THURSDAY, NOVEMBER 15, 1900.

FOSSIL PLANTS AND EVOLUTION.

Studies in Fossil Botany. By D. H. Scott, F.R.S. Pp. xiii+533. (London: Adam and Charles Black, 1900.)

THE present work owes its origin to a course of lectures delivered at University College in 1896. In appealing to a wider audience, Dr. Scott has rendered an important service to biological science, and has placed before the botanical student some of the most striking results of palæobotanical investigation, which cannot fail to demonstrate, even to the most sceptical, the supreme value of fossil records from the evolutionary standpoint. The author expressly states in the preface that his object has by no means been to write a manual of fossil botany,

"but to present to the botanical reader those results of palæontological inquiry which appear to be of fundamental importance from the botanist's point of view."

The study of petrified fragments of Palæozoic plants has of late years contributed more trustworthy and important data towards the solution of phylogenetic problems than any other department of palæobotany. It is, however, most desirable that the student should recognise that the range of fossil botany is wide, and that results of primary importance may be reasonably expected also from investigations along other lines than those which are followed in the present work.

A word of praise is due to Mr. Gwilliam, who has drawn the majority of the admirable illustrations. After a brief introduction, the author proceeds to deal with the most important Palæozoic representatives of the Equisetales, Sphenophyllales, Lycopodiales, Ferns, Cycadofilices and Cordaiteæ; a short account is given also of Mesozoic Gymnosperms. The concluding lecture, in which the general results are summarised in a clear and convincing style, is of special interest as one of the most striking contributions towards the scientific construction of botanical genealogies that we have ever read. In the lectures on the Equisetales we have a concise account of the extinct ancestors of the modern Horsetails, more particularly of the somewhat comprehensive genus *Calamites* and of the various types of fructification included in the Calamarieæ. Lecture iv. treats of the extinct group Sphenophyllales, including *Sphenophyllum* and *Cheirostrobus*; the latter genus, originally described by its author—Dr. Scott—in 1897, is of primary importance as enabling us to connect together such apparently distinct phyla as the Equisetales, Lycopodiales and Sphenophyllales. Three lectures are devoted to the Lycopodiales. Satisfactory restorations of extinct plants are always a difficulty; that of *Lepidodendron elegans* hardly does justice to what must have been one of the most striking and beautiful trees in the forests of the Palæozoic era. Although our knowledge of the anatomy of *Lepidodendron* is in several respects fairly complete, there are still a few points on which further information is much to be desired.

Dr. Scott suggests "a certain similarity" to *Isoetes* as regards the manner of secondary growth in a Lepidodendroid stem, and refers to "considerable difficulties" presented by the phloem of the Lepidodendreæ, without dealing with these questions at length. We are, I believe, still in want of satisfactory evidence of the existence of typical phloem, which was added to by cambial activity, at least in the case of the vegetative shoots of the Lepidodendreæ. The account of the leaves of *Lepidodendron* is particularly interesting; the stomatal grooves on the lower surface of the leaf suggest a xerophytic adaptation. Indications of xerophytism are afforded by other anatomical characters in certain Palæozoic types, and we are tempted to express the wish that a lecture had been devoted to the consideration of such evidence as is available bearing on the physiology and biology of Palæozoic plants. The nature of the large scars on the well-known Ulodendroid branches is admittedly still unaccounted for; it would have been a satisfaction to have a new and carefully made drawing of the often quoted specimen, described by Mr. D'Arcy Thompson in 1880, which is considered by many to prove that the scars are the result of the mutual pressure between the bases of cones and the stems which bore them.

One of the most striking cones included in the account of various Lepidostrobi is an excellent heterosporous type, which was in all probability borne on the well-known stems known as *Lepidodendron Veltheimianum*.

In referring to the enormous output of spores necessitated by the arboreal habit of the Lepidodendreæ, an allusion is made to an exceedingly important discovery, which has not yet been published in full, of a Lepidodendroid strobilus possessing seeds. This new *Cardiocarpon*-bearing cone, which Dr. Scott has recently investigated, is of great interest, as showing that "some of the Palæozoic Lycopodiales actually crossed the frontier line which separates Sporophyta from Spermaphyta." This discovery naturally suggests an additional argument in favour of a possible connection between the Lycopodiales and Coniferæ; but, on the other hand, as we are reminded in the concluding lecture, there are difficulties in the way of connecting the Coniferæ with the Lycopods, and arguments are not wanting in favour of the view that the Gymnosperms as a whole may have had a common origin from the Filicales.

The differences between *Sigillaria* and *Lepidodendron* and the exact morphological nature of *Stigmaria* are, as the author notices, points on which further light is needed. Recent research has added enormously to our exact knowledge of numerous extinct types which were until lately unknown; it has also taught us that we have still much to learn with regard to some of the commonest fossils from the Coal-measures.

