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THE DRESSING OF MINERALS.

The Dressing of Minerals. By Prof. Henry Louis. Pp. x+544. (London: Edward Arnold, 1909.) Price 30*s.* net.

THE author says, in his preface:—

"The object of the present work is to give an account of the theory and practice of the dressing of minerals, which will, I hope, prove useful to the miner or metallurgist who desires to understand the principles upon which this art is based, as also to the manufacturer who supplies the necessary appliances, and above all to the student who is preparing for either of the above professions." . . . "I have disregarded the time-honoured division which would make separate branches of the dressing of ores, and the cleaning of coals."

The first impression produced on reading this statement is that the new departure is warranted; that there are many points in common in the two branches, and that the comparison of practice under the different conditions would be of an illuminating character. The further perusal of the book, however, seems hardly to bear out this promise, and the joint treatment of the two branches rather tends to confusion, for the cleaning of coal involves the use of so many methods that are inapplicable to ores and *vice versa* that, if the two branches are to be treated in the same book, they should at least be dealt with under different sections.

Difficulties, inherent to the method adopted of dealing with the subject, are found throughout the book, and it is practically only in the chapter on general construction of dressing works that any clear differentiation between coal and ore dressing appears. It may be that the manufacturer should be acquainted with the machines used in both classes of work, and even that the student should acquire a knowledge of, and be able to draw comparisons between them, but that coal-miners should be called upon to study the various forms of rock-breakers, stamps, and other crushing mills and fine grinders seems unnecessary.

The book is well written and interesting, more especially, perhaps, in those parts that deal with theoretical considerations which relate to the construction of the machines. The designs of various machines are illustrated by excellent plates, and leading dimensions are often given, as well as the cost of the machines and manufacturers' figures regarding capacity. The latter are sometimes apt to be high; for instance, it is stated on p. 140 that a pair of Krom rolls 26 inches diameter by 15 inches face will crush about two tons of average ore per hour to about 30 mesh.

Relatively little information, however, is given as to setting up machines, their adjustments or running, the general conditions that have to be fulfilled or the general care of a dressing plant. Early forms of machines and historical references have received a good deal of attention, possibly more than they deserve, while in many cases modern forms have been passed over with brief mention, and a statement that they have not been long enough in use to enable an opinion to be formed regarding their value.

The treatment of the subject is divided into general considerations; volumetric sizing; sorting and washing; comminution; separation by specific gravity; appliances depending essentially on vertical fall; jigs; horizontal current separators; shaking tables; pneumatic, magnetic, and electrostatic separation; separation by surface tension; accessory appliances and general construction of dressing works.

It is, perhaps, in the chapter on volumetric sizing that the treatment of coal and ores together is most objectionable. It is sometimes difficult to gather whether the machine spoken of is used for coal or ores, and although, of course, many of them could be used for both, there is a more or less clear line of distinction between the two. To find a Wilfley impact screen described between the Klein screen and Zimmer conveyor screen seems curious. Trommels are said to be satisfactory to $\frac{1}{16}$-inch mesh. In the chapter on comminution such varying machines as rock breakers, rolls, Huntingdon mills, ball mills, tube mills, and disintegrators have been dealt with all too shortly. The Griffin mill is passed over in one paragraph, in which it is described as "like the Huntingdon mill with a single large roller which is caused to revolve on its spindle by means of gearing," but the construction, mode of action, and causes of crushing are so different in the two machines that the Griffin certainly merits a fuller description.

It seems questionable whether vanners should be included under the title of shaking tables, and no distinction is made between the condition of a pulp adapted for a vanner and that for a shaking table. The number of discussions that have taken place, and tests that have been made to prove whether it is better to classify the pulp or not before treatment on vanners, do not appear to be mentioned, while an authoritative pronouncement on the subject would have been of interest.

The subject of pneumatic separation has been treated more fully than it appears to deserve, and machines described which have certainly not warranted their existence. Magnetic separation has also received a good deal of attention, and many machines are figured which are used both for strongly and feebly magnetic substances.

In dealing with separation by surface tension, the author says it is impossible to offer correct or satisfactory explanations of the observed phenomena. He, however, presents an historical account of the development of the processes which depend upon this property, and briefly refers to several of the flotation processes. He has, however, only described the Elmore oil process and the Elmore vacuum process in any detail, from which it would seem that, in his opinion, they only are worthy of consideration. The chapter on accessory appliances passes from tipplers to various ore bin gates, then comes back to creepers, and returns to various conveyors of the belt, bucket, scraper, and screw types. Car and bucket elevators and tailings-wheels are dealt with, as well as ore

feeders, and the chapter is finished with a few words on weighing and sampling.

There is a great deal of varied information contained in the book, but it would have been better to confine the subject to one or other of the branches referred to in the opening paragraph.

DUSTLESS ROADS.

Dustless Roads. Tar Macadam: A Practical Treatise for Engineers, Surveyors, and Others. By T. Walker Smith. Pp. xi+225. (London: Charles Griffin and Co., Ltd., 1909.) Price 10*s.* 6*d.* net.

THE growing use of motor-cars, and the destructive action due to the rapid speed at which they are driven, and the sucking action of the indiarubber tyres on the surface of the roads, has rendered a change in their management necessary.

It is the almost unanimous opinion of road experts that, in order to preserve the surface of the roads in good condition, it is necessary that some kind of bituminous material must be used for binding the stones of the macadamising, which, while cementing them together, will also give a waterproof and comparatively dustless surface.

The book under notice has, therefore, been published at an opportune time, as the method of repairing roads described in it, which has been more or less successful, has been so far only of a tentative character, the work not being carried out on any scientific basis, but very much by the rule of thumb.

The author, who was borough engineer at Barrow-in-Furness for several years, had under his charge many miles of macadamised roads subject to motor traffic, and devoted his attention to experimenting and trying to find out the best means of solving the difficult problem of keeping these roads in good order, and preventing the creation and spreading of dust, at a reasonable outlay. The results of his experience are given in the book under notice. The author, however, not content with his own experience, has also collected the opinions of a large number of road surveyors throughout the country as to the advantages and disadvantages, and cost of tar macadam, the answers to the queries submitted being given in the tables contained in the book.

The subjects dealt with are divided into fifteen chapters relating to tar macadam as a remedy for dust nuisance; the necessity for standardisation in construction; tar; aggregates for tar macadam; preparation and laying; mechanical mixing; effect of wear and tear; scavenging, watering, and maintenance; camber, gradient, noiselessness, and hygienic advantages; tractive effort; statistics of road mileage; cost of maintenance; and tar spraying. There are twenty-four illustrations and a tabulated analysis of the replies to queries.

The author shows that the binding material used in the making or repair of macadamised roads is the crux of efficient road maintenance and the prevention of dust. His opinion is that it is absolutely necessary, if macadamised roads are to meet the needs of present-day traffic with the searching demands that motor traffic makes on the surface of the road, that a bituminous binding or matrix should be employed. He points out that so far, although this fact is fully recognised, no scientific study has been made to standardise the materials used, and the proportion and quality of this material:—

"Thus the matrix is usually prepared as it seems best to the individual in charge of the tar boiler who uses anything that comes from the local gas works; who boils it as long as he thinks necessary, and adds to it whatever he thinks may improve it in the way of pitch or creosote. It is a subject in which the personal factor has entered to an exceedingly great extent, and each man acts more or less as it seems best to him in his own mind."

The aggregates for tar macadam are also fully dealt with. The author points out that as the tar binding cements the stones together, the abrasion caused by friction in water-bound macadam is thus absent, the properties of noiselessness, elasticity, and resilience being secured. The only portion of the road material which is subject to any considerable wear is the surface, which has to bear the friction due to the rolling of the wheels, and also the impact of the horses' feet. It is, therefore, contended that the use of granite or other similar expensive material is not necessary for the lower coat, which consists of from 80 to 85 per cent. of the whole; but that where the road is only subject to moderate traffic the lower layer may consist of hard limestone or slag, either of which material holds the tar better than granite; the upper layer, which has to bear the surface wear and tear, being composed of granite. The author's experience leads him to the conclusion—

"that it is an absolute waste of money to put such good material as granite in the bottom when a less costly material will do perfectly well when armoured with a good coating of tarred granite."

The patent processes known as "Tarmac" is described. The makers of this road material have expended upwards of 20,000*l.* in the construction of works and plants at Wolverhampton. The aggregate used is slag, the tar is distilled before using, and the mixing is done by machinery. The author, however, does not seem to think that it has any special advantage over ordinary tar macadam mixed locally when this is done in a proper manner. In the tables the cost of the materials and of mixing and laying is given for a great number of localities. As an average this may be taken as from two shillings to half a crown per square yard for a coating of 3½ inches of slag and hard limestone for the bottom layer, and half an inch of tarred granite for the surface coat. The general opinion appears to be that there is a saving in the cost of maintenance of roads where tar macadam is used in place of water-bound macadam, in some cases amounting to as much as 75 per cent., the average, however, being put at 37½ per cent.

With occasional tarring and sanding of the surface, a tar-macadam road, so far as the lower layer is concerned, is practically everlasting. The surface

where there is much traffic requires re-covering about once in four years. Instances are given from the author's own experience where roads having a fair amount of traffic "have been as good at the end of six years as when first covered, and so far as can be seen will need very little for another six years."

This book ought to be carefully studied by all surveyors having charge of roads subject to motor traffic.

VECTORIAL GRAPHICS.

Vectors and Vector Diagrams applied to the Alternating Current Circuit. By W. Cramp and C. F. Smith. Pp. xvi+252. (London: Longmans, Green and Co., 1909.) Price 7*s.* 6*d.* net.

NOT many years ago a certain type of journalist used to compare and contrast the theorist and the practical man, to the demolition of the former and the apotheosis of the latter. Fortunately, such an attitude of mind is no longer possible. The merely practical man could never have constructed the Forth Bridge, nor launched the *Mauritania* on her record-making career. Innumerable examples might be given of the necessity of true theory in the economical designing of all kinds of machinery; but probably there is nothing that better proves how much mathematical science lies at the foundation of modern methods than electrical applications, especially those that have to do with the alternating current. The whole history of the development of the transformer and the alternating-current motor is simply the realisation of the solution of a differential equation given long ago by Maxwell. In this realisation the first great steps were taken by Heaviside, who introduced the terms impedance, admittance, reluctance, &c., giving a new precision to the ideas involved. By a mathematical extension of meaning the symbols which entered into the electrical equations of steady currents became applicable to the corresponding cases of sinusoidal currents. Stated in purely mathematical language, this transition depended on the properties of the complex variable.

Thus, to take the simplest case, Ohm's law $RC=E$ for steady electromotive force becomes Maxwell's expression $(R+Ld/dt)C=E$ when E is variable. Representing a sinusoidal electromotive by the exponential of the imaginary ipt, we get the solution in the form $(R+iLp)C=E$, where C and E now stand for the amplitudes of the varying quantities. This complex quantity which operates on C may be treated analytically like the real quantity R in Ohm's law. Multiplication by the conjugate gives

$$(R^2+L^2p^2)C=(R-iLp)E.$$

In the end, after all analytical transformations have been effected, the real part of the expression must be picked out. A little experience will make the average student quite efficient in this kind of algebra, especially if it is combined with numerical and practical work.

But the value of the method does not stop here. Following familiar paths, we may give a geometrical form to the expressions, and obtain graphical representations of important relations. Thus the complex quantity $RC+iLpC$ may be laid down as a vector in a plane, RC being the component along a chosen direction and LpC the component at right angles to this direction, while the ratio Lp/R measures the tangent of the angle between the vector and the chosen direction of reference. Again, if we regard C as a complete vector, the complex operator may be considered to be a versor rotating C through the angle just named. Can we utilise these fundamental vectorial and versorial conceptions to construct a graphical representation of real value to the electrical engineer? The answer has been given in the affirmative; and among those who have worked up the method along these lines, no one holds a higher place than C. P. Steinmetz. The method has been presented in more or less detail in most of the recent books on the alternating current, and now we have an extremely valuable addition to the literature of the subject in "Vectors and Vector Diagrams applied to the Alternating Current Circuit," the joint work of William Cramp and Charles F. Smith, both lecturers in the electrical engineering school of Manchester University. The authors, for reasons given, depart somewhat from Steinmetz in their development of the method, but the foundation is essentially the same. Once the fundamental propositions are admitted and grasped, the whole treatment is a model of lucidity and self-consistency. One unusual feature of the book is that it assumes a certain fairly advanced knowledge at the start. This is a good feature, which might well characterise more of our text-books. The authors are careful at the same time to indicate exactly what knowledge the student must possess before he is in a position to make effective use of their methods—he must know the fundamental laws of the alternating-current circuit very thoroughly. Nevertheless, it would have been of advantage to have indicated in a few preliminary sections the manner in which the method originally took shape as a synthesis of the symbolic solutions of Maxwell's differential equations. There also seems to be a certain looseness of argument in the way in which the properties of vectors are stated. For example, having defined in the usual geometrical way the meaning of the "vector product" of two vectors, and having so named it, they remark, "This product must itself be a vector product, since it has already been shown to possess a definite sense." This is no proof, but mere statement. The defined product must be shown to obey the vector law of addition before it can be called a vector product.

These imperfections do not, however, affect the purpose of the authors, who are to be congratulated on having enriched our technical literature with a clear and systematic exposition of the vectorial graphics of alternating-current phenomena. After a discussion of the more purely geometrical character of the method, illustrated throughout by reference to familiar electrical phenomena, a succession of chapters follows on self and mutual induction, the transformer, motors of the induction type, and alternating-current commutator motors. A chapter is then thrown in on the product of two vectors, and the two concluding and longest chapters deal respectively with locus

diagrams and examples of the application of locus diagrams. The book is amply illustrated by more than a hundred diagrams. Everything is concise and to the point, and the student who *works* through its pages will find himself equipped with a valuable weapon of research.

THE RECONSTRUCTIONAL ANATOMY OF THE KIDNEY.

Untersuchungen über Bau und Entwickelung der Niere. Edited by Prof. Karl Peter. Erstes Heft. Inhalt I., Karl Peter, Die Nierenkanälchen des Menschen und einiger Säugetiere. II., Michio Inouye, Die Nierenkänalchen des Rindes und des Tümmlers. Pp. viii+447. (Jena: Gustav Fischer, 1909.) Price 30 marks.

THE editor of this monograph holds with Koelliker that a knowledge of the morphological characteristics of the renal tubules is an important groundwork for the study of the physiology and diseases of the kidney. This ground plan he has laid down in a bulky volume, profusely illustrated by numerous and well-executed drawings. By means of maceration with concentrated hydrochloric acid and subsequent isolation of the urinary tubules, as well as by reconstruction models and serial microscopic sections, he has studied, along with his pupil, Michio Inouye, the structure of the kidney in various mammalian families in great detail. For the benefit of those who desire to ascertain his results without reading the whole of the text, he condenses a summary of his work into seventy-five pages of this volume.

Prof. Peter has worked out the structure of the kidney of the mouse, rabbit, sheep, cat, man, and pig, while Inouye has studied the organ in the seal and ox. They have given a minute description, perhaps too minute, of the organ in the various animals without adding, to any great extent, to our knowledge of the subject.

As a result of his study, Prof. Peter divides the medulla of the kidney into an inner and an outer zone, and the latter into an inner and an outer area. The cortex he divides into a *pars convoluta* and a *pars radiata*. These, to some extent, can be recognised with the unaided eye or by means of a lens, and each is composed of certain definite parts of the tubules, each zone or area being composed of the same parts in the same species. In fact, with some slight exceptions they are composed of the same parts throughout the whole of the mammalia. A summary of the zones and their contents is given.

These researches of Prof. Peter—minute and accurate as they are—have particularly little in them that will interest those who seek to elucidate the functions and diseases of the kidneys. The author himself states that as regards the significance of the Malpighian bodies his investigations have produced nothing new. Concerning the first convoluted and zigzag tubules which he includes under the name of the "Hauptstück," certain observations have been recorded with regard to variations in the amount of fat contained in the cells, and from the fact that these vary in their affinity for eosin in different parts of the convoluted tubule, the deduction is made that the functions of the latter are not the same throughout its length. The facts adduced by these investigations have very little bearing on the two rival theories of the manner in which the kidney removes the urine from the blood—whether by a process of secretion or one of filtration.

The function of the narrow, clear part of the loop of Henle is concluded to be the resorption of the water which has been thrown out of the glomerulus. This is deduced from a ratio which Prof. Peter has found to exist between the relative length of this part of the tubule and the specific gravity of the urine in various mammalia with the exception of some of the smaller ruminants. In this matter his observations support the experiments of Ribbert and H. Marger, and of Hausmann. These experimenters removed the whole of one kidney and the medulla of the second in a rabbit, with the result that the urine was doubled or trebled in amount. As the narrow, clear part of the loop of Henle is contained in the medulla, it is inferred that the increase in the amount of urine is due to the removal of the resorbing part of the tubule. So many factors have to be considered in a case like this that the author's deductions must be regarded with a certain amount of reserve. While one must admire the industry and accuracy manifested by this work, it must also be admitted that even those specially interested will find it very tedious reading, and it is to be hoped that it may be possible to confine the other promised volumes within a more modest compass.

R. D. K.

GREEKS AND HITTITES.

Ionia and the East. Six Lectures delivered before the University of London by D. G. Hogarth. Pp. 117. (Oxford: Clarendon Press, 1909.) Price 3*s*. 6*d*. net.

THE author of this book aims at solving the interesting problem of the origin of Hellenic civilisation in the Grecian colony of Ionia, in western Asia Minor. He utilises, in a masterly manner, the results of the extensive archæological researches that have been carried out within the last thirty years in south-eastern Europe. The excavations of Schliemann, Evans, and numerous other workers in this field have completely revolutionised our ideas about the origin of that early Grecian culture to which modern European civilisation owes so much.

Mr. Hogarth's conclusions are, that in Attica the home country of the Ionians, the population, before the migration to Asia Minor, was mainly Ægean, but mixed with a northern element of invaders from the Danubian area. At this date there survived in Attica a vigorous bloom of Ægean culture affected to an unusual degree by some eastern influence, so that the colonists who settled on the west coast of Asia Minor in the early centuries of the first millennium B.C. were by no means barbarians. In Ionia the Greek settlers came in contact with a highly developed Asiatic civilisation—namely, that of the Hittites—and one of the most original features of Mr. Hogarth's book is the demonstration which he gives of the powerful influence of the Hittite civilisation in the develop-

ment of the Hellenic culture in Ionia. The Hittites were predominant in Asia Minor from 2000 B.C. to 800 B.C., and, besides being possessed of a highly developed culture of their own, acted as intermediaries for the transmission of Mesopotamian culture to the Greeks. Of both these influences there is distinct evidence in the few excavations that have been carried out in Asiatic Greece.

There appears to be a rich field awaiting the archæological excavator both in Ionia and in other parts of Asia Minor. In Lydia, which was apparently a Hittite satrapy, very little excavation has been done, and in the Hittite country on the upper Euphrates hundreds of buried cities are known to exist, in some of which, it is almost certain, as Mr. Hogarth points out, bilingual inscriptions connecting the Hittite script with the Assyrian will be found. We may, then, expect discoveries equalling, if not excelling, in importance those that have recently been made in Mesopotamia, in Egypt, and in Crete.

Another iconoclastic view of Mr. Hogarth's is that the Phœnicians played an insignificant part in the development of Greek civilisation. He reduces "the part played by the Phœnicians among the Greek Isles and coasts to that of mere huckstering traders who followed seaways long ago opened by others."

Mr. Hogarth considers that the Hittites were not a maritime people, but were confined strictly to their continent by the Ægean command of the sea. In view of the migration from Lydia to Umbria related by Herodotus, and of the existing population of broad-headed races in the Balkans, which, judging from its present distribution, must apparently have landed on the eastern shores of the Adriatic, Mr. Hogarth's views on the non-maritime character of the Hittites will, we venture to think, be considerably modified by future discoveries. The one weak point in Mr. Hogarth's admirable little book is his disregard of the evidence of physical anthropology. No explanation of the ethnological evolution of the East will be satisfactory which fails to account for the transition of the primitive dolichocephalic peoples of the Balkan peninsula into the strongly brachycephalic population of the present day, and in this respect Mr. Hogarth's otherwise admirable work completely fails. J. G.

SOME NEW CHEMICAL BOOKS.

(1) *Naturgeschichte einer Kerze von Michael Faraday.* Herausgegeben von Dr. R. Meyer. Pp. viii+172. (Leipzig: Quelle und Meyer, 1909.) Price 2.50 marks.

(2) *Junior Chemistry.* By R. H. Adie. Pp. viii+266. (Cambridge: University Tutorial Press, 1909.) Price 2*s.* 6*d.*

(3) *Chemistry.* By Prof. W. A. Tilden, F.R.S. Dent's Scientific Primers. Pp. ix+108. (London: J. M. Dent and Co., n.d.) Price 1*s.* net.

(1) FARADAY'S six lectures on the chemical history of a candle were, it may be remembered, delivered to a juvenile audience at the Royal Institution during the Christmas holidays of 1860–1, nearly half a century ago.

In reading them we are impressed not merely by the delightful simplicity and freshness of their style, and by the variety and ingenuity of the experimental illustrations, but more especially with the completeness of the story he had to tell. There is little that has been modified or extended in this branch of knowledge during these fifty years; there is scarcely a single sentence which might not be uttered without comment or correction to a similar audience to-day.

It is not surprising, therefore, that a fresh edition of Dr. Meyer's excellent German translation should be in demand among young people in Germany, and it speaks well for their appreciation of Faraday and his charming "chemical history" that the translation has reached its fifth edition.

The book is attractively bound, and contains a very pleasing portrait of the author, together with a short biography.

(2) Mr. Adie justifies the production of another elementary chemistry on the ground that the average first-year student shows a lack of intelligent understanding of chemical aims and methods, for which, we infer, the other books are mainly responsible. We are inclined to think that this want of intelligent understanding is due neither to the character of a particular book, nor altogether to the teacher, but to the kind of chemistry done in schools and fostered by the scholarship system of the older universities.

