to be finally carried to the circulating blood by the main lymphatic vessel, the thoracic duct.

Now, somewhere along the path of absorption, the absorbed soaps and fatty acids are recombined with glycerine to form fats, for in the thoracic duct after a meal containing fat only fats are found.

The seat of this transformation has not hitherto been known with accuracy, but in this paper experiments are quoted to show that the change occurs in the intestinal cells which first take up the consituents of the digested fat in soluble form, and not in the cells of the lymphatic glands of the intestine through which the absorbed fatty matter subsequently passes on its way to the thoracic duct.

This is shown by analyses of the fatty matter in the small lymphatic vessels leading from the intestine, which show that, even here before the absorbed fatty matter has reached the abdominal lymphatic glands, it has all been changed back into fat. A change in the same direction is shown by analyses for fatty constituents of the intestinal cells, but here the process is found in progress, and not yet complete.

It is further shown that the cell must be *in situ* and supplied with nutrient matter in order that this change can be brought about, for no synthesis of fat occurs when the isolated intestinal cell or extracts of it are allowed to act upon the fatty constituents *in vitro*. The only change then occurring is the formation from soap of free fatty acid, which is probably the initial stage in the change occurring in the living intact cell, and is further a protective action, which would prevent the entrance of the poisonous soaps into the circulation.

This demonstrates that the living cell supplied with energy by the nutrient matter which bathes it is capable of acting as an energy transformer for chemical energy, and of carrying out syntheses impossible for enzymes which cannot add energy to the ingredients upon which they act, and hence cannot carry out complex syntheses requiring the addition of chemical energy to those ingredients, as can the living cell.

"The Theory of Symmetrical Optical Objectives." By S. D. **Chalmers**, B.A. (Cantab.), M.A. (Sydney), St. John's College, Cambridge. Communicated by Prof. Larmor, Sec. R.S.

This paper deals with the relations between the aberrations of a lens system, used with a front stop, and those of the compound system formed by two such systems disposed symmetrically with respect to the stop. The results justify the practice of correcting a single component—the back one—for astigmatism and spherical aberration, *provided* due attention is paid to the securing of the condition for no distortion.

PARIS.

Academy of Sciences, July 20.—M. Albert Gaudry in the chair.—The manner of flow of a spreading sheet of water on a plane surface, applied to the case where the surface is curved, by M. J. **Boussinesq**.—On a new method for the detection and estimation of small traces of arsenic, by M. Armand **Gautier**. It is based on the principle that ferric oxide precipitated in the presence of arsenic carries down with it the whole of the latter, even in the presence of chlorides and other salts. The arsenic in the precipitate can then be directly estimated in a Marsh apparatus. In this way the thousand millionth of its weight of arsenic can be detected in a substance, and its presence was shown in the purest distilled water and many common reagents.—On the torsion movements of the eye when looking in certain directions, the socket remaining in the primary position, by M. Yves **Delage**.—On a new action produced by the rays *n*, and on several facts with regard to these radiations, by M. R. **Blondlot**. The rays *n* falling on platinum foil heated to dull redness cause it to glow more brightly. This effect is not due to increase of temperature. The increased brilliancy is observed on both sides of the