A photograph is given (p. 207) of a transverse section of a Sigillarian stem, which was briefly described some years ago by Mr. Carruthers, but it is to be regretted that no account of the anatomy of this stem has ever been published. It is unfortunately very rare to find an undoubted *Sigillaria* in which the tissues are preserved, and we would express the hope that the example referred to in Lecture vii. may not remain much longer undescribed.

In the lectures on ferns, the most important new facts are those relating to the Botryopterideæ, which are now shown to afford among the Filices a striking instance of the combination of affinities in one extinct family. The account of this family is particularly interesting.

Dr. Scott's critical and thorough investigations have

played a prominent part in supplying us with trustworthy guides, which afford the means of tracing to their common origin many divergent lines of plant-evolution. Among other genera which have thrown new light on the course of evolution, the two Cycadofilicinean types *Heterangium* and *Lyginodendron*, dealt with in Lectures x. and xi., may be specially mentioned.

It is impossible in a short review to deal adequately with all the subjects of the lectures. A few remarks might be made by way of criticism bearing on nomenclature and terminology, but this is a matter of secondary importance. The work, as a whole, has been admirably done; its value is considerably enhanced by the fact that many of the conclusions are founded on the author's personal investigations which are characterised by ability, thoroughness and sound judgment. It may be safely said that there is no source from which the botanist can gain so clear a view of the far-reaching importance of researches into the morphology of Palæozoic plants than from the volume before us. A. C. S.

PHYSICAL CHEMISTRY IN AMERICA.

The Journal of Physical Chemistry. Edited by Wilder D. Bancroft and Joseph E. Trevor. (Cornell University, Ithaca, New York.)

THE recent development of physical chemistry may be said to date from the year 1887. The fundamental ideas on which the modern superstructure rests had been conceived and even published before that time; but though the phase rule of Gibbs, the osmotic pressure theory of van't Hoff and the electrolytic dissociation theory of Arrhenius had all appeared in print, they were buried in the little-known transactions of minor academies, and so escaped general notice. It is undoubtedly to Ostwald that the popularisation of physical chemistry is due. Himself an unflagging worker in the field, he gathered together and systematised the work done by his predecessors in the *Lehrbuch der allgemeinen Chemie*, which was completed in 1886. In 1887 the new era began with the establishment of his *Zeitschrift für physikalische Chemie*. To the first volume of this journal, van't Hoff and Arrhenius contributed succinct accounts of those theories which have since so largely inspired and dominated physicochemical work. The extent of this work may be gathered from the fact that of the *Zeitschrift* thirty-four volumes have now been published, each volume containing on the average nearly 750 pages.

Amongst the students frequenting Ostwald's laboratory in Leipzig there has always been a large number of Americans, eager and energetic after their kind. Most were enthusiastic for the new theories, and in the best the enthusiasm was tempered by intelligent and judicious criticism, differing widely from the suspicious conservatism so often displayed in this country when these theories have been under discussion. To this happy scientific temperament we owe the fact that to-day physical chemistry is being much more thoroughly cultivated on the other side of the Atlantic than in Britain. In many, perhaps most, of the Universities it is taught as part of the student's ordinary chemical equipment, and the student who wishes to specialise in the subject can find in Boston or at Cornell ample opportunity and encouragement for study and research.

Cornell University has published since 1897 the *Journal of Physical Chemistry* under the editorship of two of its professors. On the cover of the *Journal* for March 1899 we find that the department of chemistry offers the following courses, each of which runs through the entire year.

(1) *The Phase Rule.*—A comprehensive qualitative treatment of all types of chemical equilibrium, as these are classified by the Phase Rule of Gibbs.

(2) *The Law of Mass Action.*—Non-mathematical exposition.

(3) *Mathematical Chemistry*, I.—The mathematical theories of chemical equilibrium, of the velocities of reactions, and of electrochemistry.

(4) *Mathematical Chemistry*, II.—A systematic study of Duhem's "Traité élémentaire de Mécanique chimique."

(5) *The History of Thermodynamics.*—Especial consideration is given to the physicochemical applications of thermodynamic theory.

(6) *Introduction to Mathematical Chemistry.*—An elementary exposition of the essential features of: (*a*) the theory of surfaces, as applied in geometric representations of the thermodynamic properties of bodies; (*b*) spherical harmonics, as applied in the theory of diffusion; (*c*) the principles of least and varying action, as applied to the problems of chemical and electrochemical equilibrium.

(7) *Electrochemistry.*—Historical treatment.

(8) *The Velocities of Reactions.*—Historical account and mathematical theory.