If the systematic study of chemistry at the university or college were founded on a good general knowledge of mechanics and physics, and an elementary notion of those chemical processes applicable to everyday phenomena, the path of the college professor or lecturer would be made much smoother. But schools are not content with this modest programme, and insist upon a standard of knowledge beyond the grasp of the average schoolboy. The result is that the college teacher has to build upon a muddy foundation of confused ideas, which are so familiar to examiners and so difficult to eradicate later. What commends Mr. Adie's new book is not so much the disastrous effects of its predecessors as the long teaching experience of the author. The results of fifteen years' experience of a thoughtful teacher are always valuable, and, as one might have anticipated, the book offers a thoroughly sound course of practical instruction.

The arrangement of the exercises is clear and logical, the examples are thoroughly typical, well selected, well illustrated, and carefully described. Many of the experiments, without being exactly new, are modified and arranged in a convenient form, and the quantitative examples, which are numerous and varied, furnish a sound basis for that most difficult part of chemistry, the understanding of quantitative laws and the theories drawn from them. In reference to the quantitative part, it would be interesting to know what sort of errors the author obtained in determining such things as the gravimetric composition of water, the weight of steam, and the analysis of the oxides of nitrogen, of which no actual examples are given. If the two oxides of nitrogen give anything like correct results by the method described, that much-quoted example of multiple proportion would lose something of its elusive character.

(3) In the editor's preface to Dent's Scientific Primers, in which the one under review is included, we are told that the great advances in knowledge during the last thirty years necessitate a re-statement of the theories of the different sciences.

This may be true of chemistry if it were a question of publishing a new treatise or even a students' text-book; but when we consider that this miniature volume of a hundred pages is intended for a student possessing no previous acquaintance with the subject and without the leisure to study it systematically, we cannot be surprised that the advances in knowledge are not very apparent. We might even go further and state that, except for a passing reference to radium and the noble gases, and the use of the words "stereochemistry" and "polypeptides," the book might just as well have appeared thirty years ago.

With the very limited space at his disposal, Prof. Tilden has made good use of his materials, and has compressed into a small compass a very readable and suggestive account of the elementary facts and theories of chemistry. J. B. C.

OUR BOOK SHELF.

Histoire du Développement de la Chimie depuis Lavoisier jusqu'a nos Jours. By Prof. A. Ladenburg. Traduit sur la 4e édition allemande. By Prof. A. Corvisy. Pp. v+388. (Paris: A. Hermann et Fils, 1909.) Price 15 francs.

FORTY years ago, the first German edition of Ladenburg's "Lectures on the History of the Development of Chemistry during the past 100 Years" was published. This was a relatively small book of 320 pages, which presented, in the course of fourteen lectures, a carefully drawn and evenly balanced sketch of the progress of chemistry subsequent to the time of Lavoisier. At the date of its publication it was unique in dealing, in a logical and consistent manner, with the progress of the atomic theory in its application both to inorganic and to organic chemistry, and in serving at least as an introduction to the particularly difficult and complicated period in the history of organic chemistry which began in the 'thirties and extended to the late 'fifties or early 'sixties of last century. It was not until about four years later that this period was dealt with, a good deal more elaborately, by Kopp in his "Development of Chemistry in Recent Times" (1873). A specially valuable feature of Ladenburg's lectures was the abundance of references to the literature, which tended to encourage the reader to extend his knowledge of particular branches of the subject by consulting the original papers of the various authors. A second German edition was called for in 1887, when the original book was revised, and was extended by the addition of a fifteenth lecture.

In 1900 an English version of Ladenburg's "History" was published, which was translated from the second German edition, but included various corrections and minor additions by the author, and also a sixteenth lecture, specially written for this translation. A revised English edition appeared in 1905. The third German edition (1902) was merely a reprint of the second edition with the sixteenth lecture added to it, but in 1907 a thoroughly revised and very considerably enlarged German edition appeared, which extended to more than 400 pages, and contained seventeen lectures, the subject-matter being brought up to date as fully as possible, and including accounts of the progress of discovery in connection with such recent subjects of extended investigation as radium, asymmetric nitrogen, the proteins, and the colloid substances. It is from this fourth German edition that the French translation which is before us was prepared, and the fact that a French version is now published may be taken as in itself a tolerably satisfactory indication, not only that Ladenburg's book has established itself as a work of permanent value in the estimation of chemists irrespective of nationality, but also that it is free from national bias, such as is frequently met with in historical works. The translation bears every evidence of having had much careful attention bestowed upon it, and it gives a faithful representation of the original. The book is produced in a creditable style typographically.

(1) *Biologisches Praktikum für höhere Schulen.* By Dr. Bastian Schmid. Pp. vi+71. (Leipzig and Berlin: B. G. Teubner, 1909.) Price 2 marks.

(2) *Biologische Experimente nebst einem Anhang mikroskopische Technik.* By Walther Schurig. Pp. xi+180. (Leipzig: Quelle und Meyer, 1909.) Price 2.40 marks.

(1) THIS is an attempt to compress into seventy-one octavo pages a practical introduction to the study of the comparative anatomy of plants and animals, together with a certain amount of experimental physiology. There are seventy-five text-figures and nine plates. A considerable number of types, ranging from bacteria to mammals, are dealt with in a very scrappy and superficial manner in the text. A large proportion of the illustrations are borrowed from the works of well-known authors. They are well reproduced, but the text and explanations of the figures are very inadequate. A plate containing figures of the skeletons of a frog, a dog, and part of the skeleton of a bird (apparently there was no room for the skull, which is omitted), without a single bone labelled, is not likely to be of very much service even to the most elementary scholar. Doubtless, however, there are people who are gratified by observing a resemblance between an actual specimen and a book illustration, and they may even think that they have learnt something by comparing the two. It is only fair to the author to mention that the book is intended to be used in conjunction with the instruction of a teacher, who, no doubt, would be able to supply many of the deficiencies.

(2) This little book is addressed to school teachers and students of nature, and is intended to serve as a guide to a large number of simple experiments in animal and vegetable biology. It is very suggestive, but the style is rather too much that of a cookery book, and the work suffers greatly from over-condensation. A good practical course on general physiology, in itself a very desirable thing, might be founded upon it by an experienced and well-read teacher of biology, but it would take a very long time to carry out all the experiments in a satisfactory manner.

Inborn Errors of Metabolism. The Croonian Lectures delivered before the Royal College of Physicians of London in June, 1908. By Dr. A. E. Garrod. Pp. vi+168. (London: Henry Frowde, and Hodder and Stoughton, 1909.) Price 3s. 6d. net.

DR. GARROD delivered before the Royal College of Physicians in June, 1908, his Croonian lectures under the above title, and the present little book is a welcome re-publication of these lectures in a rather more extended form than those actually delivered. The author is well known for his researches on nutrition, metabolism, and the urine, and has always had a special bent in the unravelling of those rarer anomalies which in so many cases are transmitted from generation to generation. It would lead one too far into strictly medical matters to attempt anything in the

shape of even a condensed account of the matters specially selected by Dr. Garrod, and so one need only mention that the anomalies treated at length are albinism, cystmaria, alkaptonuria, and pentosuria.

It must not be supposed that the examination of these comparatively rare conditions is devoid of general interest, for it is often just these curious accidents of perverted tissue change which form the opportunity of the keen observer in unravelling the perplexities of the normal state. The natural sequence of study is physiology first, pathology next. But very often an inversion of this order leads to important accessions to knowledge. Dr. Garrod is to be congratulated on having been successful in such an experiment, and those interested in metabolism cannot do better than study his lucid and bright exposition of the subject. W. D. H.

Practical Testing of Gas and Gas-meters. By C. H. Stone. Pp. x+337. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 15*s.* net.

THIS is a laboriously complete compilation of the various methods of testing gas for illuminating power, purity, chemical composition, and calorific value, and of proving the accuracy of the indications of gas-meters. The subject is one mainly of technical interest only, and very specially so even for that, and hardly suitable, therefore, for detailed consideration in these columns. An examination of the book shows how great a diversity of apparatus has been devised and thrust upon the innocent gas-producing world, and how gratuitous some of the diversity is. Where apparatus has been designed for official testings, the objection to protecting the manufacture by patents has given the constructor liberty to alter and "improve" or spoil an instrument, as the case may be.

The American has a great opinion of the English official ten-candle lamp designed by Mr. Harcourt, but he will not take it as he finds it, and so he makes an American pattern. The English official calorimeter, too, judging by the observations made, has also gone through a metamorphosis in crossing the Atlantic. As is to be expected, the book is well got up and illustrated, and its value is increased by the inclusion of a number of tables of value to those whose business is to test and examine gas.

A Compendium of Food-microscopy. By E. G. Clayton. With sections on Drugs, Water, and Tobacco. Compiled, with additions and revision, from the late Dr. A. H. Hassall's works on Food. Pp. xxxix+431. (London: Baillière, Tindall and Cox, 1909.) Price 10*s.* 6*d.* net.

THIS book, written by an ardent disciple of the late Dr. Hassall, is largely based on Dr. Hassall's works on food and its adulteration. An account is given of the microscopical characters of all the principal vegetable food-stuffs, beverages such as tea and coffee, fruit preserves and condiments, and of tobacco, opium, and a few other drugs, together with those of the chief adulterants of these substances. In addition, chapters are devoted to foods of animal origin and the parasites which may infect them, milk, cream, butter, and cheese, and to the microscopical flora and fauna of water. The book is profusely illustrated with line drawings to scale, which usually reproduce very clearly the characteristics of the substances they are intended to depict, though occasionally there is an irritating want of systematic arrangement of the figures, Fig. A, for instance, sometimes being on the right, sometimes on the left, of the page. Though the botanical terminology is not always that used nowadays, on the whole the book should form a useful addition to the library of the analyst and microscopist.

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.*]

Molecular Scattering and Atmospheric Absorption.

SINCE Lord Rayleigh discussed the question of molecular scattering, and its bearing on the explanation of the blue colour of the sky, our experimental and observational data have become much more trustworthy. While our knowledge of the number of molecules in a gas allows us now to calculate with sufficient accuracy the amount of direct sunlight which is diverted by scattering, Mr. Abbot's series of measurements at Washington and on Mount Wilson gives us the actual observed opacity of the air for different wave-lengths.

Lord Rayleigh showed that, on the hypothesis of the elastic solid theory of light, small particles of matter, which act simply by adding inertia to the æther, scatter light and retard the passage of a wave passing over them in such a way that the relation

$$k = \frac{32\pi^3(\mu-1)^2}{3N}$$

holds, where k is the coefficient of extinction of energy, μ the refractive index, and N the number of molecules per cubic centimetre. He showed, further, that the same equation may be deduced from the electromagnetic theory if the particles locally affect the inductive capacity of the medium. In the forthcoming new edition of my "Optics" it will be proved that the equation is independent of theory, provided μ is nearly equal to unity; the limit of its applicability is only reached when there is a retardation of phase at the origin of the scattered light the square of which is appreciable, and it can be shown that this is actually the case except within the region of anomalous dispersion. The range of the formula may be further increased if $\frac{1}{2}(\mu^2-1)^2$ is written for $(\mu-1)^2$.

For N I have used Rutherford and Geiger's value $2{\cdot}72\times10^{19}$, and with the known value of the refractive index of air, k may be calculated. If h is the height of the homogeneous atmosphere above the point of observation, e^{-kh} is the fraction of light which would reach the observer if no light were lost in any other way than by molecular scattering. In the following table the transmitted light calculated in this manner is compared with Abbot's observed figures. The first column gives the wave-length, the second column contains the observed values of the transmitted energy for Washington, taking all observations into account, while the third column gives the number calculated from the observations on February 15, 1907, when the air was exceptionally clear. The calculated values are entered into the fourth column. The last three columns give the corresponding numbers for Mount Wilson. The selected clear day in this case was October 11, 1906.

	Washington			Mount Wilson		
Wave-length	Observed mean	Observed clear day	Calculated	Observed mean	Observed clear day	Calculated
4×10^{-5}	0·55	0·72	0·71	0·73	0·76	0·76
5	0·70	0·84	0·87	0·85	0·89	0·89
6	0·76	0·87	0·94	0·89	0·92	0·95
7	0·84	0·90	0·96	0·94	0·96	0·97
8	0·87	0·94	0·98	0·96	0·99	0·98
10	0·90	0·96	0·99	0·97	0·99	0·99

The close agreement between the two last columns shows that on a clear day on Mount Wilson atmospheric absorption is practically accounted for by molecular scattering. There is a slight indication of selective absorption in the red, but otherwise the columns are in complete agreement. On the average day there seems an additional absorption of about 2 per cent. It is remarkable that, even at Washington, the calculated absorption for blue light should so nearly agree with the calculated value; this means that even at the sea-level the greater part of the absorption on a clear day is due to scattering by the molecules of air. The large diminution in the

intensity of blue light at Washington on the average day seems to indicate that there is a substantial amount of scattering by small solid or liquid particles.

The figures for Mount Wilson give us confidence in the trustworthiness of Mr. Abbot's determination of the solar constant, because it is clear that the total effect of the atmosphere can be eliminated with greater certainty if it is mainly due to the permanent constituents of the atmosphere, and not to matter which is variable in amount. As the top of Mount Wilson is less than 1800 metres above sea-level, we may conclude that at high elevation the blue colour of the sky is completely accounted for by molecular scattering.

That the scattering sets a limit to the transparency of gases must be kept in mind in discussing problems of solar and stellar physics. We may feel confident, for example, that what is called the reversing layer can only have a small thickness, for otherwise we should not be able to observe so far into the ultra-violet as we do.

The scattering may profoundly modify the character of the spectrum, as I have explained in a paper on "Radiation through a Foggy Atmosphere" (*Astrophysical Journal*, vol. xxi., p. 1), in which it is shown how increased thickness, without change of temperature, may convert an absorption line into a bright line. It seems to me probable that the bright and dark flocculi shown in spectroheliograph pictures may find their explanation chiefly in variation of thickness in the absorbing layer, the bright patches being due to increased thickness.

The transparency of interstellar space has recently received a much needed critical discussion at the hands of astronomers, and Prof. Turner has applied the law of scattering to explain certain discrepancies between visual and photographic magnitudes. The value he gives for the opacity allows us to calculate the average density of the matter which is diffused through space on the supposition that it is gaseous. If the value of $(\mu-1)/D$ (where μ is the refractive index and D the density) be taken to be approximately equal to that of air, I find that the number of molecules per cubic centimetre in space would have to be of the order of a million, and the mean free path of the order of 3000 kilometres.

Although not directly connected with the subject which forms the main part of this communication, I would like to point out that the same analysis which gives the coefficient of extinction in terms of the retardation of phase at the source of the scattering also gives a resultant force acting on the molecule in the direction in which the light is passing. When summed up for all the molecules this force is found to be identical with what is generally called the "pressure of light," for if E represents the energy density, the force acting per unit volume on the scattering molecules is found to be kE, where k is the coefficient of extinction.

There is a widespread impression that light pressure only acts on particles the linear dimensions of which include several wave-lengths of light, but this is not correct. The determining factor is the extinction of light, whether by scattering or by absorption, as indeed appears if we take the view adopted in Prof. Poynting's work on the subject that a propagation of momentum accompanies the transmission of light. The momentum is destroyed equally whether the molecules act as scattering or as absorbing centres. The extinction by scattering near the surface of stellar bodies does not, however, appear to be sufficient to cause any measurable effects comparable with their gravitation.

ARTHUR SCHUSTER.

The Fixation of Nitrogen by Soil Bacteria.

MAY I be allowed through the columns of NATURE to ask Prof. W. B. Bottomley a few questions with regard to his paper on "Some Effects of Nitrogen-fixing Bacteria on the Growth of Non-leguminous Plants" (Proc. Roy. Soc., B, lxxxi., 1909, 287), abstracted in NATURE of May 13 (vol. lxxx., p. 327), as I had not the opportunity of being present when the paper was read?

Prof. Bottomley bases his conclusions on experiments to show that Pseudomonas, the bacterium associated with the leguminous plants, will fix more nitrogen in an artificial culture, when Azotobacter is also present, than when alone. He quotes the following results:—

Control	0·48	mgm. N.	per 100 c.c.	culture solution
Pseudomonas alone	0·91	,,	,,	,,
Pseudomonas and Azotobacter ...	1·24	,,	,,	,,

These differences would almost seem to be within the range of experimental error, but in any case, does not the demonstration require a further statement of how much nitrogen Azotobacter alone would fix? Other observers are accustomed to get fixations by Azotobacter alone of from 5 to 20 mgm. of nitrogen per 100 c.c. of such a culture solution, the maximum being about 10 mgm. of nitrogen fixed per gram of mannite. The only conclusion that could be drawn from Prof. Bottomley's figures would be that Pseudomonas injuriously affects the power of Azotobacter to fix nitrogen, supposing that a reasonably active culture of the latter had been used.

Turning to the field experiments, in which Prof. Bottomley claims to get an increase of crop by adding cultures of Pseudomonas and Azotobacter to soil which presumably already contains both organisms, data for estimating the probable experimental error are again lacking. From the Rothamsted experiments, where we may assume the conditions are more than usually favourable to exactitude, the mean error of a pair of similarly treated plots in a single year is about ±10 per cent., which would more than cover the differences observed by Prof. Bottomley's experiment with oats.

In another experiment with barley, Prof. Bottomley obtained a higher percentage of nitrogen in the corn from the treated strip than in the corn from the rest of the field, 1·76 against 1·55 per cent. (I presume that "milligrammes of nitrogen per cent." is a clerical error). In view of the comparatively small changes in the composition of the grain of a cereal which are usually effected by large variations in the supply of nutrient, I should like to know from Prof. Bottomley if duplicate samples were taken from different parts of the untreated section of the field, and what range of variation they showed in their nitrogen content.

Coming to the next experiment, it is difficult to judge how far a bulbous plant like *Galtonia candicans* is suitable for experiments on nutrition, but it is rather necessary to know what relation the weight of the bulbs planted bore to those harvested. Prof. Bottomley only says that 250 bulbs "of equal size" were planted in each bed. Can he let us have the weights in each case? Moreover, he tells us that the treated bed was twice watered with the culture solution, the control bed being given pure water at the same time; was the same amount of water given to each, and how much of the culture solution was applied, for it contained monopotassium phosphate, sodium chloride, &c., which may well have been a considerable factor in any beneficial effect experienced?

Prof. Bottomley will perhaps forgive me if these questions may seem somewhat critical of his conclusions, but any communication appearing in the Proceedings of the Royal Society must be taken into account, and one therefore wishes to have the data necessary for determining the weight to be attached to the results.

A. D. HALL.

The Rothamsted Experimental Station, July 12, 1909.

Occasional Unexplained Ringing of House-bells.

AN observation sent me by Mr. Alexander Sinclair, of Swansea, to the effect that during a thunderstorm drops of water leaking through the ceiling "assumed a pear shape and jumped 9 inches almost horizontally to the curtain rings above the window," suggests that house-bells of the ordinary non-electric type may occasionally be rung by this means. I picture the process as follows:—The bell wires collect atmospheric electricity, by induction or otherwise, which the walls are insufficiently conducting to carry off freely; consequently the bells get charged, are attracted to a neighbouring wall or pipe, and released suddenly by a spark. This little lateral jerk rings the bell.

I put the simple suggestion on record because I sometimes hear of an inclination to attribute the phenomenon to less familiar causes.

OLIVER LODGE.

Musical Sands.

IN an interesting letter Mr. Carus-Wilson gives us the results (NATURE, July 15) of further observations made by him on a phenomenon on which he has written from time to time. I believe I have suggested to him in years gone by—if not, perhaps you will allow me to suggest now—the possibility of the musical ring of certain sands in motion being due to their consisting largely of grains of *hyaline* quartz. That fact, if ascertained, would account for the ring of the grains in motion, while the smoothness of their glassy surfaces would facilitate their motion, and so increase the force of their mutual impact, tending to raise the pitch of the note produced. I have never had an opportunity myself of making a microscopic examination of such sands, but I venture to commend such an examination to Mr. Carus-Wilson's consideration. The assortment of the sands by the wind into possibly more rounded and more angular grains may also throw some light upon the matter.

A. IRVING.

Bishop's Stortford, July 19.

Wych Elm Seedlings.

THE prolific flowering of the Wych elm, *Ulmus montana*, this year must have been followed by the formation of unusual numbers of fertile seeds. At present the ground beneath these elms in my garden is covered with hundreds of their seedlings, many of which have already developed a second pair of serrated leaves.

The elms themselves seem to have suffered from the strain of producing so large a crop of fruits, for their leaves, though now of the usual size, were very late in appearing, and are sparsely distributed on the branches.

ROSAMOND F. SHOVE.

26 Blessington Road, Lee, Kent, July 13.

POPULAR NATURAL HISTORY.

MR. LEA'S "Romance of Bird-life,"[1] a handy and fully illustrated volume published at a marvellously low price, covers the whole life-history of the bird, from the egg upwards, the twenty-one chapters containing a summary of the observations of a great many writers on ornithology arranged in a masterly and most attractive form. One of the concluding chapters deals with the birds of the past and vanishing species, and is illustrated with a reproduction of a curious old wood-cut published in 1601, representing early voyagers knocking down dodos and other birds with sticks on the island of Mauritius. In that upon "Wisdom and Folly" we have anecdotes bearing on the intellectual capacity of birds. There are many instructive passages in the book, which is quite a mine of information. It is stated that in more than one instance, if when a chick was cheeping while still in the shell the mother uttered a note of warning, the cheeping stopped instantly; and it is pointed out that this teaches us that the simple language of call-notes is instinctive, for the chick cannot possibly have learnt their meaning by experience. Nestlings the food of which is placed in their mouths by their parents cannot be taught to pick it up from the ground like chicks until they are much older. Young moorhens, however, which are fed from their mother's beak at first, will peck upwards at anything that is offered to them, but not downwards. So far as the author is aware the frigate bird is the only species which ever carries on fishing in mid-air, waiting until the flying-fish are startled from the sea by some large fish which preys on them below the surface; other fishing birds follow them into the water. The romantic story of the ospreys at loch-en-eilein (which should be written eilean) is told and illustrated.