foil owing to the fact that cold platinum, which is opaque to these rays, becomes transparent on heating.—Study of the molecular deformations of a steel bar submitted to thrust, by M. L. **Fraichet.**—Photographs of the Borelly comet (1903 *c*), by M. **Quénisset.** These photographs were taken at the author's observatory at Nanterre, and in pairs, so as to give a stereoscopic representation.—On the theory of the acoustic field, by M. **Charbonnier.** The theory serves to explain certain photographs of projectiles obtained by Dr. Mach, of Vienna, and is the basis of Gossot's method of measuring the velocity of projectiles.—Contribution to the study of superheating, by M. A. **Petot.**—Sublimation curves, by M. A. **Bouzat.** A comparison of the sublimation curves of carbon dioxide, ammonium sulphide, and ammonium carbonate with the dissociation curve of the compound of silver chloride and ammonia.—On the law of recombination of ions, by M. P. **Langevin.** An expression is developed which gives the ratio of recombinations to the number of collisions between two ions of opposite sign, and is verified by comparison with the experimental values for air and carbon dioxide.—On commutation in continuous current dynamos, by M. **Iliovici.**—The influence of temperature on the dichroism of mixed liquids, and a proof of the law of indices, by M. Georges **Meslin.** Substances are chosen for which the value of the index of the liquid but very slightly exceeds the mean value for the solid. The change in sign of the dichroism with rise of temperature was experimentally verified in a number of cases.—On photographic spectrophotometry, by M. C. **Camichel.** Various catalytic reactions brought about by metals and the accelerating and retarding influences, by M. A. **Trillat.** Reactions between copper or platinum and the vapour of alcohols of oxidising, reducing, condensing, or saponifying effects. The reactions are considerably affected by traces of impurities, and the copper must first be tarnished by heating in air.—On ferrisulphuric acid and ethyl ferrisulphate, by M. A. **Recoura.** The ethyl ester is obtained by boiling the acid with alcohol as a yellow solid. On heating the acid, it loses simultaneously one molecule of sulphuric acid and two of water, leading the author to assign to it the formula $Fe_2O_3.3SO_3.H_2SO_4.2H_2O+6H_2O$.—Prussian and Turnbull's blues. A new class of complex cyanides, by M. P. **Chrétien.** A soluble acid blue or hydrodiferrocyanic acid, $Fe_2Cy_6H_3H_2O$, is obtained by the spontaneous decomposition of hydroferrocyanic acid at about 20°. It reacts with alkalis as follows:—$Fe_2Cy_6H + 4KOH = FeCy_6K_4+Fe(OH)_3+H_2O$. This and other reactions are studied thermochemically.—On spartein. General characteristics; action of some reducing agents, by MM. Ch. **Moureu** and A. **Valeur.** This communication contains a repetition of previous work on spartein, and an account of unsuccessful attempts to obtain reduction products.—On the isonitrosomalonic ethers and their conversion into mesoxalic ethers, by MM. L. **Bouveault** and A. **Wahl.** The methyl and ethyl ethers were obtained pure, and converted into the corresponding mesoxalic ether by means of nitrogen peroxide.—Action of ammonia on the compound of oxide of ethylene and *β-o*-cyclohexanediol, by M. Léon **Brunel.** With an excess of ammonia *o*-aminocyclohexanol is obtained; with less ammonia, more complicated substances.—Researches on the nutrition of etiolated plants, by M. G. **André.**—On the phospho-organic reserve material of plants, by M. S. **Posternak.** The method is given for the separation of this substance as the salt of an acid, CH_3PO_3, from seeds and other parts of plants. In this way 70 per cent. to 90 per cent. of the phosphorus in the seeds can be accounted for, lecithine representing only 1 per cent. to 7 per cent. of the phosphorus.—On roots trained by experiment to grow upwards, by M. H. **Ricome.** The plants (beans) were attached to the end of a long thread kept oscillating. The development of the root and longitudinal growth were perfectly normal.—A resinous Granadilla, by M. Henri **Jumelle.** The exudation from the base of the stem of this plant, the *Ophiocaulon Firingalavense*, is a resin rather than a wax, and contains 83 per cent. of true resin, which is deposited as an amorphous mass from solvents.—Contribution to the study of the Aepyornis of Madagascar, by M. Guillaume **Grandidier.** Particulars of the lower portions of a skeleton of the *Aepyornis ingens*.—On basic inclusions from the volcanoes of Martinique and St. Vincent, by M. A. **Lacroix.**—Contribution to the study of congenital changes in the nervous system, by MM. Claude **Vurpas** and André **Léri.**—On the organic respiratory gases in diabetes, by M. J. **Le Goff.** These gases contain acetone, which was separated as iodoform and estimated. In one case it amounted to nearly 3 grammes in twenty-four hours.—On the retention of irritability of certain organs separated from the body and immersed in an artificial nutritive medium, by MM. E. **Hédon** and C. **Fleig.**—The formation of callus, by MM. V. **Cornil** and P. **Coudray.**—Observations on the sea-level since historic and prehistoric times, by M. Ph. **Négris.** From the fact that two ancient piers at the south entrance of the Straits of Leucade are now nearly three metres under water, and from the encroachments of the sea in various parts of the Mediterranean during the last 2500 years, conclusions are drawn as to the change of level of the latter during a long period.—On the use of fluorescein in subterranean hydrology, by M. E. A. **Martel.**

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