(9) *Laboratory Work.*—Laboratory methods and experimental research.

Two or three lectures weekly are given in each course, the aggregate weekly number of lectures being twenty. Certainly no German university offers a more complete or systematic course of instruction in physical chemistry than this.

As might be expected from the countrymen of Gibbs, the lecturers give a prominent place to the application of thermodynamics to the problems of chemical equilibrium. The same predilection appears in the *Journal*, to which Duhem, the chief contemporary exponent of the subject, is a frequent contributor. Electromotive force also receives a large share of attention. The reviews of books and critical abstracts of papers on physical chemistry appearing in other publications are in general well done, being brief, clear and to the point.

The personality of one of the editors is deeply impressed on the *Journal*. His views of the physical chemistry of to-day may perhaps best be seen from the following extract, taken from a notice of the new edition of Ostwald's *Grundriss der allgemeinen Chemie*:—

"Physical chemistry is not yet a quantitative science: it is a pseudo-quantitative science. There are all the outward signs of a quantitative science. We have formulas and tables; we make use of thermodynamics and the differential calculus; but this is for the most part a vain show. Long before we reach the point where the formula is to be tested experimentally, we slip in a 'simplifying assumption'; that the concentration of one component may be considered as constant; that the heat of dilution is zero; that the solute may be treated in all

cases as though it were an indifferent gas; that the concentration of the dissociated portion of a salt may be substituted for the total concentration; &c., &c. The result is that our calculations apply at best only to limiting or ideal cases, where an error in deducing the formula may be masked by the error of observation. Helmholtz did not do this, but Helmholtz is considered old-fashioned."

What Mr. Bancroft would have us do is to study concentrated solutions. The object is most laudable; but until a Helmholtz appears who is capable of attacking the problem in all its complexity, physical chemists will probably continue their work on dilute solutions, for which the conditions are comparatively simple, and the behaviour of which is represented closely by the results deduced from a consideration of the limiting or ideal cases above referred to.

There is one point about many of the reviews (and some of the original contributions) which calls for remark—they seem needlessly scathing. Should any one be so unfortunate as to differ in opinion from the reviewer, he is forthwith tomahawked, and his scalp brandished in triumph before the horrified reader. It is painful to see one's friends—nay, even one's enemies—ruthlessly butchered in this fashion, and we would earnestly counsel a less close adherence to the former methods of the Wild West. J. W.

THE EXPLORATION OF THE UPPER AIR.

Sounding the Ocean of Air. Being six lectures delivered before the Lowell Institute of Boston in December, 1898. By A. Lawrence Rotch, S.B., A.M. "Romance of Science" Series. Pp. viii + 184. (London: Society for Promoting Christian Knowledge, 1900.)

A CORDIAL welcome for this little book may be anticipated from the fact that it is the latest addition to the series which has given us Boys's "Soap Bubbles," Perry's "Spinning Tops," Worthington's "Splash of a Drop" and Sir R. Ball's "Time and Tide." Its author has won for himself a prominent place among those who are best acquainted with modern ways of sounding the ocean of air, by the work done at his observatory at Blue Hill, Massachusetts, and by his personal association with the observers of clouds and the users of balloons and kites in Europe.

Perhaps the very width and depth of his acquaintance with the details of the subject have made the task of the popular exposition of it in six short chapters a difficult one. The procession of facts, each one of great interest in itself, is apt to become panoramic and even kaleidoscopic; and when one page, or sometimes one paragraph, has to accommodate a succession of scientific ideas, the inexpert reader may find himself a little bewildered with the rapidity of the transitions, and occasionally even with some short cuts to scientific conclusions.

After a short historical introduction the book deals successively with the exploration of the upper air by means of clouds, balloons and kites. Each section gives a brief account of the earlier experiments, before treating of the recent results. The romance begins in the first chapter with a striking diagram of the heights of certain observatories, mountain peaks, kites and balloons, showing one balloon—an unmanned one, be it said—at the almost incredible height of 13 miles or more (upwards of 70,000 feet), where the corresponding barometric pressure is about one and a half inch of mercury; it culminates in the chapter describing these extremely lofty ascents. The chapters on the various types of balloon, captive balloons, free balloons and *ballons sondes* (unmanned balloons) are, both from the historic and the scientific point of view, the most interesting to the general reader. The study of clouds is clearly too large a subject for a single chapter; and the final chapters, which are devoted to the description of kites and the results obtained at Blue Hill, enter into details which the meteorologist will find of great value and interest, but which require close attention from the reader. The diagrams with which the book is illustrated have suffered a little from the reduction in scale for the purpose of reproduction; but the reader who will take the trouble to follow them carefully with the text will be rewarded by obtaining an excellent survey of the work done with kites up to a height of 12,000 feet, and some idea as to what they may be expected to accomplish in the future.