Possibly the "romance" is a little overstrained in places, and ordinary incidents in a bird's general life habits sometimes magnified or transfigured into something more wonderful. For instance, it is a common custom with snow buntings (and with some other quick-footed birds which feed in flocks) for the rear ranks to fly to the front over the backs of the others, a manœuvre repeated by the others in turn. This simple desire (and its expression) to have first turn at whatever food is going is here advanced as "a boisterous little game of their own" in the section on sport and play. The combats of ruffs are much milder and much less important affairs than is here represented; and it seems really unlikely that nuthatches could drive out squirrels from their nest, or would want to take possession of it. Unlike most of the popular bird books published in recent years this one fills a vacant place.

Almost anyone seems to feel capable nowadays of writing a book on British birds, and, in good truth, there is material enough to compile from. Time was when to write an account of British birds was an undertaking attempted by few, and those only who had made the subject their main study for many years, and were on all hands accounted authorities. Now almost anyone does it, and there is a perfect stream of books on this subject. They come out so frequently that, although the title has been turned and twisted in a great variety of ways, it has even been found impossible to discover fresh and original names to distinguish them by. Most of them put forward some special claim upon the public. Many of them purport to cater for the ignorant and the beginner; one, indeed, made a point of picking brains without acknowledgment. Here is one[1] "with a new method of identification." This book has been written with the exclusively practical object of enabling persons unacquainted with British birds to identify them by their most obvious characteristics. By the grouping of birds, as here carried out, under such headings as "Black-and-White Birds," "Ruddy-breasted Birds," "Trunk-climbing Birds," it is claimed that the birds are presented to the beginner as he himself sees them. Where necessary, notes are appended to the descriptions indicating those birds with which the one described is most likely to be confounded, and the chief characteristics by which it is to be distinguished from them. Before proceeding to observe birds, however, the user of this book need do no more than read through the list of group-headings. The book is, in fact, another attempt at a royal road to a knowledge of our birds. The idea has been tried over and over again in some shape or form, both here and in America, but we do not think it will ever be successful. In the present case the difficulties of grouping begin to be apparent very shortly. "Skuas" as a group heading will convey nothing to the beginner without good pictures. In the end the author is left with three birds, the jay, the goldfinch, and the white wagtail, which do not fall into any groups. The two first are so conspicuous that perhaps they do not want grouping; but, really, after some of the grouping, *e.g.* putting the hedge sparrow and some others among those which are "brown above and white below," it seems rather like straining at a gnat not to have dropped the third in among the black-and-white birds. We are glad to read that there are a few breeding pairs of kites in the Midlands of England, and hope

[1] "The Romance of Bird Life." Being an Account of the Education, Courtship, Sport and Play, Journeys, Fishing, Fighting, Piracy, Domestic and Social Habits, Instinct, Strange Friendships and other interesting Aspects of the Life of Birds." By John Lea. Pp. 376; illustrated. (London: Seeley and Co., Ltd., 1909.) Price 5*s*.

[1] "British Birds and their Eggs, with a New Method of Identification." By J. Maclair Boraston. Pp. x+301; 136 coloured illustrations. (London and Edinburgh: W. and R. Chambers, 1909.) Price 6*s*. net.

it is the case. There is a classified list of the birds contained in the book, and an index, so that every facility is given to those who try to learn birds' names in this way. Illustrations of the eggs of *all* British-breeding birds appear in the sixteen plates devoted to that part of the subject. Some of the plates of birds are pleasing. But in the great majority of cases the three-colour process has probably played sad tricks with the colours, and some of the pictures are misleading. Others make the bird-lover shudder; for horrible and appalling crudeness of colour their equal would be hard to find.

Young egg-collectors are also provided with a simple guide to identify their finds.[1] A part of a larger work, "The Young People's Nature-study Book," it is in the form of a pocket-book, with blank leaves at the end for making notes on the spot. The system of this key is as follows. The nests are grouped under the headings according to their locality and position. Turning to the particular section to which a nest belongs we find additional characteristics of the nests and eggs described, which it is hoped should lead by process of elimination to a correct result. The eggs figured on the four coloured plates are those most generally confused. They can hardly be expected to be very good, but will be useful. The introductory remarks are instructive, and there are some photographs of nests.

Mr. Vos has issued[2] the second and third parts of a description (illustrated) of the rambles of two friends in search of birds' nests near London, comprising the results of two seasons. They seem to have been exceptionally fortunate in finding many interesting birds and nests, and some which would not have been expected. For instance, a snipe's nest almost within earshot of Bow Bells seems wonderful. But even more so in some respects, perhaps, is "a little colony of three pairs" of carrion crows on a small island; for in our experience, even where crows are common, it is most unusual for these unsociable birds to nest in close proximity to one another. The situation of one nest, in the top of an elder-tree, about twenty-five feet from the ground, seems unusual in a country where big trees are to be found, and the egg described as about an inch long was very small, an average crow's egg measuring an inch and three-quarters. The third part concludes with a grouping of the birds mentioned to aid in their recognition; a description with figures of the eggs; a synopsis, an alphabetical index of some of the birds mentioned, and a general index. A number of nests have been nicely photographed for the book, but the photographs of *stuffed* birds are open to criticism, as is usual.

Some of our best and really competent ornithologists have from time to time considered the possibility or advisability of editing Johns's classic,[3] but they have feared to tread. With regard to the present edition we can only regret that a good old book has been spoilt to some extent. Fortunately, not much has been done to it, for although the editor claims to have rectified statements as to the local distribution of various species which, with the progress of time and local changes, no longer apply, and to have added facts here and there which he considered of some value, this has been done so inadequately that it might as well have been omitted altogether. There are some birds, the Lapland bunting and shore lark, for instance, the status of which on the British list has entirely altered since Johns wrote; yet the articles on these species are left just as he wrote them. The editor has also brought the scientific arrangement of the species up to date. If this was to be done, more care should have been taken, when the order and sequence of the species was altered, to avoid absurdities consequent upon careless revision of the articles. As it is, we are told that the black tern is scarcely less aquatic than the whimbrel; that the name laughing gull is often given to the common gull; that the snow-bunting does not confine itself so closely to the Arctic regions as our homely reed-bunting, and various other absurdities, all of which are due to the fact that the use of the expression "the preceding species" has not been revised. Harmless as are these misstatements to the seasoned ornithologist, they might easily confuse the beginner. A large number of species included in the older editions of Johns's work have been omitted from this edition, presumably because of their rarity. But this weeding out, if done at all, should have been done consistently, and on some definite plan. Here we find that while the whole of the rarer herons, including the little bittern (which is believed to have bred with us), have been left out, the black stork, a very rare casual visitor, has been retained. The spotted eagle, which has only occurred on a very few occasions, is included, while the blue-throated warbler, an annual visitor, sometimes in some numbers, has been cut out. Then why include the little crake and not Baillon's crake? Why the Pomatorhine skua and not Buffon's skua? The black-necked grebe (which has bred in this country) is not included in the text, though it is figured. But it is needless to go further through the list, except to say that one very rare bird, the lesser grey shrike, has been inserted. The statement that the green sandpiper breeds probably in wild parts of Surrey, Sussex, and Hampshire has been added to Johns's account of this bird because "the Son of the Marshes considers that it does so." More definite information would have been very desirable. There is a glossary of provincial names and of technical terms, and an index. The old (and often unsurpassed) wood-cuts with which we have been so long familiar no longer appear, and we cannot but regret them. Instead we have sixty-four original coloured plates, comprising 256 figures. Many of these are absolutely charming and excellent portraits of birds, and altogether they are by far the best coloured pictures of our birds we have seen in a book published at anything like so low a price as this. The colour reproduction has been much more successful than usual, for which the artist may well be pleased and the publishers congratulated.

The account of the principles and measures which Baron von Berlepsch advocates[1] for the exercise of a rational protection of birds as carried out at Seebach will be read with interest and profit by the many people who like to feed the birds in winter and get them to breed in boxes. The main features of the protection here treated of are the provision of shelter woods and plantations, pruning bushes and trees in such a way as to provide nesting situations, winter feeding, and making up for the loss of natural nesting-places of the breeders in holes consequent upon the removal of old and decayed trees. With planting for birds we are not so much concerned in England as

1 "The Young People's Bird's-nest Chart. A Simple Guide to Identify the Nests of Common British Birds." By the Rev. S. N. Sedgwick. Pp. 61; illustrated. (London: Robert Culley, n.d.) Price 1s. net.

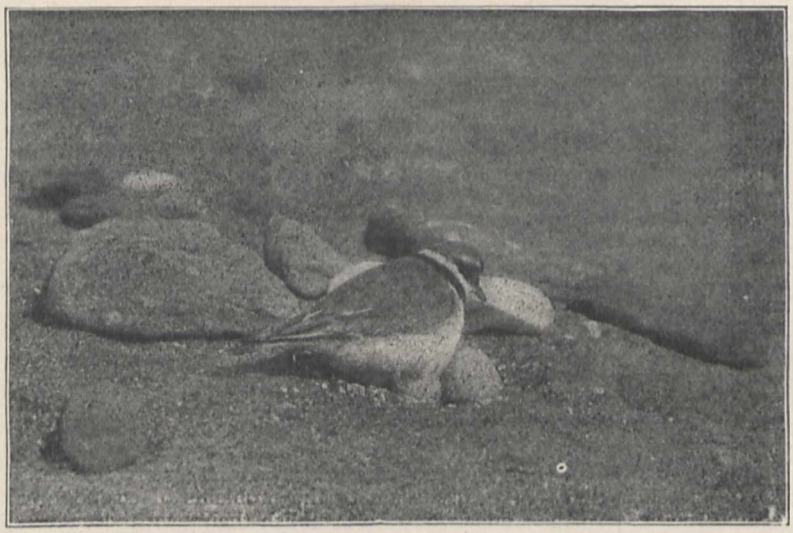
2 "Birds and their Nests and Eggs, found in and near Great Towns." By George H. Vos. Second Series, pp. viii+223. Third series, pp. xii+240. (London: George Routledge and Sons, n.d.) Price 1s. each.

3 "British Birds in their Haunts." By the late Rev. C. A. Johns. Edited, revised and annotated by J. A. Owen. Illustrated with 64 coloured plates by William Forster with a Glossary of Common and Provincial Names and of Technical Terms. Pp. xxvi+326. (London: George Routledge and Sons, 1909.) Price 7s. 6d. net.

1 "How to Attract and Protect Wild Birds." By Martin Hiesemann, translated by Emma S. Buchheim, with an introduction by Her Grace the Duchess of Bedford. Pp. 86; illustrated. (London: Witherby and Co., 1908.) Price 1s. 6d. net.

they are on the more open plains of the Continent; nor is feeding so necessary in our usually more open winters; but the chapter on bird-boxes will be sure to interest those who have been in the habit of hanging up boxes in their gardens and woods. Baron Berlepsch came to the conclusion that the nesting-boxes in use in his boyhood served no purpose, and that the only chance of success lay in the boxes being made to imitate nature. He has now succeeded in getting proper boxes made, most of which are exact imitations of woodpeckers' holes. They are here figured and fully described, and the manner of fixing and hanging them. They are now to be bought in England. Other illustrations show sections of woodpeckers' holes, correct and worthless boxes, plans of shelter woods for birds, the woods before and after cutting, pruned bushes, &c. A useful calendar of operations concludes this very practical little volume.

The first volume of the "Book of Nature-study"[1] covers animal life from mammals to insects, spiders and worms, &c., and is educational in character, written chiefly for the education of those who have to teach natural history to the young. The editor



Ringed Plover going to nest; the breast feathers are being drawn over the eggs. From "The Book of Nature-study."

points out that one of the causes of teachers failing with their students of natural history is their ignorance of the subject; and one of the main objects of this book has been to place the necessary information in such a form as to be accessible to the teacher. It is also most truly pointed out that in teaching natural history a principal object which should never be lost sight of is the stimulation of the powers of independent inquiry and observation on the part of the children themselves. The introductory chapter expounds certain general themes which must form part of the intellectual background of successful nature-study in the field of animal life, and the subsequent sections contain an excellent and clearly written introduction to the various forms thereof, their structure and life-history. A useful bibliography of works dealing with the subject, and in which it can be followed up, is appended to each section. The matter dealt with is so extensive that space cannot here be found to indicate more than the general character of the work, and it must suffice to say that it serves its purpose admirably. The illustrations are exceedingly fit and suitable for the purpose in view. The book is well printed on good paper, and the six coloured plates are simply delightful, as well as most instructive, and are some of the best and most successful efforts at colour printing we have seen.

[1] "The Book of Nature-study." Edited by Prof. J. Bretland Farmer, F.R.S., assisted by a staff of specialists. Vol. i. Pp. xii+212; illustrated. (London: Caxton Publishing Company, n.d.) Price 7s. 6d. net.

THE ADAMELLO GROUP.[1]

THE Adamello group is a conspicuous though distant feature in the panoramic view of snow-clad giants which greets us on reaching some lofty peak of the Pennine Alps in the neighbourhood of Zermatt. It rises like an island above a sea of lower mountains, almost untouched by snow—a vast tabular mass covered with glaciers, "a huge block," to quote Mr. Douglas Freshfield's graphic description, "large enough to supply materials for half-a-dozen fine mountains. But it is, in fact, only one. For a length and breadth of many miles, the ground never falls below 9500 feet. The highest peaks (about 11,600 feet) . . . are merely slight elevations of the rim of this unlifted plain. . . . Imagine an enormous white cloth unevenly laid upon a table and its shining skirts hanging over here and there between the dark massive supports" ("The Italian Alps," p. 202).

One huge mass of intrusive igneous rock, now laid bare by denudation, practically forms the Adamello. On the east it is defined by the great Judicaria fault; on the west by the Val Camonica; on the north the narrow neck crossed by the Tonale Pass alone separates the waters running to the Lago d'Iseo from those which flow either to the Lago di Garda or to the Adige. Thus it seems indicated by nature as a subject for a monograph, and Dr. W. Salomon accepted her challenge nearly twenty years ago. From time to time he has published papers on important details, and now gives us the fruits of his studies in one of those massive memoirs which only a national institution can afford to publish. We have but to glance at his route-map, in parts of which the red lines showing his track cross and recross like a mass of wriggling worms, to see that he has done his work with Teutonic thoroughness, leaving hardly any accessible place unvisited, while in order to ascertain how the rocks are related to those of neighbouring regions he has extended his investigations to the Val Tellina and to the lakes of Iseo and Idro.

Selection from so great a mass of details is impossible, and criticism of them demands a knowledge of the district comparable with that of the author, so that we can only indicate his main conclusions and comment on one or two which have a more general character. The igneous holocrystalline rock, to which Von Rath, about half-a-century ago, gave the name tonalite (from the Tonale Pass) consists of quartz, plagioclase felspar (probably andesine), biotite, and hornblende. It varies a little in coarseness and in composition, especially in the relative abundance of

[1] "Die Adamellogruppe, ein alpines Zentralmassiv, und seine Bedeutung für die Gebirgsbildung und unsere Kenntniss von dem Mechanismus der Intrusionen." Von Wilhelm Salomon. i. Teil: Lokale Beschreibung, kristalline Schiefer, Perm, Trias. Pp. xiii+433. (Wien: Abhandlungen der k.k. Geologischen Reichsansta't, 1908.) Price 30 kr.

the last two minerals, the second of which is often fairly idiomorphic. It is, in fact, a variety of quartz-diorite, for which some petrographers use the name. Enclosures of a darker, more basic rock are not unfrequent, which in some cases much resemble included fragments, but in others may have a concretionary origin. The tonalite is cut by dykes of a more aplitic character, and apophyses from it penetrate the neighbouring sedimentary rocks. The percentage of silica is rather lower than in an average granite, that of ferro-magnesian constituents is higher, while in the alkalies the soda much exceeds the potash. The monzonite of the Fassathal differs from it in being poorer in silica and richer in alkalies; the granite of that valley and of the Cima d'Asta exceeds it in both respects; but, as we see from the neighbourhood of Predazzo, these early Mesozoic ejections indicate much differentiation of any original magma. But for these interesting questions it is enough to refer to Prof. Brögger's classic memoir [1] on that district.

If this tonalite *massif* represents the supply basin to one or more volcanic orifices, all traces of the latter have completely disappeared. The blood-red "porphyries," so characteristic of a broad region east of the Adige, above and below Bozen, can also be seen west of that river, at no great distance from the Adamello, and can be traced south of it to beyond the Sesia. These were erupted in Permian times, but the tonalite, like those other holocrystalline masses already mentioned, is later than most of the Trias. On that point evidence has been accumulating since 1846, but it is made more than ever certain by Dr. Salomon's exhaustive examination of the relations of the tonalite and the various stages of that system from the Werfener Schichten (Bunter) to the Haupt Dolomit (lower part of the Rhætic). The usual proofs of intrusion can be seen in many places, and a zone of contact metamorphism traced for a considerable distance outwards from the margin of the invading rock. It can also be seen breaking into Permian sediments and into the older crystalline schists.

These schists Dr. Salomon divides into three groups: the Edolo Schiefer, the Rendena Schiefer, and the Tonale Schiefer. The first, which occur on the north and in the northern part of the west of the Adamello *massif*, are said to be phyllites, sometimes anthracitic, with quartzose-banded phyllites and quartzites; the second, consisting of phyllitic gneisses and mica schists, occur occasionally on the west, but are more developed on the east; and the third, specially characterised by bands of saccharoidal marble, often rich in silicates, and associated in one part with a zone of augen gneisses, occur on the north, on the other side of the Edolo Schiefer. Dr. Salomon regards the Rendena Schiefer as early Cambrian or late Archæan, but refers some of the Tonale Schiefer to the Mesozoic, considering the marbles to be infolded Triassic limestones, metamorphosed by intense pressure. It may seem presumptuous for one who has merely traversed this district, and that not at all recently, to express any difference of opinion, but, as Dr. Salomon supports his views by references to other parts of the Alps which the present writer has carefully and continuously studied, he has no hesitation in saying that the identification of those Alpine marbles with the acknowledged Triassic limestones is very like that of Monmouth and Macedon, and that the asserted Mesozoic age of the crystalline schists, to which most of the so-called phyllites belong, and with which these marbles are associated, is supported by no better evidence than mistakes in elementary mineralogy and the neglect of important facts, such as the presence of fragments of those crystalline schists in indubitable Triassic rock. So we venture to think that the last word has not yet been said on the subdivisions and the ages of these crystalline schists.

As dolomitic limestone occurs in the neighbourhood of the Adamello, the author discusses the relation of these rocks to coral reefs. Here we are surprised at not finding any direct reference to the Royal Society's memoir on the borings at Funafuti, and the author is apparently satisfied with the following quotation (p. 417):—"Die Bohrung auf Funafuti erscheint in demselten Licht; die dort erreichte grosse Dicke wurde wahrscheinlich in der Grunlage einer alten Kalksteines erreicht, so dass die erlangten Resultate keinesweg die Annahme der Senkungstheorie nötig machen." We can only suppose that Dr. Salomon has never seen the conclusion of Dr. C. J. Hinde's study of the cores (Memoir, p. 334):—"The evidence appears to me to indicate a continuous formation of reef rock, without any abrupt break, from the depth of 1114 feet to the present time"; while Prof. J. W. Judd (p. 175), after stating that specimens of Tertiary limestones from reefs in Indian and Pacific seas had been carefully studied for purposes of comparison, expressly states:—"The same recent forms of foraminifera, corals and other organisms occur from the top to the bottom of the series of cores. On this point the evidence appears to be conclusive, and we are justified in stating that no basis of old Tertiary limestone was reached in the deep boring at Funafuti."

But these two defects, for such we deem them, do not blind us to the many merits and great value of this memoir. The facts will remain, even if, in a few cases, Dr. Salomon's interpretation of them be ultimately set aside. The book is the outcome of years of patient toil, and, when completed by the petrographical and palæontological studies of his collections, will be a permanent monument to his scientific energy, zeal, and acumen. T. G. B.

[1] "Die Eruptionsfolge der triadischen Eruptivgesteine bei Predazzo," 1895.

TIDAL PROBLEMS.[1]

THE authors of the planetesimal theory have in this volume made a further important contribution to the discussion of the problems of cosmogony. In their endeavours to establish their own theory on a sound footing, much work has necessarily to be done in the way of criticising earlier theories. The classical nebular hypothesis of Laplace has already been discussed in a series of papers by Profs. Chamberlin and Moulton, and found wanting in many respects. To them in part is due the general abandonment of this hypothesis in anything like its original form by most astronomers of the present day. The present volume of papers is directed mainly against the tidal theories developed by Sir George Darwin, and more particularly against the view that at some far-distant epoch the moon separated from the earth.

Prof. Chamberlin's paper on "The Former Rates of the Earth's Rotation" opens with an attack on the theory of centrifugal separation of the heavenly bodies. We are compelled to admit the force of many of his criticisms with regard to the separation of the planets from a parent sun, but the similar criticisms levelled against the formation of the planetary sub-systems are lacking in weight. In particular, the argument from a comparison of the present orbit of Phobos with the ring system of Saturn fails if a change in the dimensions of the orbit of Phobos, assumed negligible, is allowed for. Also the mere statement

[1] "The Tidal and other Problems." By Profs. T. C. Chamberlin, F. R. Moulton, and others. Pp. iv+264. (Washington: Carnegie Institution, 1909.)

that the recently discovered retrograde satellites complicate the centrifugal hypothesis is no serious argument against this hypothesis. They can be made to fit into a general modified scheme. With regard to the earth-moon system, the criticism based upon the irregularity of present-day ocean tides seems irrelevant to the main issue. In the past, at any rate, we must look to regular body tides in the earth as the main factor in tidal evolution; of these tides, as mathematical analysis shows us, a natural result is a retardation of rotation. There are several further criticisms of interest in the paper, notably the reminder that the moon, if brought down to the surface of the earth (assumed to be of its present size), would be inside the limit given by Roche's criterion of stability, and would split into fragments. This point has already been considered by Sir G. Darwin (NATURE, 1886). In his discussion of it he abandons any idea that his theory explains the actual method of genesis of the moon, while he claims that it is of importance in dealing with the moon's later history.

The dynamical arguments of the paper are reinforced by geological arguments. It is shown that there is no geological evidence supporting the view that in earlier times the earth's rotation was much more rapid, and consequently the earth itself much more oblate than at present. The greater part of the changes must have taken place before the earth had solidified and its surface had become a book for the geologist to read. Only on such terms will the geologist accept the tidal theory, and on this particular point he has the support of Kelvin. In view of recent discoveries of unsuspected sources of heat and energy, it seems that the necessary extension of time involved in this requirement of the geologist may be granted by the physicist, and that the theory need not be abandoned by the mathematician at the bidding of the geologist.

Prof. Moulton's line of attack is quite distinct from that of his colleague. By considerations of energy and momenta alone he traces back the earth-moon system under various simplifying assumptions to the time when day and month were equal. He obtains in all cases a distance between the centres of the two bodies of more than 9000 miles. This result is very much the same as that originally found by Sir G. Darwin, but the latter suggested, without examining the point very closely, that a consideration of the sun's tidal effect would greatly diminish this distance. Prof. Moulton proves that the actual difference due to this cause is very slight, and his conclusion strongly reinforces the view that fission must have taken place, if at all, at a time when the earth was much less dense than at present. The further contention that the fission could not have been the result of increased rotation alone has already been recognised as valid by Sir G. Darwin. The latter's suggestion that the coincidence of a solar tide with a free period of oscillation of the earth might have led to a condition of instability has been examined by Prof. Love (Phil. Mag., March, 1889), who showed the idea to be quite feasible.

Of the remaining papers in the volume, which deal mainly with special points discussed by Chamberlin or Moulton in relation to the wider problem, the most interesting is an examination by Dr. Lunn of the heat which would be developed in the building up of a planet according to the planetesimal theory. A general qualitative agreement with the known requirements of facts is reached. More could, perhaps, hardly be looked for. Perhaps the following general criticism of the planetesimal theory may be made at its present stage of development. In many respects it gives a general *qualitative* agreement with observed facts, while its supporters are criticising older theories on the ground that they lack at times a close *quantitative* agreement with observed facts. It remains to be seen whether the newer theory will come up to the standard by which the older theories are being judged.

F. STRATTON.

PROF. SIMON NEWCOMB.

BY the death of Prof. Simon Newcomb science has sustained one of the most severe blows of recent years. America has lost her most eminent man of science, and not since the death of Adams has the world been deprived of so illustrious an investigator in theoretical astronomy. Newcomb's career up to 1899 was described by Loewy in the article on "Scientific Worthies" in NATURE, vol. lx., p. 1, and his activity and marvellous powers of work continued up to the date of the illness that has just terminated fatally. Since 1899 he has given us his interesting book entitled "The Reminiscences of an Astronomer" (1903), in which he described the early incidents of his life and related the extraordinary circumstances by which his steps were guided into the career which led him to such eminence.

Newcomb commenced his reminiscences with the words:—"I date my birth into the world of sweetness and light on one frosty morning in January, 1857, when I took my seat between two well-known mathematicians (Winlock and Runkle) before a blazing fire in the office of the 'Nautical Almanac' at Cambridge, Mass."

Though born at Wallace, in Nova Scotia, March 12, 1835, Simon Newcomb was of almost pure New England descent. His father was, he tells us, the most rational and the most dispassionate of men, who, when he had reached the age of twenty-five, set forth to search for a wife who possessed the qualities most suitable in a helpmeet. His search had extended nearly a hundred miles before, in the village of Moncton, he found in Emily Prince what he desired, and his son says the marriage was "in all respects a happy one, so far as congeniality of nature and mutual regard could go." . . . "My mother was the most profoundly and sincerely religious woman with whom I was ever intimately acquainted, and my father always entertained and expressed the highest admiration for her mental gifts, to which he attributed whatever talents his children might have possessed. The unfitness of her environment to her constitution is the saddest memory of my childhood. More I do not trust myself to say to the public, nor will the reader expect more of me."

How Newcomb's early years were passed may perhaps be conjectured from the fact that the autobiographical chapter in which he records them bears the title of "The World of Cold and Darkness." He had, however, from his earliest years a keen desire for knowledge, and read whatever books were available. His first introduction to the intellectual career he desired was not promising. In those days there was a so-called physician, Dr. Foshay, living near Moncton, who was reputed to have effected cures of sick persons given up by other doctors. As Newcomb says, "Diomeds of the medical profession before whose shafts all forms of disease had to fall were then very generally supposed to be realities." By the intervention of an aunt, young Newcomb agreed to live with the doctor, rendering him all assistance in preparing medicines, while the doctor, on his part, undertook to supply Newcomb's bodily needs and teach him "the botanic system of medicine." After a little experience it began to dawn upon Newcomb that Dr. Foshay, notwithstanding his

boasted medical skill, was no more than an ignorant pretender, and that the time of his assistant would be utterly wasted instead of being, as he expected, expended on studying botany and scientific medicine. So on September 13, 1853, Newcomb determined to run away after leaving a letter for the doctor, in which he explained that, as the doctor had shown no indication of fulfilling his promises, his assistant felt that the arrangement was annulled. Newcomb was on the road before daybreak, and walked until late at night, ever fearing pursuit from the doctor. It appears that the doctor did actually attempt a pursuit, but, by good fortune, Newcomb eluded recapture, and at last reached a house where he was hospitably entertained. "Thus ended," he says, "a day which I have always looked back to as the most memorable in my life."

After a week of hardship, which Newcomb says he will not harrow the feelings of the reader by describing, he arrived at Calais, where he found a boat bound for Salem. The little money that he had in his pocket was less than the price of the passage, but he undertook to supplement the deficiency by working his way. A few months later we find him engaged as a teacher in a school at a place called Massey's Cross Roads, in Kent County, and devoting every spare hour to reading whatever mathematical books he could obtain. His first appearance as an author was in refutation of a Mr. Eveleth, who doubted the Copernican system, and Newcomb published in the *National Intelligencer* an exposition of the fallacies in the paradoxer's essay. In 1856 he was teaching in the family of a planter, near Washington, and on a visit to the library of the Smithsonian Institution he was delighted to see among the mathematical books the greatest treasure that his imagination had ever pictured, a work that he had thought of almost as belonging to fairyland—Laplace's "Mécanique Céleste." Shortly afterwards he summoned up enough courage to seek for an interview with Prof. Henry, who suggested that he should look for some position in the Coast Survey, and his reception by Mr. Hilgard was such that Newcomb writes:—"I found from my first interview with him that the denizens of the world of light were up to the most sanguine conceptions I ever could have formed." Mr. Hilgard introduced him to Prof. Winlock, of Cambridge, Mass., and thus in 1857 he entered "the world of sweetness and light" by becoming one of the computers in "The American Ephemeris and Nautical Almanac."

From this time the progress of Newcomb to the height of astronomical fame was unchecked. Dr. Gould, the well-known astronomer, wrote to tell him that there was a vacancy in the Corps of Professors of Mathematics attached to the Naval Observatory at Washington, and suggested that he might like the post. Newcomb at first was disinclined to consider the proposition. Cambridge seemed to him the focus of the science and learning of his country. He also rather shrank from what he called the drudgery of night work in the observatory, for he considered that it would interfere with the mathematical investigations in which he was specially interested; but he finally decided to apply, and a month later, September, 1861, was much gratified in receiving the appointment duly signed by Abraham Lincoln. Newcomb accordingly settled in Washington, where he married, in 1863, Mary Caroline, daughter of Dr. C. A. Hassler, U.S. Navy, and three daughters were the issue of the marriage.

In the winter of 1870 Mr. Cyrus Field, of Atlantic cable fame, had a small dinner-party at the Arlington Hotel, Washington. A young son of Mr. Field's was present, who had spent the day in seeing the sights of Washington. The youth described his visit to the observatory, and expressed his surprise in not finding any large telescope. The guests were at first incredulous, but, finding that the statement was true, a senator who was present declared that this must be rectified, and in due course Alvan Clark and Sons were entrusted with the manufacture of a great objective of 26-inches aperture.

Newcomb was specially interested in this enterprise, because, as he says, "the work of reconstructing the tables of the planets, which I had long before mapped out as the greatest one in which I should engage, required as exact a knowledge as could be obtained of the masses of all the planets. In the case of Uranus and Neptune, the two other planets, this knowledge could best be obtained by observations on their satellites. To the latter my attention was therefore directed." In 1875 the instrument was given over to Prof. Asaph Hall, and of course it has become for ever famous as the means by which Hall made his beautiful discovery of the two satellites of Mars.

In Newcomb's "Reminiscences" we find, in a chapter on "The Author's Scientific Work," a most interesting sketch of the great problems to the solution of which his life's work was devoted. It appears that the first important investigation on which he entered in his early years at Cambridge, Mass., related to the orbits of the asteroids. This particular investigation discussed the theory that these bodies originated as fragments of a large planet broken up by some cataclysm. It involved an extended examination of the secular perturbations of the orbits of the asteroids to determine whether at any epoch even hundreds of thousands of years ago all the orbits passed through one point, though by the influence of perturbations they have now ceased to do so. The investigation seems to show that no such cataclysm as that looked for ever occurred, and that each of the asteroids has been a separate body since the solar system came into existence.

Another problem which shows the lines of thought habitually present to Newcomb may be thus stated. Do the mutual attractions of the sun, planets, and satellites completely explain all the motions in the solar system? or, as he expressed it, "Does any world move otherwise than as it is attracted by other worlds?" This opens up two great researches: first, in bringing the labours of astronomers together so as to determine with the utmost accuracy the actual movements of the heavenly bodies, and, second, in securing all attainable perfection in the mathematical methods employed in their examination. A very important branch of this inquiry is presented by the movements of the moon. Such an investigation as Newcomb sketched out had a stimulating effect on the discussion of old and valuable observations of the positions of the moon deduced from ancient eclipses, and much of Newcomb's best work was done in connection with the lunar theory.

In 1875 Newcomb was offered the position in Harvard University which is now filled with such distinction by Prof. Pickering, but he declined this offer after careful consideration. On September 15, 1877, he was appointed editor of "The American Ephemeris and Nautical Almanac." He tells us that "the change was one of the happiest of my life. I was now in a position of recognised responsibility where my recommendations met with the respect due to that responsibility, where I could make plans with the assurance of being able to carry them out." He approached the duties of this office in the loftiest spirit, and devoted his energies to the task of improving the fundamental constants employed. With this object in view, extensive investigations in

various parts of dynamical astronomy had to be undertaken. His efforts were unremitting to improve at every point the processes of calculation, as well as the materials on which the calculations were based. Among the greatest of Newcomb's labours, measured by their value to science, are, undoubtedly, those done in connection with this office. Astronomers all over the world recognise "The Astronomical Papers of the American Ephemeris" brought out under Newcomb's guidance as works of classical value. In this great task he had the good fortune to obtain the assistance of many eminent men, among whom was Mr. George W. Hill, who, in Newcomb's generous words, "will easily rank as the greatest master of mathematical astronomy during the last quarter of the nineteenth century." Newcomb's important "Compendium of Spherical Astronomy," published in 1906, should also be mentioned in connection with the "Astronomical Papers." After his term of service in the office of the American Ephemeris had expired in 1883 by the age-limit, Newcomb became professor of mathematics and astronomy in Johns Hopkins University in Baltimore, and this post he held until 1893.

As in the case of other men who have risen to a foremost position in science, Newcomb was wonderfully versatile. He was, as we have seen, a leader among mathematical astronomers, he did good work on various occasions in practical observation, and that he was a skilful experimenter when occasion required is shown by his beautiful investigations of the velocity of light; but Newcomb also wrote a number of books intended more for the general public than for technical astronomers. His "Popular Astronomy" is universally recognised as an admirable work full of lofty thought and luminous suggestion. It is remarkable for its literary grace no less than for its scientific accuracy, and those who had the privilege of enjoying Prof. Newcomb's friendship will recognise throughout "Popular Astronomy" indications of that quaint humour which was so characteristic of the author. He wrote many other books; he was recognised as an authority on economics and life assurance, and he even wrote a novel, though I do not know whether this particular venture was sufficiently successful to encourage a repetition of the experiment. All the honours which his own country or other countries could bestow on a man of science were liberally showered on him with universal approval.

It need hardly be said that for a self-taught man to become one of the most consummate mathematicians of his day, and one of the great leaders of science, not only great abilities, but indomitable industry were necessary. Newcomb was an indefatigable worker. From morning until night he was at his desk, and yet such was the kindliness of the man that when a demand on his time and friendship was made by a brother astronomer or mathematician, his books were laid aside, and he would devote himself assiduously to a day of gracious offices for his visitor. Newcomb had a serious illness about fifteen years ago, but he made a remarkable recovery, and until the last few months he was still hard at work. He died after a long illness on July 11, 1909.

Thus passes from the world the most conspicuous figure among the brilliant band of contemporary American astronomers. His inspiring example will long be treasured by those who were acquainted with his work. His habitual loftiness of thought, nobility of character, dignified courtesy, and ever-ready helpfulness endeared him to his many friends on both sides of the Atlantic. His private acts of quiet kindness and goodness of heart will be affectionately cherished by those fortunate persons to whom they are known. ROBERT S. BALL.

NOTES.

THE first attempt to cross the Channel by aëroplane was made by M. Latham on Monday, July 19. The machine, which is a monoplane, started from Sangatte, and was about 600 feet above sea-level when it left the land. This altitude was increased to about 1000 feet, and a speed of between forty and forty-five miles an hour was attained. After travelling about eight miles from the shore in the direction toward Dover the engine stopped, and the monoplane glided steadily down in a straight line to the water, where it floated until the destroyer *Harpon* came up about five minutes later. M. Latham was then taken on board, and his monoplane towed into Calais harbour.

THE death is announced of M. Henri de Parville, who was for several years editor of *La Nature*, and more recently a contributor to *Cosmos*. M. de Parville did much useful work in the direction of instructing and interesting the French public in the achievements of science. Primarily an engineer, he was well versed in other branches of pure and applied science, and for many years devoted the greater part of his energies to work for the scientific Press.

THE Institute of Metals has just completed the first year of its existence, during which period the membership has increased from barely two hundred to well over five hundred. The autumn meeting of the association will be held at Manchester on Thursday and Friday, October 14 and 15. A series of about half a dozen papers will be read and discussed at the two morning sessions of the institute. The afternoon of the first day will be devoted to a visit to the University of Manchester, where members will be received officially, on behalf of the University, by Vice-Chancellor Alfred Hopkinson, K.C. The new engineering laboratories will be open for inspection, and facilities will also be given for inspecting the Municipal School of Technology. In the evening a reception will be held by the Lord Mayor at the Town Hall. During the afternoon of Friday, October 15, members will have the opportunity of visiting works of metallurgical interest in the neighbourhood of Manchester.

THE committee nominated by the Paris Academy of Sciences for the distribution of the Bonaparte fund (25,000 francs) for 1909 has received thirty-five applications, only nine of which are considered to conform with the regulations laid down by the committee of 1908. It is proposed to allocate the fund as follows:—4000 francs to M. Cayeux, to enable him to pursue his researches on the fossils of the Oolitic iron deposits in the United States; 4000 francs to M. Chevalier, to assist him in carrying on his geographical and ethnographical researches in the French colonies in tropical Africa; 4000 francs to M. Pérez, to assist in the publication of his memoir entitled "Recherches histologiques sur les Métamorphoses des Muscides"; 3000 francs to M. Houard, to enable him to proceed to Corsica, Algeria, and Tunis to collect material for his anatomical and physiological studies; 2000 francs to M. Berget, for the construction of an apparatus for the study of the distribution and intensity of gravity; 2000 francs to M. Bernard, to continue his studies of the variation of the solar radiation and the illumination of the sky in the immediate neighbourhood of the sun; 2000 francs to M. Blaringhem, for the continuation of his experimental researches on the variation of species; 2000 francs to M. Estanave, for the continuation of his researches on stereoscopic projection by direct vision, stereoradiography, and autostereoscopy; 2000 francs to M. Mathias, to enable him to continue in the cryogenic laboratory of Leyden his re-

searches on liquids and on the law of corresponding states at low temperatures.

THE seventh annual meeting of the South African Association for the Advancement of Science will be held at Bloemfontein during the week ending on Saturday, October 2, under the presidency of Sir H. Goold Adams, K.C.M.G. The work of the association will be divided into three sections, as follows:—section i. will include mathematics, physics, astronomy, meteorology, geodesy, geography, engineering, mining, and architecture; section ii. will include chemistry, metallurgy, mineralogy, geology, botany, zoology, agriculture, forestry, bacteriology, physiology, and hygiene; section iii. will include education, philology, psychology, history, archæology, economics, statistics, sociology, anthropology, and ethnology. Papers on any of the subjects enumerated will be welcomed, and should be submitted to either of the secretaries. A strong reception committee has been formed under the chairmanship of the Mayor of Bloemfontein (Mr. C. L. Botha), who is taking active steps towards making the visit to Bloemfontein a success. The joint honorary secretaries at Bloemfontein are Dr. Geo. Potts, of the Grey University College, and Mr. Arthur Stead, 40 Victoria Road, Bloemfontein. Further details regarding this meeting of the association may be obtained from the assistant general secretary, P.O. Box 1497, Cape Town.

THE provisional programme of Section H (Anthropology) of the British Association, for the Winnipeg meeting, has now reached us. In arranging the proceedings of the section an attempt has been made, so far as possible, to cover the latest developments in anthropological science. Dr. T. Ashby, director of the British School at Rome, will deal with archæology in the western Mediterranean; Mr. R. M. Dawkins, director of the British School at Athens, with archæology in the eastern Mediterranean; and Mr. D. G. Hogarth with the archæology of Asia Minor, with special reference to the Hittites. Miss Breton will review the present state of our knowledge of the arms and armour and of the physical type of the ancient inhabitants of Central America. It is hoped that the first results of an expedition which Dr. Haddon is now conducting among the natives of the western coast of North America may be available for the meeting. A number of prominent anthropologists of the United States have promised to contribute to the proceedings of the section. Among these may be mentioned Dr. F. Boas, who will deal with anthropological problems in Canada; Miss Fletcher, who will read a paper on her work among the Omaha people; papers will also be contributed by Dr. Gordon, of Pennsylvania, and Dr. Clarence Moore. Dr. Harry Piers, of Halifax, Nova Scotia, will deal with our present knowledge of the natives of Nova Scotia, and Mr. C. Hill-Tout will present his final report on the natives of British Columbia. The valuable reports which have been presented to the association from year to year by Mr. Hill-Tout are the results of work undertaken under the auspices of the Canadian Ethnographic Survey Committee of the British Association, now defunct. In this connection it may be mentioned that papers dealing with the urgent necessity for an ethnographic survey of Canada will be contributed by Mr. E. S. Hartland and Dr. F. C. Shrubsall.

IN the *Revue scientifique* for July 3 is published the discourse delivered by Dr. Edmond Perrier, Director of the Paris National Museum of Natural History, on the occasion of the inauguration, on June 13, of the statue of Jean de Lamarck. In this oration, which is characterised by eloquence and insight, M. Perrier does full justice to the extraordinary industry of Lamarck, and to the merits of his work on the systematics of invertebrates and plants. In dealing with his speculative treatises on meteorology and kindred subjects, while allowing that his imagination was apt to get the better of his judgment, M. Perrier pertinently asks what would become of science if its professors never permitted themselves to attack questions which current opinion pronounces insoluble. On the subject of organic evolution, the author brings out in an interesting way the contrast between the influence of Lamarck and that of Darwin upon scientific opinion. M. Perrier does not concern himself to defend Lamarck's view of the method of evolution against objections, but points out that while Lamarck was himself thoroughly convinced of the truth of the general principle which is everywhere accepted today, his work met at the time with almost universal neglect. On the other hand, it fell to Darwin's lot to secure the general assent of his scientific contemporaries. After discussing the opposition to Lamarck offered by Cuvier, M. Perrier concludes with the observation that the great anatomist, in the pride of his assurance, was after all mistaken, and once more it is the *pêcheur de Lune* who was right.

THE Torquay Natural History Society has started a journal of its own, of the first number of which we have received a copy. This opens with an account of the history of the society, which is followed by a series of short papers, several of them dealing with local subjects.

WE are indebted to the Conchological Society for a copy of the July number of the *Journal of Conchology*, in which special reference is made to the need of further workers in Scotland to assist the "census" of British land and fresh-water molluscs now being taken.

THE July number of the *Popular Science Monthly* contains two articles on Darwinian subjects, one, by Prof. F. H. Giddings, dealing with Darwinism in the theory of social evolution, while in the second Prof. Dewey discusses Darwin's influence on philosophy.

THE July number of the *Museums Journal* deals largely with American topics, one article being devoted to the tariff on certain objects of art, a second to exhibits in the Brooklyn Institute illustrative of evolution and the preservation of animals, and a third to the history and collections of the Chicago Academy of Sciences.

TO vol. xxvi. (pp. 283–331) of the *Bulletin of the American Museum of Natural History*, Mr. A. Hermann, the chief preparator to the museum, contributes an interesting account of the methods now in use in preparing vertebrate fossils. The plates accompanying this paper illustrate the newest American systems of mounting fossil skeletons for the combined purposes of exhibition and study.

DR. G. STEINMANN has sent us a copy of a paper entitled "Zur Abstammung der Säuger," published in vol. ii. of the *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, in which he further elaborates his remarkable views as to the polyphyletic origin of mammals. The extent to which he carries his views will be apparent when we state that while he derives Glyptodon from the dinosaurs of the Ancylosaurus group, its relative Panochthus is considered to be descended from Polacanthus.

ACCORDING to the July number of the *Selborne Magazine*, the Brent Valley Bird-sanctuary is yearly proving more and more successful, nightingales being numerous, while nuthatches and nightjars have made their appearance in the preserve. At least one pair of nuthatches is known to

have nested, and it is not improbable that the nightjars may have laid in a recently made clearing. The Selborne Society desires to make it known that its work is by no means limited to birds, but that antiquities, as well as many other subjects, come within its purview.

THE New York Zoological Society has recently issued a special "Wild-Life Preservation Number," dealing with the efforts that have been recently made, alike in the States and in British Columbia, to preserve a remnant of the big-game fauna of the country. The year under review is a notable one, on account of marking the establishment of no fewer than five new game-reserves on the North American continent. By special enactment, the prongbuck, of which it is estimated that above 5000 head still remain, has been placed on the totally protected list; but it is a question whether the law will be obeyed in remote districts. If not, the only course is to form a reserve in the special habitat of this remarkable and interesting species.

IT is surprising how long it takes to acquire a complete knowledge of the structure even of an animal so thoroughly investigated as the frog. It is not many months since the existence of Reissner's fibre in the *canalis centralis* of the central nervous system of this animal was first announced by Nicholls, and now we learn that the frog also possesses a *nervus terminalis*, morphologically similar to that of fishes. For this information we are indebted to Herrick, who contributes a short paper on the subject to the May number of the *Journal of Comparative Neurology and Psychology*. The nerves in question, for they are, of course, paired, are extremely short and slender, and may be observed in transverse sections lying beneath the olfactory bulbs, but they appear to be quite distinct from the olfactory nerves. They are composed of non-medullated fibres. In the next paper in the same journal, R. E. Sheldon records the occurrence of the same pair of nerves in the carp.

STUDENTS of embryology will find much to interest them in two recent numbers of the *Zeitschrift für wissenschaftliche Zoologie* (vol. xcii., parts iii. and iv.). A memoir by Erwin Taube on the development of the Euphausidæ deals with the segmentation of the egg up to the time of gastrulation, and constitutes an important contribution to our knowledge of cell-lineage in the earlier stages of ontogeny. A kindred topic is ably handled by E. Martini in a study on the constancy of the histological elements in *Oikopleura longicauda*. The author maintains that in many species certain cell-individuals in every specimen come to occupy exactly the same position in the body, always show the same relations to their surroundings, and can also be recognised as homologous by their histological characters. He refers to Goldschmidt's recent work on the central nervous system of Ascaris as one of the best examples of such constancy, and finds a similar condition of things in the nervous system, notochord, and certain other organs of Oikopleura, while the endostyle does not conform to the general rule.

IN the May number of the *Journal of Experimental Zoology*, Raymond Pearl sketches out a comprehensive scheme for the study of the physiology of reproduction in the domestic fowl, and makes a commencement with a biometrical investigation of the shape of the eggs laid by a particular pullet. The first egg was very abnormal in shape, but the normal form was ultimately attained by a progressive regulatory change which is shown to follow a logarithmic curve. The author concludes that the shape of the egg is determined by the muscular activity of the walls of the uterus. The physiology of nematocysts is dealt with in the same journal by O. C. Glaser and C. M. Sparrow, whose investigations support Grosvenor's view that the discharge of the thread-cells is brought about by osmotic pressure. They also afford further proof of the fact, recently demonstrated by Toppe, that the threads are capable of penetrating the tissues of other animals; but it appears that in order to do this they must make their punctures before eversion is complete.

WE learn from the *Transvaal Agricultural Journal* (No. 27) that *Phylloxera vastatrix* has appeared in the Transvaal vineyards, and may be expected to spread and do a considerable amount of damage. Fortunately the Transvaal possesses an excellent Agricultural Department, and all proper steps to cope with the pest will be taken. In an article in the journal Mr. Davis, the Government horticulturist, describes phylloxera-resistant vines that would be suitable for the country and should in future be planted.

THE *Agricultural Journal* of the Cape of Good Hope recently directed attention to the ravages caused by the *Antheraea tyrrhea* caterpillar in certain districts, and published an appeal from the Government entomologist, Mr. Lounsbury, for material. The caterpillar comes as a plague, but between its intervals of abundance it appears to be held in check by some parasitic enemy. Two parasites are known, and others are being looked for as the simplest and most effective way of getting rid of the caterpillar.

THE necessity for looking after fruit trees properly is well brought out in a Bulletin (No. 253) recently issued by the Michigan State Agricultural College. Upon many Michigan farms there are said to be mature apple orchards that have been neglected for many years, and have produced no income beyond an occasional small crop of apples of uncertain quality. A detailed account is given of the methods, chiefly involving pruning and spraying, by which three such orchards were improved and made to yield an average net profit of 104 dollars per acre per annum for a period of five years.

THE results of field experiments in Shropshire and Staffordshire, and at the Harper Adams Agricultural College, have just been issued by the Staffordshire Education Committee. They include manurial trials on grass land, potatoes, mangolds, and swedes, and are on the lines generally adopted in such cases. Unfortunately, no analyses of the soils are given, nor any descriptions sufficient to enable anyone to apply the results to any other case. However, if the intention was simply to show that artificial manures increase crops the experiments have been a success. The experiments carried out at the college are fuller, and some interesting notes are added from the various departments on black scab of potatoes, by Mr. Malthouse; black leg in cattle, by Mr. Wilson; and agricultural chemical analyses, by Mr. B. F. Davies.

IT has always been recognised in England that an agricultural college should have its own farm, but in Scotland the conditions have hitherto been rather different, and it has been held that the college could do without one. We now learn, however, from the *North British Agriculturalist*, that the Glasgow College of Agriculture has decided to acquire a farm at Kilmarnock, to be used both for teaching and experimental purposes. The sum of 3000*l.* will be needed for equipment, but the Scotch Education Department has promised to contribute one half, on condition that the other half can be raised locally. The experiment is attracting a good deal of attention among agriculturists in Scotland.

EXPERIMENTS made in Cape Colony, and reported in the *Agricultural Journal* of the Cape of Good Hope, show that Turkish tobacco of good quality can be grown in certain districts. Irrigation was not found necessary, excepting when planting was to give the crop a good start; indeed, the crop will stand drought quite as well as vines when once it is established. The price realised in 1907 was 1*s*, 11*d*. per lb., being 5*d*. in excess of the previous year's price; nearly three times as much was grown in 1908 as in 1907, and there has also been a great improvement made in the method of curing. Although the labour required is somewhat special, it has not been found impracticable to train women, girls, and boys to do the finer work.

THE removal of charlock from corn crops was formerly a costly matter when it had to be effected by hoeing, but has become much more simple since chemical methods were devised. Experiments carried on at various centres are reported by Mr. G. F. Strawson, and confirm the results obtained by other investigators. They show that young charlock can be destroyed in growing corn crops without injury to the latter by spraying with fifty gallons of a 3 per cent. solution of copper sulphate per acre. If the charlock is older a stronger solution must be used; early spraying is therefore economical. The crop—whether corn, tares, beans, or peas—increases considerably when the competing weeds are killed, and young grass seeds and clover sown in with the corn are not injured by the copper sulphate because their leaves are too smooth for the solution to remain on.

A WELL-ILLUSTRATED description of the Polish Miocene species of Turritella is given by M. W. Friedberg in the *Bulletin international* of the Cracow Academy, 1909, 2. The author finds that the genus is well represented, and contains a number of varietal forms differing from those ordinarily described. This applies specially to *T. Turris* and *T. pythagoria*, of each of which M. Friedberg describes five varieties.

THE probable origin of the white Florentine iris forms the subject of a note by Drs. R. Pirotta and M. Puglisi in the *Atti dei Lincei*, xviii., 10. Forms have been observed with blue spots variously arranged, and it is found that these are not peculiar to individual plants, but may occur on different plants in different years. From this, as well as from geographical considerations, the authors propound the view that *Iris florentina* is a variety of *I. pallida* which has become permanent.

BY the publication of a well-arranged catalogue, the authorities of the Bradford Public Libraries have shown in the most practical way their appreciation of a large collection of scientific books and pamphlets acquired from the library of the late Dr. F. A. Lees, the author of the "Flora of West Yorkshire." The collection is especially rich in local floras of the British Isles. The herbarium of 25,000 specimens collected by Dr. Lees was acquired at the same time, and is arranged in the Cartwright Memorial Hall.

AN account of the black wax of Burma known in the vernacular as "pwê-nyet" is provided by Mr. D. Hooper in the *Agricultural Ledger* (No. iii., 1908). The wax is stored by a small bee, *Melipona laeviceps*, which forms its hive generally in a hollow tree, and constructs a peculiar trumpet-shaped entrance. The bees commonly swarm in the kanyin-tree, *Dipterocarpus turbinatus*, because in tapping for resin large holes are made in the trees which furnish suitable cavities for the construction of the hives. Incidentally, Mr. Hooper publishes analyses of resins from various species of Hopea, Shorea, Dipterocarpus, and Canarium for comparison with the wax. The chemical tests point to the wax being similar to the resins of Dipterocarpus and Hopea, while the substance forming the vestibule is almost certainly the resin of Dipterocarpus.

A FOURTH article on the sylva of Colorado dealing with forest formations and forest trees is contributed by Prof. F. Ramaley to vol. vi., No. 3, of the University of Colorado studies. There is a well-differentiated forest region in the river valleys, where cotton woods and willows predominate; two mesophytic formations are the canyon and aspen forests of the foothills; the higher montane and sub-alpine formations are composed of pines, firs, and Douglas spruce. The flora contains a number of interesting trees. The pinyon, *Pinus edulis*, yields large edible seeds; the rock pine, *P. scopulorum*, is recommended for planting in semi-arid districts; the Colorado blue spruce, *Picea parryana*, is a fine ornamental tree. The genus Populus includes the aspen, the balsam poplar, broad-leaf cotton-wood, *P. Sargentii*, narrow-leaf cotton-wood, *P. angustifolia*, and lance-leaf cotton-wood, *P. acuminata*. *Rhamnus purshiana* furnishes the drug "cascara sagrada."

THERE are differences of opinion as to the best method of improving the Indian cottons, but there can be no doubt as to the advisability of testing the possibilities of improvement by the hybridisation of native varieties. The problem, which furnishes a capital opportunity for disciples of the Mendelian school, has been broached by Mr. P. F. Fyson, who records his experiments in the Memoirs of the Department of Agriculture in India (vol. ii. No. 6). His object was to test the stability of certain characters as a preliminary to more definite investigations. Colour of flower, shape of leaf, and fuzziness of seed were selected as likely characters. With regard to colour, yellow appeared to be dominant over white, and since the colour in Gossypium is a sap colour, this conforms to general experience. The pointed leaf characteristic of *Gossypium neglectum* (*arboreum*) was dominant over rounded *herbaceum*, but the segregation of "fuzzy" and "naked" seeds was not distinct.

IN the July number of the *Reliquary*, Mr. E. H. Goddard continues the useful series of articles dealing with local collections of antiquities, his subject being Roman objects discovered in Wiltshire. Though the county possesses no Roman sites ranking in interest and importance with those of Dorchester, Silchester, Bath, or even Lydney or Woodchester, it contains Cunetio near Marlborough, villas at Box, Colerne, and Wraxall, and, in particular, Old Sarum, which will remain a sealed book until the excavations now projected are taken in hand. But besides these there are numerous smaller sites, of which only one, Rotherley, has been properly investigated. The best collection of late-Celtic pottery is that gained from the Westbury Ironworks. Mr. Goddard figures and describes a number of interesting objects—pottery, bronze rings and fibulæ, kitchen utensils, the sole of a Roman lady's shoe, and a curious bronze plaque with a figure of Minerva, the last from the downs above Lavington. On October 21, 1638, the Devil visited Widdecombe Church, a fine building on the river Webburn, in Dartmoor, a full account of which remarkable event is recorded on a tablet in curious versification, the work of the village schoolmaster, which is preserved in the church. As a matter of fact, the place was the scene of a terrible thunderstorm, which caused the loss of several lives, damaged the tower, and caused such consternation that it was attributed to demoniacal agency. The original tablet, a curious instance of the popular beliefs current at the time, is reproduced by Mr. Le Blanc Smith in the July number of the *Reliquary*.

THE seventh annual report of the director of the Bureau of Science, Manila, shows what the Americans are accomplishing in the Philippines. One of the most pressing needs has been to obtain a sufficient medical staff to cope with the infectious and epidemic diseases and the pernicious superstitions of the natives relating thereto. At present there is but one doctor to every 430 square miles of territory in the Philippines, and many towns even of some importance have no resident medical man. In these circumstances the medical school is training intelligent natives, and is making efforts to secure sufficient numbers of students to remedy the deficiency. Anthropomorphic measurements of Filipinos and of Igorots are made, and other studies have been undertaken to throw light on the histories of the natives. In addition, a large amount of work is recorded on the natural resources of the island—sugar, fibres, essential oils, &c. It is stated that the fruit of *Pittosporum resiniferum*, Hemsl., commonly known as the petroleum nut, yielded on distillation 7 per cent. of heptane.

"A SHORT Guide to the Museum of Practical Geology, Jermyn Street, London, S.W.," has been issued anonymously at the price of one penny. It seems strange that the names of the curator and director are not attached, but we may take it for granted that they are responsible, as the guide is "sold only at the museum." It will undoubtedly prove of great service to visitors in directing attention to the many objects of scientific interest and practical importance that are exhibited, and in giving so far as possible within the compass of forty-eight pages a good deal of explanatory information. The last handbook to the museum, prepared by Mr. Rudler, the former curator, was issued in 1896, and since that date many alterations and improvements have been made. The removal of the fine collection of British pottery and porcelain, though lamented by many students, was necessary for the proper display of further raw materials in place of manufactured articles. Thus the exhibition of British minerals has been considerably extended, and the practical applications of geology have been more fully illustrated by examples of brick clays, road stones, &c. The map department has received special attention, and illustrations are displayed of the mode of preparation of the Geological Survey sheets on the scales of six inches and one inch to a mile. Instructive models of the Isle of Purbeck and of the complicated district of Assynt, in Sutherlandshire, have also been introduced. Plans showing the arrangement of the specimens on the several floors of the museum form an exceedingly useful feature in this new guide.

WE have received from the Philippine Weather Bureau reports by the Rev. J. Coronas of two severe typhoons experienced in 1908. The first, called the Hong Kong typhoon of July 27 and 28, resembled in its leading characteristics the destructive storm of September 18, 1906. The Manila Observatory was able to announce its appearance to the north of Luzon on the morning of July 26; it increased in speed in the China Sea, where its velocity of translation was about 8½ miles an hour, and about 14½ miles when it struck Hong Kong, but once in China it began to fill up, as is generally the case. The Hong Kong Observatory carefully watched the progress of the storm, and gave timely warning of its approach. The second storm, called the *Tarlac* typhoon of September 18 to 27, from the wreck of the ship of that name, was first announced on the morning of September 20, being then near the Western Carolines. When it reached the Philippines its velocity was about fifteen miles an hour. The storm was most violent at Borongan (Samar), and reduced that town to a heap of ruins; it reached the northern part of Indo-China on September 27. An eye-witness at Borongan states that the roof of the town church was "blown up like a huge kite," while the convent was "simply crushed down" soon afterwards, showing that there were ascending and descending currents on the same side of the centre, the winds being in both cases from the same direction. The area of destructive winds had an average radius of about fifty miles. The full reports, with diagrams, are published in the bulletins of the Weather Bureau.

WE have received a reprint of the article "London by Night," by Mr. H. Wild, which appeared in *Photography and Focus* in March last. It contains four very realistic reproductions of photographs of London streets taken at night by means of the illumination provided by the ordinary artificial lights. The photographs were taken on rapid quarter plates of several makes by means of a portrait lens (Dallmeyer's 2B) with an exposure of about half a second, and they will bear enlargement up to 15×12 inches. They open up a field in photography which was undreamt of a few years ago.

THE June number of *Le Radium* contains an article by M. Moulin on the most probable value of the atomic charge e of electricity according to the most trustworthy of the observations made up to the present time. The three methods which M. Moulin discusses are:—First, the condensation method adopted by Sir J. Thomson and his pupils, and by Profs. Millikan and Begeman in America; second, the direct measurement of the charge on the particle, by Prof. Rutherford and Dr. Geiger; and third, the calculation of the number N of molecules in a gram molecule, based on the measurements of the Brownian movements by Prof. Perrin. The first and third of these methods agree in giving for e the value $4{\cdot}1\times10^{-10}$ electrostatic units, while the second gives 4·6, a high result which M. Moulin attributes to the want of uniformity in the layer of radium C with which Messrs. Rutherford and Geiger worked. His final conclusion is that the most probable value of e is $4{\cdot}1\times10^{-10}$ electrostatic units, and of N 7×10^{23}.

IT is well known that reaction steam turbines have a lower efficiency at the high-pressure end than at the low-pressure end. This is caused by the relatively small area of blades at the high-pressure end and the proportionally high percentage of clearance which permits of excessive leakage of steam round the blades. Published tests of a large marine turbine show an efficiency ratio of the high-pressure turbine of 55 per cent. at full power, as against 63 per cent. for the low-pressure turbine, in spite of the adoption of lower steam and blade speeds in the high-pressure turbine, thus securing a higher ratio of blade area to clearance area for the purpose of reducing leakage. In the Melms-Pfenninger turbine, illustrated in *Engineering* for July 9, a successful attempt is made to combine the advantages of the impulse type for the high-pressure end with the reaction type for the intermediate and low-pressure sections. An important feature of this turbine is the adoption of a drum construction for the impulse section, in which it differs from the wheel construction usual in turbines of the Curtis type. The remainder of the turbine is of the well-known Parsons type. The makers say that they have found it practicable to work with a clearance of but 10 mils. between the nearest points of the opposed fixed and moving surfaces.

THE steamer *Tortuguero*, which was launched from the shipbuilding yard of Messrs. Alexander Stephen and Sons, Ltd., at Linthouse, on the Clyde, on March 24, and sailed on April 22, represents the latest practice in the transport

of bananas from the West Indies. A full description of the vessel appears in the *Engineer* for July 9, from which we note that she is of 5000 tons gross, having insulated space of 220,000 cubic feet, the capacity of the fruit bins being 175,000 cubic feet. Granulated cork is used for the insulating material, the average thickness of the cork being from 7 inches to 8 inches, and the bins are so constructed that the bunches of fruit do not come into contact with metal surfaces during transit, all such being protected by wood gratings and battens, or by hemp-rope coverings. An elaborate arrangement of air passages enables cooled air to be supplied throughout the cargo, the cooling of the air being effected by a Hall's CO_2 refrigerating plant. An even temperature of 55° F. is maintained, and the fruit is inspected frequently so as to ensure its arrival at Manchester in proper condition for the market. In loading, the fruit is stored without covering of any kind, the lowest bunches are arranged with stems vertical, and the final layer placed horizontally, an arrangement which economises space and ensures freedom from damage.

A SECOND edition of Mr. Arturo Massenz's "Lavorazione e Tempera degli Acciai" has been published by Mr. Ulrico Hoepli, of Milan. The price of the volume is 2 lire.

SOLUTIONS of the exercises in their "Modern Geometry" have been prepared by Messrs. C. Godfrey and A. W. Siddons, and are published in volume form by the Cambridge University Press at 4*s*. net.

MESSRS. DAWBARN AND WARD, LTD., have published a fifth edition of the 1909 "Photographic Annual, incorporating the Figures, Facts, and Formulæ of Photography." This year-book is edited by Mr. H. Snowden Ward, and the present issue has been extended, largely rewritten, and revised to June, 1909.

MR. BERNARD QUARITCH has just issued a catalogue of books on natural history which he is offering for sale. Particulars are given of works on zoology, geology, palæontology, mineralogy, and botany. Among other interesting items we notice the original drawings of Hubner's European butterflies, an example of Jacquin's Selectarum Stirpium Americanarum Historia, and a few important herbals.

WE have received in two volumes parts A, B, C, and D of the quarterly bulletin of the results for the year 1907–8 secured during the periodical cruises and in intermediate periods in connection with the Permanent International Council for the Exploration of the Sea. The parts in order deal with the temperature and salinity of the surface water; the temperature, salinity, density, &c., of sea water at different depths; the oxygen, nitrogen, and carbon dioxide dissolved in sea water; and plankton tables for August and November, 1907, and February and May, 1908. The first three parts have been prepared with the assistance of Mr. Martin Knudsen, and the last with the help of Mr. Harry M. Kyle. The volumes are published by Andr. Fred. Høst et Fils, of Copenhagen.

OUR ASTRONOMICAL COLUMN.

STATIONARY METEOR RADIANTS.—Since Mr. Denning announced the existence of stationary meteoric radiants in 1878, many observers have endeavoured to explain, and account for, them, hitherto without much success. The apparent radiant of a meteor depends almost as much on the true direction of the earth's motion as it does on the true motion of the meteor itself, therefore it seems almost impossible that these bodies should appear to stream from the same point of the heavens for months at a time. In an article appearing in No. 5, vol. xxix., of the *Astrophysical Journal* (June, p. 365), Prof. W. H. Pickering shows, however, that this apparently puzzling phenomenon is only what is to be expected, arguing from our present knowledge of meteor-orbits. Briefly, he shows by diagrams and tables that the attracting force of the earth's mass is, at different times, capable of deflecting or accelerating the smaller bodies, so that the apparent change of the longitude of the radiant counterbalances the variation produced by the earth's motion; thus the radiant appears to be stationary, or nearly so. Prof. Pickering also produces arguments against the prevalent idea that meteors are generally of infinitesimal mass.

COMPARISON OF THE SPECTRA OF THE CENTRE AND EDGE OF THE SUN'S DISC.—Previous observations having indicated that in passing from the centre to the edge of the sun's disc the spectrum suffers modification, MM. Buisson and Fabry recently repeated the observation, using their interferometer method, in which each wave-length is examined independently of those of the other lines. Their observations, which are published in No. 26 of the *Comptes rendus*, confirm the earlier ones of Hale and Adams, and Halm.

The latter showed that the wave-length of a line in the spectrum at the limb was a little greater than when the centre of the disc was observed. From the study of fourteen lines in the region of λ 4400 MM. Buisson and Fabry find that the increase of wave-length varies from 0·004 to 0·006 Ångström; to this rule the two vanadium lines, λ 4379·4 and λ 4406·8, are exceptions. The observations also show that in the spectrum at the limb the same lines are a little broader than in the spectrum at the centre, the increase of breadth amounting, in the mean, to 0·010 Ångström.

MM. Buisson and Fabry suggest that these two phenomena, displacement and broadening, are due to the same cause. The only modification a line really undergoes is a displacement, amounting to 0·010 Ångström, of its red edge, the more refrangible edge remaining invariable. In the exceptional case of vanadium the broadening is apparently symmetrical. They suggest, further, that the asymmetrical broadening may be caused by pressure—an increase of seven atmospheres would be sufficient to produce the observed effect—but only becomes apparent at the limb where a greater thickness of the denser layers is traversed by the radiations.

CHANGES OF FORM IN SUN-SPOTS.—Some interesting results of detailed observations of sun-spot forms are discussed, and illustrated by drawings, by M. A. Amaftounsky in No. 4332 of the *Astronomische Nachrichten*.

He shows that whilst, in general, the outline of the penumbra roughly follows the form of the nucleus, tremendous changes may take place in the former, whilst the latter is apparently undisturbed. This is what would be expected on the hypothesis that the nucleus of the spot is a depression, a hole, and the penumbra is produced by the ascending and descending of incandescent vapours. The appearance of bright spots in the nucleus, sometimes followed by the bridging and disintegration of the latter, is explained by the supposition that the nucleus is at a higher temperature than the photosphere, and constantly re-vaporises the filaments and tongues of the penumbra by the expulsion of hotter vapours.

MUTUAL OCCULTATION OF JUPITER'S SECOND AND FOURTH SATELLITES.—In No. 4338 of the *Astronomische Nachrichten* M. Pidoux describes the conjunction and mutual occultation of J ii. and J iv. observed by him at the Geneva Observatory on June 17, 1908. Plotting the various measures, he finds that the conjunction took place at 8h. 33·4m. (G.M.T.), the shortest distance between the centres of the satellites being 1·9″. Whilst the latter quantity agrees exactly with that calculated and published by Oudemans, the time is 4·6 minutes in advance of the ephemeris.

According to calculation, satellites iii. and iv. should have been in conjunction at 7h. 58·5m. on July 3, 1908, but when first observed by M. Pidoux, at 7h. 52m., the conjunction was already complete and the satellites appeared as one. At 7h. 59m. the system was elongated, and at 8h. 2m. the two images were distinctly separated. It therefore appears that the observations prove the calculated times to be several minutes too late.

THE YERKES OBSERVATORY.—From the University of Chicago we have received a brochure in which Prof. E. B. Frost gives a brief, detailed account of the establishment, equipment, and work of the Yerkes Observatory. Fourteen excellent reproductions of photographs of instruments, spectroheliograms, nebulæ, &c., illustrate the twenty-four pages of the booklet, and give the reader a very fair idea of the enormous activities and possibilities of the institution. One point which attracts our attention is Prof. Frost's emphasis of the necessity for having, in a modern astronomical observatory, well-equipped workshops wherein repairs and modifications of existing instruments may be executed, and new instruments constructed.

PROMINENCE OBSERVATIONS.—No. 6, vol. xxxviii., of the *Memorie della Società degli Spettroscopisti Italiani* contains Prof. Ricco's periodical summary of the Catania prominence observations, dealing with the first six months of 1908. Prominences were observed on ninety-three days during the six months, and 170 in the northern, and 247 in the southern, hemisphere were measured. The mean latitude for the two hemispheres was 27·5°, but, dividing the latitude, N. and S., into 10° steps, there were two maxima (lat. 10°–20° and 50°–60°) in the northern hemisphere and only one (20°–30°) in the southern.

SCIENTIFIC WORK IN INDIA.

THE annual report of the Board of Scientific Advice for India for the year 1907–8 has lately been issued by the Superintendent of Government Printing, Calcutta. The Board was constituted in 1902, and consisted originally of the heads of the meteorological, geological, botanical, forest, survey, agricultural, and veterinary departments, but the Government of India invites from time to time to serve upon it other men of science in the service of the imperial and provincial Governments. The Board is a central authority for the coordination of official scientific inquiry, intended to ensure that the work of research is distributed to the best advantage and the prevention of useless duplication of inquiries and lack of interdepartmental cooperation. The advice of the Board is given with the view of aiding the Government of India in prosecuting practical research into questions of economic and applied science on the solution of which the progressive prosperity of the country depends. The Board discusses annually the proposals of the head of each of the great departments in regard to the programme of investigation in his department, and submits each year a general programme of research to the Government. Its reports and programmes are communicated through the Secretary of State for India to the Royal Society, which has appointed an advisory committee to consider them.

The present report opens with a summary of the proceedings at the three meetings held during 1908, two at Calcutta and one at Simla. As indicative of the scope of the labours of the Board, some of the subjects discussed at the first meeting may be mentioned. The Board had under consideration the remarks of the Royal Society committee on the Board's report for 1905–6 and its programme for 1907–8. The subjects discussed included, among many others, the preparation of a hand-list of the species of the flora of India, economic and industrial chemistry, and the limits of the imperial mycologist's research work, the relations of the zoological section of the Indian Museum to other departments engaged in zoological research, and proposals for a special report on the progress of the Geological Survey.

The conclusions arrived at by the Board in these matters were as follows:—that, as regards the preparation of a hand-list of the flora of India, although its importance was recognised, lack of staff and the existence of more immediately necessary work precluded its preparation forthwith; that the consideration of economic and industrial chemistry and the work of the imperial mycologist should await the results of the discussion of the subjects by the Board of Agriculture for India; that reference should be made, so far as possible, to the zoological section of the Indian Museum by other departments engaged in zoological research; and that no officer was available for the increase of work that the preparation of a special report on the progress of the Geological Survey of India would necessitate.

Very full reports upon the work of the various scientific departments during the year 1907–8 then follow. Dr. J. W. Leather and Mr. D. Hooper deal with the work on industrial and agricultural chemistry, and Mr. Puran Singh with forest chemistry; Dr. G. T. Walker, F.R.S., with solar physics, meteorology, and terrestrial magnetism; Sir Thomas H. Holland, F.R.S., with geology; Colonel S. G. Burrard, F.R.S., with geodosy and geography; Messrs. W. W. Smith, A. Howard, E. J. Butler, and R. S. Hole with various branches of botany; Mr. A. M. F. Caccia and A. J. Gibson with forestry; Dr. N. Annandale and Messrs. H. Maxwell-Lefroy and E. P. Stebbing with zoological subjects; and Colonel H. T. Pease with veterinary science.

The programmes of work of the various scientific departments for the year 1908–9, as approved by the Board, constitute the next section of the volume, which concludes with an appendix by Dr. W. R. Dunstan, F.R.S., director of the Imperial Institute, describing the economic investigations conducted for India at the Imperial Institute during the year ended September 30, 1908.

The detailed programmes of work teem with particulars of investigations of great interest, but since the bare enumeration of the researches to be undertaken runs to twenty-seven large pages, it is possible here only to give an example or two. In meteorological work, a special endeavour is being made this year to secure meteorograph records of temperature and humidity up to great heights by means of small balloons. At four nearly equidistant periods between April and December batches of registering balloons have been, and are to be, liberated at some place in the west of the Punjab, and organised efforts made to recover as many as possible on descent. Each batch was to comprise, perhaps, ten complete units, the adjustment and liberation of which takes between a week and ten days. It was hoped to reach heights of 25,000 feet in the earlier experiments, and later in the year it is hoped to increase the heights at which the balloons are caused to descend until 50,000 feet has been reached. It is important to reach this height in order to see whether the isothermal zone, which has been almost invariably found at or near that level by sounding balloons in Europe, is to be encountered over India.

The new work to be undertaken by the Geological Survey provides another typical instance of the activity of scientific workers in India. The mapping of previously unsurveyed areas in the Amherst district of Lower Burma is being proceeded with, the geological map of the Raniganj coalfield is being revised in conjunction with a committee appointed by the Mining and Geological Institute of India, and the following pieces of work are in hand:—a survey of the ossiferous deposits of the Siwaliks and the Salt Range; an examination of copper-ore and associated sulphide-ore deposits in Sikkim; a survey of certain glaciers in Sikkim; and a study of the palæontology of (*a*) the Cretaceous rocks of Tibet, (*b*) the fossil fishes of the East Coast Gondwanas.

POSITION FINDING WITHOUT AN HORIZON.

WHEN about three years ago the first Gordon-Bennett balloon race was held, and several of the aëronauts descended precipitately on the north coast of France, believing they were approaching the Bay of Biscay, it seemed to me worth while to consider the possibility of designing an instrument by the aid of which observations could be taken so as to obtain even a rough idea of position. For this purpose the observation of the altitude and azimuth at any moment of a single star or of the sun will be sufficient to establish the locality, or the altitudes of two stars not in the same vertical plane with the observer will do as well.

If the observation is such that the error is as great as the diameter of the sun or moon, the resulting uncertainty of position will be a little more than thirty miles, and so in proportion. The observer will be, of course, on a circle on the earth described round the point where the star is in the zenith, the radius of which in nautical miles is

equal to the zenith distance of the star expressed in minutes.

A search at the Patent Office library showed that a large number of inventors had for nautical purposes, rather than for use in balloons, imagined instruments which, for various reasons, would be impracticable. In some an attempt has been made to combine a sextant and a pendulum, but even if the observer were not expected to watch the star and the pendulum at the same time, the pendulum was made so short and of such quick period that the inevitable trembling of the hand would give rise to angular relative movement of the pendulum represented by several diameters of the sun. The beauty of the sextant is the property it possesses of gluing the two objects, *e.g.* the sun and horizon or moon and star, which are being observed together, so that with all the spasmodic movements which the magnification of the telescope and the unsteadiness of the hand make inevitable, the eye, nevertheless, can follow them and see if there is continuous close contact or not, whereas if the apparent position of one of the objects only depended upon the steadiness of the hand, no observation worthy of the name would be possible. It is therefore essential, if any approach to accuracy is required, that the star or sun should be seen in the same field with, and glued to, the mark, whatever form that may take, which determines the altitude, and also that the angular variation in the position of this mark should hardly be affected by the trembling of the hand. I tried at the time to interest one or two instrument makers, but unsuccessfully; now, however, that the subject is attracting attention in Germany, as shown by Dr. Lockyer's (vol. lxxx., p. 29) article in a recent number of NATURE, perhaps my design may be worth bringing forward. I would only remark that an instrument of the kind would be useful on board ship when the sun or stars may be visible while the sea horizon is obscured, provided only that, as is usual in fog, the ship is not rolling seriously. These worse conditions can only be met by the more complicated gyroscopic horizon perfected by Admiral Fleuriais.

The instrument depends essentially upon the use of a vertical collimator suspended on gimbals, and top-weighted like a metronome, so as to have a period of swing either way of as much as one second. The collimator has at its focus a scale of, say, tenths of a degree in transparent divisions upon an opaque ground, and above its lens a clear or half-silvered glass mirror set at 45° with the axis of the collimator. The collimator is suspended in a tube, which is the handle of the instrument, and which carries also the parts of a small sextant.

Figs. 1 and 2 are vertical sections through the axis of the instrument, the latter partly in elevation. *a* is a box frame to which are attached the tubular handle *b*, the telescope *c*, and other sextant parts. The telescope is carried by means of a slide *d* and pin *e*, so that it may be moved sideways or be hinged downwards when not in use. Inside the handle is mounted a gimbal ring *f*, on which the collimator *g* is supported on knife-edges *h*; *i* is the scale already described; *k* is the unsilvered mirror attached to the collimator, by means of which the scale *i*, illuminated by the mirror 7, may be seen in the telescope; *l* and *n* are the horizon and index glasses respectively of the sextant, but made as prisms for convenience, though, of course, the usual mirrors might be used; *r* is the top weight of the collimator; and *t* a correcting weight running on a screw to bring the zero of the scale *i* apparently on to the true horizon. A conical damper *u*, lined with velvet, is made to slide within the handle, being pressed upwards by a spring *v* so as to steady or even to lift the collimator off its *v*'s and against the pins 1, and capable of being moved downwards by the thumb-lever *x* and fork *y*. An exterior sleeve 5 carries a cap 8, which serves as a protector to the translucent window at the base of the handle, and as a holder also for the illuminating mirror 7; 3 is a quadrant carrying three dark or tinted glasses.

When the telescope is directly opposite the mirror *k* and the reflectors *l*, *m* of the sextant, the star will be seen by double reflection projected upon the scale, of which one half is marked + and the other −. The arm of the sextant being therefore set to any position to bring the star on to the scale, a series of scale readings may then be made, which, added to or subtracted from the vernier reading, give the series of altitudes. If the telescope is slid sideways so that half its field is to the right of the mirror *k*, it may be made to look into the object-glass end of a surveyor's level or even at the sea horizon with a known dip, and the zero of the scale tested and so adjusted by means of the moving weight *z*. At any time when a sea or artificial horizon is available, observations may be made as with an ordinary sextant with the telescope laterally displaced, and by this means also the index-glass may be adjusted.

I have experimented with a collimator and telescope mounted as described, and found that, without the top

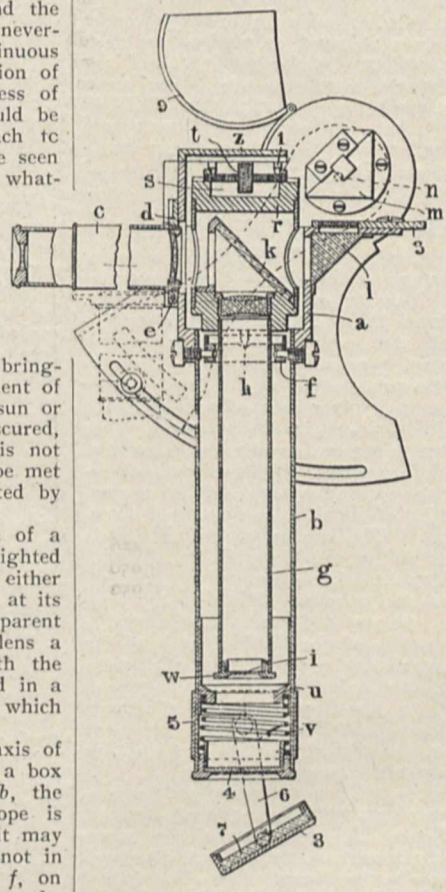


FIG. 1.

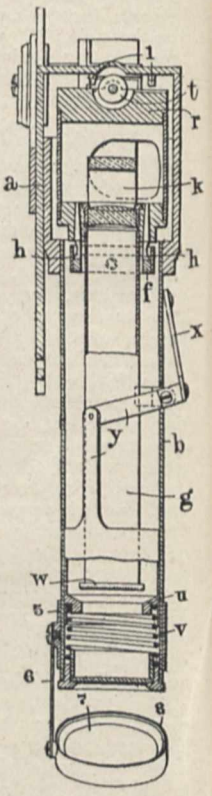


FIG. 2.

weight, the angular movement due to unsteadiness of the hand is far too great for accurate observation, but that when the period is increased to about one second by top-weighting, the angular movement is so far reduced that, when sitting at a table and holding the instrument in the hand, an accuracy of 1′ is possible. Of course, with the trembling of the hand the collimator turns about its centre of oscillation, and so with the period named a sudden movement of 1/100 inch will correspond to 1′ about, while if the period is two seconds the angular accuracy will be four times as great.

If used on a ship with any appreciable rolling it would be best to get down to the neutral axis, and observe zenith stars through a hatchway, so as to avoid the horizontal acceleration which is so pronounced on the bridge, for, of course, the collimator will hang, not in the true vertical, but at an angle equal to $\tan^{-1}\frac{\text{horizontal acceleration}}{g}$. If this is small the star may be observed to move a corresponding degree upon the scale in time with the

rolling of the ship, and the successive elongations may be read off.

In a balloon, owing to the extreme quiet, I believe useful observations could be taken, more especially at those times at which it is not turning. I do not think it would be of any use on a flying machine in motion.

C. V. BOYS.

THE POSITION OF HIGHER EDUCATION.

THE higher education subcommittee of the education committee of the London County Council has had under consideration the relations which it is desirable should subsist between the University of London and other institutions of university rank in the metropolitan area and the London County Council. The subcommittee's report was presented to the education committee towards the end of May, and contains, not only a valuable *résumé* of the various steps taken by the late London Technical Education Board and by the Council itself to improve the supply of higher education in London, but also an important collection of statistics concerning the financial aid given by municipal and other authorities in the great provincial centres of population.

The subcommittee's report includes tables of grants made by other local education authorities to university education, the grants made by the Treasury in London and the provinces, and those provided by the London County Council. In London the grant from the Council is 48·6 per cent. of the Treasury grant, and in other towns the grant from the local authorities is 75 per cent. of the Treasury grant.

Grants made by Provincial Local Authorities to Universities and University Colleges.

	Treasury grant	Grants from Local Authority
Universities:	£	£
Birmingham	11,000	7,010
Leeds	11,000	14,456
Liverpool	13,050	14,650
Manchester	15,200	5,950
Sheffield	5,700	11,744
University Colleges:		
Bristol	4,750	532
Newcastle-upon-Tyne	6,750	2,890
Nottingham	5,800	4,340
Reading	3,950	1,800
Southampton	3,250	2,113
Aberystwyth	4,000	—
Bangor	4,000	—
Cardiff	4,000	4,712
Dundee	1,000	80
Total	£93,450	£70,277

London County Council Grants to University Education.

	Treasury grant	Council grant
	£	£
Bedford College	4,000	800
King's College	8,700	2,000
University College	10,000	1,500
London School of Economics	1,150	1,200
East London College	—	1,000
Imperial College of Science and Technology	20,000	5,000
University of London	8,000	10,000
Extra Grants	—	3,720
Total	£51,850	£25,220

It is pointed out in the report that the various universities and university colleges have been successful in obtaining great assistance from generous donors, and that in such cases the receipt of State aid and financial help from the local authority does not seem to affect the flow of private benevolence. Thus Birmingham has received more than 256,000*l.* in this way; Leeds 380,000*l.*; Liverpool more than 188,000*l.*; Manchester more than 192,000*l.*; and Sheffield more than 229,000*l.*; while, in London, University College had received up to the date of the latest Government report 453,000*l.*; King's College 206,000*l.*; and Bedford College more than 29,000*l.* from private benefactions.

The subcommittee has given careful and sympathetic consideration to the applications received from certain London institutions of university rank for grants during the present year, and has come to the conclusion that more might be done in London for university education in consideration of the amount of the grant received from the Treasury, and having regard to the rateable value of the county of London. In this connection the following table, abbreviated from one included in the report, is instructive:—

Town	Rate in £ necessary to raise grant to local University or University College	Amount obtainable from a similar rate in London
		£
Birmingham	0·498	92,672
Leeds	0·638	118,724
Liverpool	0·6027	112,162
Manchester	0·227	42,203
Sheffield	0·646	120,228
Bristol[1]	0·070	12,946
Newcastle-upon-Tyne	0·173	32,129
Nottingham	0·851	158,360
Reading	0·6033	112,288
Southampton	1·00	186,111
Aberystwyth	—	—
Bangor	—	—
Cardiff	0·977	181,840
Dundee	0·019	3,604
London	0·135	25,220

The table shows very clearly that if London made the same proportional provision for higher education that Cardiff does, the annual grant would be 181,840*l.* instead of 25,220*l.*; or 158,360*l.* if it applied the same fraction of the rate as Nottingham does for higher education.

It is of interest to pass from the comparison of rate-aid and State-aid for higher education in England and Wales made in this and the preceding tables to some facts relating to the position of the subject in other countries. By a fortunate circumstance, an exhaustive article by Prof. Guido H. Marx in the issue of *Science* for May 14 shows remarkable growth and spread of interest in higher education, and the consequent great increase in the number of young men and women pursuing advanced studies, and receiving higher scientific and other training, in various countries.

It is natural to look to Germany for significant educational movements, and Prof. Marx, dealing with the combined attendance at the twenty-two German universities, shows that prior to 1870 this attendance was fairly uniform, keeping regular pace with the population. Immediately after 1870 the increase of attendance grew much more rapidly than the population, and there is not the slightest tendency for the increase to fall off. At the beginning of the period of rapid development in 1870 there was in Germany one student in the institutions of higher education for every two thousand inhabitants, while in 1907 there was one such student to every thousand inhabitants.

In the case of the United States of America, the combined attendance at all the colleges, universities, scientific, technical, and professional schools—omitting preparatory departments—up to the year 1885 showed a condition of practical stability, but beginning with that year the ratio of these students to the population increased year by year, and at present indicates no signs of falling off. In 1885 there was one such student for every seven hundred inhabitants, and twenty years later one for every four hundred of population.

Several important deductions can be made from the following table, drawn up by Prof. Marx:—

[1] The Bristol Town Council has decided to devote the produce of 1*d.* rate (about 7 000*l.* a year) to university education.

Number of Students in Higher Educational Institutions in different Countries.

Country	Population	Total number of students	Population per student
United States ...	84,000,000	210,333	400
Switzerland ...	3,500,000	6,500	530
Germany	61,000,000	61,267	1,000
Sweden	5,300,000	5,000	1,060
France	39,000,000	32,000	1,200
Roumania	6,000,000	5,000	1,200
Italy	33,000,000	24,000	1,400
Belgium	7,100,000	5,000	1,400
Holland	5,600,000	4,000	1,400
Austria-Hungary ...	47,000,000	30,000	1,570
Spain	19,000,000	12,000	1,600
Great Britain ...	44,000,000	25,000	1,750
Russia	147,000,000	23,000	6,400

Russia, it is seen, is the only western country of prominence which has not passed Germany's figure of the year 1870, namely, one student for two thousand inhabitants. "Perhaps," says Prof. Marx, "the most striking fact displayed by this table is the way Great Britain has lagged in this vast movement of the democratisation of the advantages of higher education—and, scarcely less significant, the strong leading position of the United States."

Too much importance must not, however, be attached to the table here reprinted with slight modifications, or to Prof. Marx's conclusions. The total number of students of higher education in the case of the United States includes students of both sexes in colleges, universities, technical and professional schools (exclusive of preparatory departments), in the session 1905–6, and in the case of Germany, too, the students of technical and professional schools above gymnasial rank are included in the total. But Great Britain's 25,000, and the totals assigned to all the remaining countries except Russia, deal only with their universities; their technical colleges and professional schools being ignored, apparently. It is not by any means contended that higher instruction in science and letters receives anything like the consideration it should in this country, but it is desirable, in making a comparison such as that Prof. Marx has instituted, to eliminate as many sources of error as possible, and to confine attention rigidly to matters which are really comparable. The article upon "The Supply of Secondary Education in England and Elsewhere," which appeared in NATURE of June 17, supplements to some extent the information brought together by Prof. Marx and summarised in the foregoing tables.

ASSOCIATION OF ECONOMIC BIOLOGISTS.

THE eighth annual meeting of this steadily growing association was held in the new School of Forestry at Oxford on July 13–15. The outstanding features of the meetings were the extremely interesting, and in many cases important, papers that were read and the discussions which followed, signs alike of the increasing importance of the application of biological science.

The president, Dr. A. E. Shipley, F.R.S., opened the meeting with a paper on the relations of certain cestodes and nematode parasites to bacterial disease. He argued that the piercing of the wall of the alimentary canal by parasites carries with it bacterial infection. In the case of the "disease" of the grouse, the piercing of the wall of the cæcum by the tapeworm *Trichostrongylus pergracilis* was followed by an intrusion of bacteria into the submucous layers. It is found that there is a definite relation between the number of worms in the alimentary canal and the number of bacteria in the body of the host. This perforation of the intestinal wall and subsequent invasion of the lesions by bacilli is of importance in such diseases as peritonitis and appendicitis. Such worms as Oxyuris, &c., are frequently associated with peritonitis, and other entozoa with appendicitis. He strongly advocated the greater use of vermifuges, which are used less than heretofore, and in this he was supported by Prof. Osler in the discussion that followed.

One of the most important papers was that of Prof. G. H. F. Nuttall and Dr. S. Hadwen, who gave an account of their successful curative treatment of piroplasmosis. This "tick-fever" is very fatal. In severe cases 80 per cent. to 85 per cent. of the red blood-corpuscles are infected, and the escape of the parasites into the blood gives rise to the characteristic hæmoglobinurea. The life-cycle, which was described, bears a definite relation to the treatment, and the double pyriform and large rounded forms of the parasite are dominant in the blood. It was found that if trypanblau was injected subcutaneously or intravenously all the pyriform parasites disappeared, and the remaining parasites degenerated two hours later. The animals (dogs) showed no symptoms. The parasites returned in very small numbers after about ten to twelve days, but the animals appear to be quite well, and the parasites disappear. One injection was sufficient, and nearly all the animals injected were cured, while the uninjected controls all died; a 100 per cent. mortality which occurred in this disease in dogs was converted into an 85 per cent. recovery. The drug has the same effect on the Piroplasma causing "red-water disease" in cattle. Further investigations of a thorough character are necessary before the drug can be put to practical use, but its discovery is of the greatest importance.

Mr. C. Warburton gave a very interesting account of his experiments on the life-histories of the human Pediculi, the clothes and head lice. Great difficulties were encountered at first, but finally, by allowing them to feed on the back of his hand two or three times a day, the author was able to fill a very important blank in the knowledge of these insects. He found that the female of *P. vestimenti* laid 124 eggs in twenty-five days. The eggs began to hatch in eight days, and continued to do so for about a month. The larvæ feed as soon as they are hatched, and after moulting three times became imagines in eleven days. Great trouble was experienced in breeding *P. cervicalis* (*P. capitis*), but patience and discomfort were rewarded with success, and it was found that a single female deposited forty-eight eggs, which hatched in seventeen to eighteen days, and the later stages were correspondingly lengthened compared with those of *P. vestimenti*.

The actual and possible applications of recent discoveries in heredity to biological problems of an economic character were discussed by Mr. A. D. Darbishire. He showed how important were such Mendelian principles as segregation and the breeding true of organisms bearing the recessive character. The recessive character may be a resistance to the rust fungus, as Prof. Biffen discovered in wheat. He was inclined to believe that resistance to the attacks of the beetle Bruchus might be dealt with according to Mendelian principles, and also the increase of the saccharine contents of peas by the selection of the absorptive character, which is different in round and wrinkled peas.

Mr. S. A. Neave gave an interesting account of his observations on the distribution and habits of the tsetse-fly *Glossina palpalis*, which were made in the Congo Free State and North-east Rhodesia in the years 1907–8. It would appear that the high plateau country forming the watershed between the basins of the Congo and Zambezi rivers forms a barrier against the southward extension of the distribution of the fly. He was of the opinion that, on the whole, *G. palpalis* will not be found to occur in the Zambezi basin, an important fact in view of the possibility of the spread of sleeping sickness into South Africa entertained by some authorities.

The results of observations and investigations on other insects of economic importance were communicated to the association. Dr. C. Gordon Hewitt has continued his investigations on the large larch saw-fly *Nematus erichsoni*, and finds that the natural enemies are increasing in number. The percentage of parasitic ichneumons has increased, as also the attacks of the small vole *Microtus agrestis*. A parasitic fungus (Cordyceps) has been found attacking the pupal stage, and the insectivorous birds are being encouraged. In spite of all these he was of the opinion that the results of the attack would be of a grave character, an opinion which was shared by Prof. Somerville in the subsequent discussion. A number of successful experiments on the breeding of the house-fly during the winter months (February) under favourable conditions of

temperature, &c., were described by Mr. F. P. Jepson, who has thus been able successfully to confirm the observations of previous investigators. Mr. Walter E. Collinge described the part played by the Collembola, or "springtails," in the destruction of such plant life as developing seeds, bulbs, orchids, and hops. The structure of the rose-aphid *Siphonophora rosarum* was described by Mr. A. J. Grove, and Prof. E. B. Poulton exhibited a collection of predaceous insects and their prey.

The disappearance of the fresh-water crayfish from the Thames valley and other localities in this and European countries owing to the so-called "plague" is a problem of great interest to biologists. Mr. Geoffrey Smith's paper on some of the work that he has been carrying on in cooperation with Prof. Dreyer on the pathogenic bacteria of *Carcinus moenas* was of especial interest to economic biologists, as this work is connected with the question of the relation of the so-called plague bacillus to other pathogenic bacteria living on the outside of crabs, lobsters, and crayfishes.

Prof. William Somerville exhibited an interesting collection of injurious fungi and the injuries caused by the same, and a paper on the blossoming and pollen of our hardy cultivated plants, by Mr. C. H. Hooper, was communicated to the association.

On July 14 a very enjoyable excursion to the School of Forestry's arboretum at Tubney and to Bagley Woods was made. It was also resolved to accept the invitation to hold the meeting next year at the University of Manchester.

THE MUSEUMS ASSOCIATION.

THE twentieth annual conference of the Museums Association, which opened at Maidstone on July 13, attracted a fair number of members from the more southern towns, though the northern districts were not very generally represented.

Preceding the conference there was a council meeting on the evening of Monday, July 12, when the secretary and editor, Mr. E. Howarth, resigned those offices, after being editor of the *Museums Journal* since its first issue in 1901, and secretary for many years prior to that date. The formation of the association was first advocated in an article written by Mr. Howarth and published in NATURE in 1877. From that time the idea gradually extended, and in 1889 the association was duly organised at York, where it will very fitly hold its twenty-first anniversary next year.

The president, Mr. Henry Balfour, curator of the Pitt-Rivers Museum at Oxford, opened the proceedings with an extremely interesting address, which dealt cogently with the question of a national folk-museum, one of the phases of museum work that has been strangely neglected in these islands. While the ethnology of most regions of the world is illustrated in museums with profusion, the mediæval and post-mediæval life of our own country has received quite inadequate attention. Even the British Museum is everything except British so far as ethnology is concerned. The president instanced two museums, however, where praiseworthy efforts were made to illustrate local folk-culture, viz. the Museum of the Society of Antiquaries in Edinburgh and the Guildhall Museum, London. "What is required is a national folk-museum dealing exclusively and exhaustively with the history of culture of the British nation within the historic period, and illustrating the growth of ideas and indigenous characteristics. Others have, indeed, a perfect right to criticise us, for in most European countries a folk-museum is a prominent and patriotic feature of very many of their cities and towns," Berlin, Budapest, Sarajevo, Moscow, Paris, Helsingfors, Copenhagen, Bergen, Christiania, and Stockholm being cited as a few examples.

Mr. Balfour then described with some detail the Nordiska museum in Stockholm as a model upon which to base a national folk-museum of our own, and said, "I feel sure that a well-organised and carefully arranged folk-museum standing in grounds which could be adapted for an open-air exhibition would be as much appreciated by students and as popular with the masses as any institution in the country." If a strictly national collection develops as it should, and is treated upon broad scientific lines, there will be no lack of lessons that may be learnt from it. The development of culture within the geographical region would be illustrated by chronological series depicting the general life and habits of the people at successive periods. An open-air exhibition in connection with the main museum would enable obsolete types of habitations and other large structures to be erected, and admit of the exhibition of many features of the older domestic and social economy; and, further, it would supply a permanent centre for the performance of the folk-dances, songs, and old-time ceremonies of the British people.

It was rather singular that the special subject of the "arrangement of mammalia in museums," which had been selected by the council, was completely ignored, not a single paper with any reference to it being submitted, while ethnology received a large amount of attention. Mr. H. L. Braekstad supported the president's plea with a bright, descriptive paper on open-air museums in Norway, Mr. F. W. Knocker discoursed on the practical improvement of ethnographical collections in provincial museums, and Mr. W. Ruskin Butterfield offered some suggestions for loan exhibitions of local antiquities. Art museums were dealt with in thoughtful papers by Benj. I. Gilman, of the Museum of Fine Arts, Boston, and Dr. A. H. Millar, of the Albert Institute, Dundee. Other papers comprised the Maidstone Museum, by J. H. Allchin; the relation between libraries and museums, by F. Woolnough; mounting and displaying coins, by R. Quick; life-history groups of injurious insects, by H. Bolton; and a very serviceable description by Sir Martin Conway of his ingenious and convenient method of dealing with photographs.

The annual report, read at the business meeting on July 15, recorded the uninterrupted growth of the association, which now possesses a cash balance of 250*l.*, as well as a stock of publications that are constantly in demand. The ballot papers showed that Dr. Tempest Anderson had been elected president, Mr. E. E. Lowe secretary, and Mr. F. R. Rowley editor. It was decided to publish a directory of all the museums in Great Britain and the colonies, the work to be proceeded with at once by Mr. H. M. Platnauer and Mr. E. Howarth.

ADAPTATION IN FOSSIL PLANTS.[1]

THE Darwinian theory of the origin of species by variation and natural selection only fulfils its *rôle* in so far as the distinctive characters of organisms are, or have been, adaptive, *i.e.* beneficial to the species. Purely "morphological" characters (if any such exist) and non-adaptive characters in general are not explained by the Darwinian theory (or only indirectly with the help of correlation). I therefore make no apology for having a good deal to say about adaptations in what follows.

That the great bulk, if not the whole, of organic structure is of the nature of an adaptive mechanism or device cannot be seriously doubted.

The origin of species by means of natural selection does not, as has sometimes been imagined, involve a constantly increasing perfection of adaptation throughout the whole course of evolution. Darwin expressed his belief "that the period during which each species underwent modification, though long as measured by years, was probably short in comparison with that during which it remained without undergoing any change."[2]

During the long periods of rest, adaptation to the then existing condition of life must have been relatively perfect, for otherwise new variations would have had the advantage and change would have ensued. It thus appears that, as a rule, a state of equilibrium has existed in the relation of organisms to their environment, only disturbed when the conditions were changing. That such long periods of evolutionary stability have actually occurred is shown, for example, not only by the familiar case of the flora of Egypt, unaltered during a long historic period, but still more strikingly by the absence of any noticeable change

1 Abridged from the presidential address delivered before the Linnean Society on May 24. By Dr. D. H. Scott, F.R.S.

2 "Origin of Species," sixth edition, p. 279.

in the plants of our own part of Europe since Glacial or pre-Glacial times.

The conclusion follows that at any given time, apart from the relatively short critical periods when changed conditions had to be met, we must expect to find organisms in a state of complete adaptation to their surroundings. When physical, and especially mechanical, conditions are in question, such as have practically remained constant through all geological time, we may reckon on finding the corresponding adaptive structures essentially the same at the earliest periods as they are now.

Hence the attempt to support the Darwinian theory by the detection of imperfect mechanical adaptations in Palæozoic plants is wholly futile, as was well shown by the late Prof. Westermaier. This author's own point of view was not that of a Darwinian, but, nevertheless, his conviction that efficient adaptation has always been characteristic of living organisms is a perfectly sound one, thoroughly in harmony both with the principles of Darwin and Wallace, and with the observed facts, as far back, at any rate, as the palæontological record extends. In particular, Westermaier's contention that the construction of the Carboniferous plants followed the laws of mechanical stability and economy of material, just as is the case in plants of our own day, is completely confirmed by accurate observations on their structure, while an opponent's supposed detection of Palæozoic constructions "in direct contradiction to the principles of the engineer" merely showed that the critic had failed to distinguish between the supporting and conducting tissues of the plant. It appears to have been characteristic of Palæozoic plants that their mechanical tissues were, to a great extent, independent of the wood and concentrated in the outer cortex—the most advantageous position on engineering principles. For example, the extremely prevalent "Dictyoxylon" type of cortex, in which bands of strong, fibrous tissue, united to form a network, alternate with the living parenchyma enclosed in their meshes, was an admirable mechanical construction for stems which did not attain any great thickness by secondary growth.

In the Calamites we find, in young stems, the same alternation of fibrous and parenchymatous bands in the cortex, which is so familiar to physiological anatomists in the stems of our living horsetails.

The great tree-ferns of the later Carboniferous (if ferns they were) evidently depended for their mechanical strength on a stereome or supporting tissue quite distinct from the vascular system, and for the most part peripherally disposed, as it should be. Their power of resistance to bending strains was no doubt greatly increased by the dense external envelope of strongly constructed adventitious roots, imbedded in the cortex, a mode of support which we meet with in some monocotyledons such as Kingia (Liliaceæ) and species of Puya (Bromeliaceæ) at the present day.

When we come to the most highly organised of the Palæozoic plants, the Cordaitales, constituting the characteristic gymnosperms of that epoch, we find that the young stems had the same "Dictyoxylon" construction of the cortex as was so common among the contemporary fern-like seed-plants. The cordaitean wood, however, often assumed a dense structure, and in many cases (as also sometimes occurred among the pteridosperms) there were tangential bands of narrow fibre-like wood-elements, suggesting, though not identical with, the autumn wood of recent coniferous trees, and no doubt subserving a special mechanical function.

The exigencies of secondary growth, when occurring on a great scale, ultimately demand that the mechanical tissues should be seated in the wood, on the inner side of the growing zone, though this is not the best position on engineering principles. The old plants were, on the whole, more correct in their methods; their successors have more often had to adopt a compromise, which sacrifices a certain degree of mechanical efficiency in order to facilitate construction.

In the leaves of the Cordaiteæ we meet with remarkably perfect types of mechanical construction showing various applications of the I-girdle principle, with utilisation of the "web" for the protection of the conducting vascular strands. The construction is on the same lines as that of many of the monocotyledonous leaves investigated by Schwendener in his classical work. It will be remembered that the cordaitean leaves were originally classed as those of monocotyledons, which they closely resemble in form and mechanical requirements. Here there is no secondary growth to disturb the lines of a rational construction; the leaves were of great length and borne on lofty stems, requiring a strong mechanical system for their support, and hence we find that they present admirable illustrations of engineering principles.

Without pursuing the subject further, it may be added that other Palæozoic leaves show essentially the same types of mechanical construction as are found in leaves of corresponding shape and dimensions in the living flora.

These few illustrations may suffice to show that, from an engineering point of view, the plants of the Palæozoic were just as well constructed to resist the strains to which their organs were exposed as are their recent successors.

I have elsewhere dwelt on the gradual change in the construction of the wood, correlated with the on-coming of secondary growth, and have traced the slow extinction of the old, "cryptogamic," centripetally developed wood, as the newer, centrifugal wood, derived from a cambium, more and more effectually took its place.[1] In the former we have to do with a structure becoming vestigial, but it is interesting to note how the doomed tissue was not always left in its old age to be a mere pensioner on its more active neighbours, but was often employed, while it survived, on such work as it was still able to do. We find, in quite a number of cases,[2] that the central wood had changed its character, and shows by its structure that it had become adapted to the storage rather than to the transmission of the water-supply, its earlier function now being more conveniently left to the external parts of the wood. Such utilisation of vestigial structure appears to be a good mark of a high standard of adaptation.

Another interesting case of adaptive specialisation in an organ which may be regarded as of an old-fashioned type is to be found in the rootlets of Stigmaria. The nature of these appendages has been much disputed; last year we had an interesting discussion on the subject, opened by Prof. Weiss. I have used the word "old-fashioned" because there is some reason to suppose that these organs were not yet quite sharply differentiated as roots; at any rate, there are certain points in which they rather resemble modified leaves, though in my opinion the root-characters predominate. Though they may thus be "primitive," from the point of view of our current morphological categories, these organs, as Prof. Weiss has discovered, show a remarkable adaptive mechanism in the presence of strands of water-conducting elements running out from the central vascular bundle, and terminating in plates of tracheæ placed in the outer cortex. The whole constitutes an absorptive apparatus more elaborate than anything found in recent roots, if we except a few highly specialised haustorial roots of parasites. This example seems to me instructive, for it shows how a very high degree of adaptation may co-exist with characters which suggest a somewhat archaic type of organ.

As an example of adaptation to more special conditions, I may instance the xerophytic characters shown by various Carboniferous plants, especially in the structure of their leaves.

Though there is no question of absolute perfection in nature, it appears that, under given conditions, adaptation is and was sufficiently perfect to make it very difficult to put one's finger on any defect. When we think we can do so, it generally turns out that the defect is in the mind of the critic rather than in the organism criticised. We will take a particular case, where the history seems to give some justification for our fault-finding.

The late Palæozoic family Medulloseæ were in some respects the most remarkable plants, from an anatomical point of view, that we know of. Most of them were plants of great size, with rather sturdy stems bearing immense fern-like fronds; the habit altogether must have been something like that of a tree-fern, but their reproduction was by large seeds, borne on the fronds. To

[1] Scott, "The Old Wood and the New" (*New Phytologist*, vol. i., 1902).
[2] Megaloxylon, Zalesskya, *Lepidodendron selaginoides*.

adapt the vascular system of the stem to the supply of the large and compound leaves, the polystelic type of structure was assumed, *i.e.* the single vascular cylinder (still to be recognised in some of the earlier members of the group) became broken up, in various ways, into a number of distinct cylinders, only connected at intervals. So far the change was in the same general direction as in the evolution of the higher ferns; the fossil family, however, was not content with a complex primary vascular system, but must have secondary growth as well. Now if you have a number of vascular columns in the same stem, each growing continuously in thickness on its own account, it is evident that very special arrangements will be necessary to avoid overcrowding. The difficulty was overcome, and the Medulloseæ for some time flourished among the dominant families—the Permian formation represents their Golden age. But one is tempted to think that the system was too complicated to last; at any rate, it seems not to have lasted, for these elaborate stems have not been found in any later rocks. Either, as Mr. Worsdell supposes, the medullosean stem became reduced and simplified to form the cycadean type of stem of later days, or, as I am more inclined to believe, the family died out altogether. Even here, though we seem to have an instance of a cumbrous mechanism, over-reaching itself in elaboration, yet it worked well enough for a time, and it would be difficult to say exactly what the conditions were that led to its being superseded.

The hypothesis of "a gradual development from the simpler to the more complex" is not borne out by the facts of palæobotany—the real course of events was infinitely more involved. On a general view, as Darwin himself recognised, "the geological record does not extend far enough back to show with unmistakable clearness that within the known history of the world organisation has largely advanced."[1] This wise saying has been too often overlooked by those who have tried to popularise evolution—it is eminently true of the geological history of plants. Though there is no doubt a balance on the side of advance, due chiefly to the increasing complexity of the inter-relations among the organisms themselves, the general progress since Palæozoic days is by no means so great as has often been assumed, and we may be sure that as our knowledge of the older plants increases we shall come to form a still higher estimate than we do now of their adaptive organisation.

It has been alleged that it is the fact of the gradual appearance of higher forms which enables us to determine the relative age of strata by their fossils. So far as plants are concerned, this statement is only true to a very limited extent. A fossil angiosperm, no doubt, would be evidence of an age not earlier than the Cretaceous, but, on the other hand, a lycopod of much higher organisation than at present would establish a strong presumption of Palæozoic age; so would the higher forms of the equisetales; a cycadophyte with a fructification far more elaborate than that of recent Cycadaceæ would afford sure proof that the bed containing it belonged to the Lower Mesozoic.

Of course, much depends on the meaning we give to the words "higher" and "lower." If by "higher" we mean nearer to the recent types, then it is merely a truism to say that the higher forms are characteristic of the later rocks; but if by "higher" we mean more elaborately differentiated, then the statement quoted is, in any general sense, untrue. If, again, we imply by the word "higher" more perfectly adapted to the existing conditions, then it would be very difficult to prove any advance, for, as I have endeavoured to show, adaptation has in every age been fully adequate in relation to the then conditions. If organisms have grown in complexity, it is only where the conditions of their life have become more complex. The most striking examples of high organisation in relation to organic environment are presented by the characteristic modern subkingdom, the angiosperms, in the evolution of which, as Saporta pointed out, insect fertilisation has been the chief determining factor, leading to an infinite variety in the special adaptations of the flower, and no doubt indirectly affecting the mode of life of the whole plant. The advent of the angiosperms seems to have been almost simultaneous with that of the higher families of insects, which now, at all events, are chiefly concerned in pollination. It would be difficult to overestimate the importance of these relations in their effect on the flora of the world. If the vegetation of our own epoch appears, on the whole, definitely more advanced than that of earlier geological periods, this is probably due in a greater degree to the contemporary insect life than to any other cause.

I have discussed the subject of reduction in evolution elsewhere,[1] and will only briefly allude to it here. In many groups (lycopods, equisetales, cycadophytes) there has been a lowering of the standard of organisation, partly due to direct reduction, partly to the extinction of the higher forms in each group. There are, however, many other cases in which the simplification of particular organs means a real advance.

Taking into account all the causes which make for simplification, the question suggests itself whether, when we find a simple type of structure existing at the present day, there is any presumption in favour of its primitive nature. It has sometimes been urged that such a presumption exists (except when direct evidence of reduction can be adduced) on the ground that the general course of evolution must have been from the simpler to the more complex, a rule, as we have seen, subject to so many exceptions that, within the limited period to which the palæontological record extends, it has practically no validity. My own conviction is that in such cases there is no *presumption* of primitiveness at all, and that we should demand very strong evidence before admitting that a given simple structure is primitive. Of course, it may happen that a primitive simple type, or at least an old simple type, may have survived to our own day; this may have been the case in decaying families, where the less advanced members have had the best chance of evading the competition of ascendant races; but, on the whole, it is very unlikely that, among all the changes and chances of the world's history, a really primitive simplicity should have been preserved. "The eternal ages are long," and there has been time enough for many ups and downs on every line of descent.

The subject of reduction, so essential a clue in any attempt to trace the course of evolution, suggests a reference to the question of the simpler angiospermous flowers. While the older morphologists were wont to interpret such flowers (*e.g.* those of Aroideæ, Piperaceæ, Cupuliferæ) as reductions from more "perfect" types, there has been a tendency in more recent times to accept the simpler flowers as primitive structures from which more elaborate forms have been evolved. Quite lately, however, a reaction has set in, due to the discovery by Dr. Wieland of the wonderful bisexual flowers of the Mesozoic cycadophyta, which are constructed on the same plan (though, of course, with many differences in detail) as the more perfect angiospermous flowers, such as those of Magnoliaceæ. If the angiospermous flower was derived from a source allied to the Bennettiteæ, its evolution, as suggested by Wieland, must have been essentially a process of reduction. I only wish to point out that this view is not inconsistent with the great relative antiquity of simple and, *ex hypothesi*, reduced forms, for which, in the case of the Amentiferæ, there seems to be good geological evidence. Reduction appears to have often been a rapid, indeed a comparatively sudden, change, as shown by the frequent occurrence of much-simplified forms in the same family in which the prevailing structure is typically complete. It appears quite probable that some groups with very simple flowers, though not "primitive," may be very ancient, tracing their origin from forms which in quite early days underwent reduction (as a means of specialisation) from the highly developed flowers which probably characterised the first autonomous angiosperms.

The tentative and somewhat fragmentary observations which I have here stated tend to the following conclusions:—

(1) That at all known stages of the past history of plants there has been a thoroughly efficient degree of adaptation to the conditions existing at each period.

[1] "Origin of Species," sixth edition, p. 308.

[1] "Darwin and Modern Science." XII. The Palæontological Record. II. Plants. (1909.)

(2) That the characters of plants, having always been as highly adaptive as they now are, natural selection appears to afford the only key to evolution which we at present possess, for all periods covered by the palæontological record.

(3) That this record only reveals a relatively short section of the whole evolution of plants, during which, though there has been considerable change, there has not been, on the whole, any very marked advance in organisation except in cases where the conditions have become more complex, as shown especially in the floral adaptations of angiosperms.

(4) That simple forms existing at the present day are, as a rule, of a reduced rather than a primitive nature, but that such reduction may have often set in at a relatively early stage of evolution, and is, therefore, consistent with a considerable degree of antiquity in the reduced forms.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. C. G. BARKLA, demonstrator and assistant lecturer in physics at the University of Liverpool, has been appointed professor of physics in King's College, London, in succession to Prof. Harold A. Wilson, F.R.S., who has accepted an appointment in McGill University, Montreal. Mr. P. H. Kirkaldy has been appointed an assistant professor in chemistry in the same college.

HARVARD has this year conferred only one honorary doctorate of science. The recipient is Mr. S. F. Emmons, of the U.S. Geological Survey. The University has conferred upon its late president, Dr. C. W. Eliot, not only the honorary LL.D., but the honorary M.D. "It has not been our custom," said the new president, Prof. Lowell, "to confer the degree of Doctor of Medicine *honoris causa*, but an exception is fitting in the case of one who, in the opinion of professors of medicine, has accomplished more for the progress of medical education in this country than any other living man, Charles William Eliot. Not in its buildings alone, but also in the instruction and research within its walls, he found our medical school brick and left it marble." At Yale the honorary D.Sc. has been conferred on Profs. E. W. Morley, W. T. Sedgwick, and E. H. Moore—a chemist, a biologist, and a mathematician respectively.

A FOURTH series of lectures on scientific microscopy is to be held at the institute for microscopy of the University of Jena from October 11–16 next. Prof. H. Ambronn will give two lectures, the first on Abbe's theory of the formation of the microscopic image, and the second on the method of testing objective systems. Dr. H. Siedentopf also will lecture twice, dealing with dark-ground illumination and ultramicroscopy. Dr. A. Köhler's two lectures have for their subjects photomicrography: (*a*) projection of the image on the plate, (*b*) illumination of the object with transmitted and incident light, and photomicrography with ultra-violet light. In connection with each lecture suitable practical work has been arranged, and demonstrations also will be provided. Application for admission to the lectures should be made to Dr. Ehlers, Jena, Beethovenstr. No. 14. A fifth series of lectures will be held from March 7–12, 1910, in the anatomical institute of the Leipzig University.

THE first volume of the report on attendance, compulsory or otherwise, at continuation schools, prepared by the Consultative Committee for the Board of Education, was published (Cd. 4757) a few days ago. The evidence on which the recommendations of the committee have been based will be issued later as a separate volume. The committee was instructed to consider, among other matters, "whether any means, and if so what, can be devised, in respect of rural areas and of urban areas respectively, for securing (i.) that a much larger proportion of boys and girls should on leaving the public elementary school commence and continue attendance at evening schools than at present do so, and (ii.) that employers and other persons or bodies in a position to give effective help shall co-operate in arranging facilities for such attendance on the part of their employees, and in planning suitable courses and subjects for the schools and classes." The witnesses examined by the committee included representatives of employers of labour, of labour organisations, the Public Services, local education authorities, teachers of all grades, inspectors of schools, and persons specially interested in philanthropy. The volume available, with its careful consideration of every aspect of the problem, brings home forcibly to the reader its complexity and importance, and we hope to deal more fully with the whole question in a future issue. Here we will only express satisfaction that the views of enlightened educationists are being brought prominently into public view by reports such as that before us. The resolutions as to leaving age and continuation schools contained in the report of the Education Committee of the British Science Guild (NATURE, January 28, vol. lxxix., p. 382) receive substantial support from the Consultative Committee's conclusions, and it may be hoped that action will be taken before long in the direction indicated by them. Most of the German States have compulsory continuation schools, and Scotland was placed in the same position by its Education Act of last year. It remains for England to adopt a like standard of educational efficiency for its children.

ON the vote of 13,648,792*l.* for the expenses of the Board of Education, Mr. Runciman, President of the Board, made a statement in the House of Commons last week reviewing the state of education in the country. Dealing with technical education, the Minister spoke hopefully. It has been, he said, the object of the Board of Education to make technical education more practical, with a closer bearing on the duties likely to be required from the young men and women who pass through technical classes. In agriculture there is one remarkable fact, namely, that garden classes in elementary schools have been enormously on the increase, and during the last few years the number of these classes which are now carried on in these schools has been trebled. There has been considerable development in technical classes which can be attended by those who intend to enter on an agricultural career, by young farmers and young labourers who at the present time have to spend long and laborious days in the fields or farmhouses, but who are prepared to devote one or two evenings a week to the specialised training which can be provided in technical classes. The cumulative effect of technical training on the young men and women of our country must show itself sooner or later. The great employers have been giving help, said Mr. Runciman, in many parts of the country to those who organise the technical schools. Messenger boys, for instance, are induced more and more to take advantage of the classes in the evening. Some great employers, like the General Post Office, not only give direct inducement to their messenger boys, but put a certain amount of pressure on them to take advantage of classes, and many employers all over the country have made it a condition of service in their works or their great business establishments that the boys should attend a certain number of classes every week. The inspectors of the Board are not only taking a keen interest in the curriculum, but they are also acting as missionaries in what is one of the most useful forms of educational work initiated during the last few years. In concluding his speech, Mr. Runciman pointed out that we still have nothing but an old, temporary building in which our valuable science collection is housed, and he expressed the hope that it may be possible in the near future to give this great collection a better building in which it may be exhibited, and to give to those who have lent or given to that museum some security that the objects which they have given will be well preserved and well exhibited.

THE new engineering buildings of the University of Manchester were opened by Sir Alexander Kennedy on July 15. The general scheme comprises four adjacent buildings; the main block, a three-storied building, contains the lecture rooms, tutorial rooms, drawing offices, private rooms, and research room. The hydraulic and testing laboratory covers the space at the back of this building, and connected to it by a covered way are the thermodynamic laboratories and the workshop. Principal Hopkinson presided at the opening ceremony, and in the course of his remarks pointed out that the example set by the Owens College in 1866, in providing for the professional education of engineers, has been followed by all the

important universities in the country. During his speech Sir Alexander Kennedy made it clear that the old system of apprenticeship has become inadequate. The function of the laboratory, he said, is to try to let a man learn by handling, experiment, and measurement the nature of the materials with which he will have to deal later. The extraordinarily rapid progress which has been made in mechanical and electrical engineering during the last generation has been largely due, Sir A. Kennedy thinks, to the good training all over the country of the men who have to carry out the details of the work. On the part of colleges and universities, he continued, there is a tendency to attempt to make students do a great deal too much. While it is necessary that an engineer shall have a knowledge of a great many things before he gets to his profession, he cannot acquire much knowledge in three years. It may be hoped that a strong university with a strong man at its head will draw a very distinct line in some common-sense fashion in defining what knowledge shall be imparted to the students. Sir William Mather proposed a vote of thanks to Sir A. Kennedy, and expressed his disappointment at the neglect displayed by the large engineering firms of the Manchester district in connection with the higher development of engineering science among young men. The success of engineering in the future will depend almost wholly on elements quite different from those which have distinguished it in the past. The next generation of engineers must be trained carefully by methods enabling them, above all things, to combine economy with efficiency. The technical school must perforce stop short of what may be called the practical part of applying machinery in the best possible way. To ensure success, there must, he continued, be a certain number of young students devoting themselves to laboratory work, and this extension of Manchester University must prove of great usefulness.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, June 25.—Dr. C. Chree, F.R.S., president, in the chair.—A transition point in zinc amalgam: Prof. H. S. **Carhart.** The paper gave the preliminary results of an investigation which has for its primary object the determination of the heat of dilution of zinc amalgams. This heat of dilution is negative, that is, the dilution of zinc amalgam by the addition of mercury absorbs heat. In the course of the experimental work, which was conducted by Dr. W. D. Henderson, phenomena so extraordinary were encountered that the concentration at which they occur was called a transition point in zinc amalgam. The method employed was electrical, by means of a concentration cell, the only difference between the two legs of the cell of H-form being in the concentration of the amalgam composing the electrodes.—A method of producing an intense cadmium spectrum, with a proposal for the use of mercury and cadmium as standards in refractometry: Dr. T. M. **Lowry.** Of the twenty-six wave-lengths that have been used in the study of rotatory dispersion (Proc. Roy. Soc., lxxxi., p. 472, November 19, 1908) the following seven have been found to be the most suitable for general use:—

Li	Cd	Na	**Hg**	Cd	Cd	Hg
6708	6438	5893	**5461**	5086	4800	4358

In refractometry it has been customary to use the series:—

H_α	**Na**	H_β	H_γ
6560	**5893**	4861	4341

This series has the disadvantages (1) that the chief standard Na 5893 is a doublet, and (2) that the other three lines are of such weak intensity that they are useless for the majority of optical measurements. It is therefore urged that—in view of the readiness with which the mercury and cadmium spectra can now be produced—the mercury green line should be generally adopted in place of sodium as chief standard in optical work of all kinds, and that the hydrogen lines should be abandoned even as secondary standards in favour of the series of wave-lengths set out above.—The measurement of wave-length for high-frequency electrical oscillations: A. **Campbell.** The experiments had for their object the calibration of wave-meters for the measurement of the high frequencies (200,000 up to 1,000,000 ~ per second) used in wave-telegraphy. Two wave-meters (A and B) were tested, both being of the type consisting of a series of self-inductance coils used singly (L) in series with a variable air-condenser (K) and a thermo-ammeter, the reading of K being obtained by altering the capacity until the circuit shows resonance with the working circuit. The coils of wave-meter (A) were wound with solid wire, those of (B) with stranded wire (7/36s), each strand being separately insulated. The absolute value of the frequency was determined by photographing spark-trains in the primary circuit by means of a rotating mirror running at a constant and accurately measured speed. The value of the frequency deduced from the measured values of K and L with wave-meter (B) were in close agreement with the actual frequency deduced from the spark-photographs. With wave-meter (A) the agreement was naturally not nearly so close, but was much improved when the values of the self-inductances of the solid wire coils were corrected to the high-frequency values by the formulas of Heaviside and L. Cohen.—An electromagnetic method of studying the theory of and solving algebraical equations of any degree: Dr. **Russell** and Mr. **Alty.** The problem of finding the roots of an algebraical equation of the nth degree is identically the same as that of finding the positions of the "neutral points," that is, the points where the resultant force due to the earth and definite currents in n long vertical wires is zero. The n wires are arranged at any convenient distances apart in a plane which is at right angles to the magnetic meridian. The currents in the wires are then adjusted to certain values which are readily found by the methods of partial fractions. If x_1 and y_1 be the coordinates of one of these neutral points measured with reference to certain definite axes, $x_1 \pm y_1\sqrt{-1}$ is a pair of roots of the original equation. All the real roots lie on the axis of X which cuts the wire at right angles. The positions of the neutral points thus determine all the roots, real and imaginary, of the given equation. The peculiar advantage of the method is that it is easy to see, in many cases almost at once, what effect varying the value of the coefficient of any power of x will have on the roots of the equation.—The sine condition in relation to the coma of optical systems: S. D. **Chalmers.** The condition for the correction of coma in a centred optical system is the well-known sine condition. This has been proved by Clausius, Helmholtz, Hockin, and others, and the importance of this condition in the design of optical systems has been pointed out by Abbe, Steinheil, Conrady, and others. The present paper shows how to obtain the relation between the coma of a system and the errors in the sine condition.—A new Féry thermo-electric calorimeter: Dr. C. V. **Drysdale.** This form of calorimeter can be used continuously, and permits the value of the gas produced in a gas-works or producer-plant to be watched from time to time.—An instrument for measuring the strength of an intense horizontal magnetic field: F. W. **Jordan.** The method consists in measuring directly the transverse force on a conductor traversed by a current in a direction at right angles to the field.—A method of determining the sensibility of a balance: Prof. **Poynting.**—The balance as a sensitive barometer: Mr. **Todd.**

Challenger Society, June 30.—Dr. A. E. Shipley in the chair.—Colour changes in tropical sea perches from the Bermudas: C. T. **Regan.** In one case an individual specimen exhibited successively the coloration of three so-called "species."—Recent observations of Prof. Otto Pettersson on tide-like movements in deep water: Dr. H. R. **Mill.** Daily observations on temperature and salinity were made at close intervals from surface to bottom in the Gullmar Fjord, when covered by ice, between January 30 and March 25 of this year. The effect was that of an invasion of sea water from the Skagerack twice in a lunar period, followed by a withdrawal of the sea water and the filling up of the upper part of the fjord with brackish land water in rhythmical succession, and Prof. Pettersson inclined to the belief that these movements were of tidal origin. Dr. Mill pointed out that Sir John Murray and he had shown that similar effects of a non-periodical kind were produced in sea- and fresh-water lochs of Scotland by the action of wind, and that he had shown analogous effects on the Atlantic coast of the Hebrides.

PARIS.

Academy of Sciences, July 12.—M. Émile Picard in the chair.—The nature of the change undergone by crystals of heptahydrated sodium sulphate in contact with crystals of the decahydrate: D. **Gernez.** From an examination of the phenomena occurring with supersaturated solutions of sodium sulphate, sodium chromate, acetate, and hyposulphite, it is concluded that the opacity of the lower hydrated crystals in contact with the higher hydrate is due to penetration of crystals of the higher hydrate into the crystalline network of the lower. There is no evidence for any change in the proportion of water in the crystals first formed.—Observations on the nature and origin of the gases which form in volcanic fumaroles or which emerge from the craters of old volcanoes: Armand **Gautier.** The gases from the old crater of Agnano, near Naples, consist almost entirely of carbon dioxide (96 per cent. to 98 per cent.), together with traces of methane and a little more than 1 per cent. of nitrogen. The latter contains argon, neon, and helium, and possibly the other argon gases.—The influence of anæsthesia on the decomposition of certain glucosides in plants: L. **Guignard.** Plants of black mustard, submitted to the action of chloroform vapour, produce the mustard essence; cooling to the temperature of boiling methyl chloride produces the same effect. Similar observations have been described by M. Mirande regarding the formation of hydrocyanic acid.—A hæmogregarian of *Pituophis melanoleucus*: A. **Laveran** and A. **Pettit.**—The neutral carbonates of rubidium and cæsium: M. **de Forcrand.** A thermochemical paper.—The theory of functions: Henri **Lebesgue.** A correction of a previous paper.—The singularities of uniform analytical functions: D. **Pompeiu.**—Systems of reservoirs: Edmond **Maillet.**—Orthoscopic telescopes: M. **Tscherning.**—Chemical reactions and ionisation: G. **Reboul.** The apparatus described is capable of measuring ionisation over a wide range; details are given of the results obtained in numerous chemical reactions.—Remarks on the preceding paper: A. **Gautier.**—A new method of separating uranium X, and on the relative activity of this substance. B. **Szilard.** The method is based on the addition of ferric acetate, ammonium acetate, and acetic acid to the uranium solution, and the precipitation of the iron by heating; uranium X is concentrated in the precipitate.—The chemical action of the penetrating rays of radium on water: Miroslaw **Kernbaum.** Radium rays that had passed through glass decomposed water in accordance with the equation $2H_2O = H_2O + H_2$, both the hydrogen and hydrogen peroxide being determined quantitatively. An attempt to obtain a similar reaction by allowing Röntgen rays to act upon water for 100 hours gave negative results.—The diffusion of ions through metals: Georges **Moreau.** The passage of ions through heated plates of platinum, nickel, iron, and brass has been studied. A theory of the diffusion has been developed, and an experimental confirmation given.—The action of the α rays on solid dielectrics: Tcheslas **Bialobjeski.** A study of the alteration in the conductivity of sulphur produced by the α rays of polonium.—The hydrolytic decomposition of bismuth bromide: René **Dubrisay.** There is only one bismuth oxybromide produced in this reaction; a rise of temperature does not appreciably affect the hydrolytic dissociation of bismuth bromide.—A proposed solution for the equation of condition relating to the calculation of atomic weights: G. D. **Hinrichs.** The author points out that his equation of condition is diametrically opposed to that given by L. Dubreuil.—The cementation of iron by carbon in a vacuum: Léon **Guillet** and Ch. **Griffiths.**—The extraction of lutecium from the gadolinite earths: G. **Urbain,** MM. **Bourion** and **Maillard.** For the final purification from thorium and scandium, the oxides were converted into the chlorides by heating them in the vapour of sulphur chloride. This method of fractional sublimation of the chlorides promises to be of service in the separation of the rare earths.—The condensation of isopropyl alcohol with its sodium derivative: formation of methylisobutylcarbinol and dimethyl-2 : 4-heptanol-6: Marcel **Guerbet.**—The iso-indogenides: A. **Wahl** and P. **Bagard.**—The production of peat on the rocks of tropical Africa: Aug. **Chevalier.**—The ferment of belladonna: C. **Gerber.**—The influence exerted by certain vapours on plant cyanogenesis. A rapid method for testing plants for hydrocyanic acid: Marcel **Mirande.** Any cyanogenetic plant, submitted to the action of chloroform vapour, at once gives off hydrocyanic acid. The latter can be detected by the use of Guignard's picrate paper.—The action of urohypotensine on the arterial pressure: J. E. **Abelous** and E. **Bordier.**—The proof of alimentary glycosuria in epileptics: MM. **Florence** and **Clement.**—The hypotensive action of serum from a dog which had been deprived of its suprarenal capsules: Jean **Gautrelet** and Louis **Thomas.**—The chemical composition of ox bile: N. A. **Barbieri.**—The life of yeast after fermentation: E. **Kayser** and A. **Demolon.**—The action of the ultra-violet rays on cider in fermentation: MM. **Maurain** and **Warcollier.**—Experimental reproduction of exanthematic typhoid in the ape: Ch. **Nicolle.**—The chemical effects of immersion in water of the quartz mercury-vapour lamp: J. **Courmont,** Th. **Nogier,** and A. **Rochaix.** No ozone is produced which would account for the observed bactericidal effects, and no other chemical change of importance could be detected.—Symmetry of organs in some species of Syllis: Aug. **Michel.**—The reactions of some mitochondria: E. **Fauré-Fremiet.**—The ichthyological fauna of Lake Victoria: Jacques **Pellegrin.**—The Silurian of Nova Zembla: V. **Roussanof.**—The earthquake of Provence, June 11, 1909: Louis **Fabry.**—The earthquake of July 7, 1909: Alfred **Angot.**

CONTENTS.