One side of the romance of kite work is only touched with a light hand. The Berlin experimenters could supply at least one thrilling story of a kite that absconded for the night with its wire, and made a long and very eventful journey; but Blue Hill has perhaps been more fortunate; doubtless its situation lends itself less easily to romantic exploits of that description.

It is interesting to notice the geographical distribution of the work of exploring the upper air as it appears in Mr. Rotch's account. Speaking quite generally, the United States are conspicuous for the work with kites, Germany for various forms of manned balloons, and France for *ballons sondes*, although the most adventurous of these last, the "Cirrus," belonged also to Berlin; while cloud work is more evenly distributed, the services of Hildebrandsson in that department render Sweden conspicuous. Great Britain is credited with an active share in the initiation or early development of the scientific exploration of the air by clouds, balloons and kites in turn, but in later years seems to have withdrawn from such enterprises.

Mr. Rotch's interesting lectures may well leave the impression that the further sounding of the upper air of the British Isles might be exciting on account of the special situation and circumstances of the islands, but, for the same reason, would be of great scientific importance.

OUR BOOK SHELF.

The Locust Plague and its Suppression. By Æneas Munro, M.D., Edinb. and Cordova, Fellow of the Faculty of Physicians and Surgeons of Glasgow. With illustrations. Pp. xvi + 365. (London: Murray, 1900.)

THE volume before us has been prepared by the author after nearly ten years' observation of locust ravages in the Argentine Republic and in South Africa. He is profoundly convinced of the enormous damage caused by locusts in various parts of the world, and has brought together a considerable amount of information respecting the various means which have been adopted for destroying them. Dr. Munro writes from a practical point of view,

and treats the locusts of different countries as, to all intents and purposes, the same insect. His book will no doubt be very useful to agriculturists in countries infested by locusts; but he scarcely allows for the variations in habit which exists between different species. For instance, he observes that the South American locusts are said to breed on the shores of certain lakes in Bolivia, and asserts that if they could be destroyed in this locality they would be exterminated from the whole of South America (!). It is hardly possible to take such a remark seriously; but we may perhaps observe that even if the story were true, it could only be true of one or two species at most. It is also suggested that ophthalmia in Egypt (well known to be spread by flies) may be caused by locusts.

Dr. Munro also claims that his book is the first on the subject; but we are more inclined to think that a locust bibliography would fill a book as large as his own. Besides, some of his illustrations appear to be taken from American works.

An interesting account is given of the appearance of what is called the "new" locust in South Africa, and he quotes from Mr. Péringuey: "The present species was very closely allied to *Acridium peregrinum*, and in the same way that that species had swarmed into Algeria after the myriads of a smaller locust, *Stauronotus* (not *Jauronotus*, as printed) *marocanus*, had been destroyed at great expense, this present species was following in the rear of a smaller locust, *Pachytylus migratorius*" (§ 166). One curious point is that the "new locust" is said to be unwholesome, if not actually poisonous, by the natives. However, in § 32, under the heading, "Scientific Definition," we read, "the locust we have here (in Africa) is, to all intents and purposes, the same insect called technically the *Acridium peregrinum*, *Locusta migratoria*, or the wandering locust" (Fig. 4*a*, p. 37). Here it will be seen that two species, by no means closely related, are spoken of as if they were the same; and on turning to p. 37 we find two figures of locusts, specified as "The African Locust" and "The South American Locust," as if there was only one species in each continent.

The book is very diffusely written, and treats of a great variety of subjects, some of them rather irrelevant to the locust question. It is, however, divided into 900 numbered paragraphs, and provided with an excellent index, which will make it a useful book of reference, though it would be rather a formidable undertaking to read it through from cover to cover.

Leçons d'Anthropologie Philosophique, ses Applications à la Morale Positive. Par D. Folkmar. Pp. xiv+336. (Paris: Schleicher Frères, 1900.)

SCIENCE exists for the sake of something beyond itself. Doing, not knowing, is what determines the place and significance of any body of doctrine in the hierarchy of arts and sciences. The synthesis of the human sciences in the light of their worth for action is not effected by sociology. This fails to include certain individual sciences. In this way Prof. Folkmar makes the transition from the sociological studies, which engrossed him at Chicago, to the philosophical, as opposed to physical, anthropology, which he expounds from his chair at Brussels.

The changed point of view involves an endeavour after a new classification of the sciences of man, a critical determination of the limits of those sciences as hitherto pursued, and a sketch of the unifying conceptions that involves disquisitions psychological, anthropological in the narrower sense, and ethical. To the practical applications of his teaching Prof. Folkmar proposes to devote his life.

Dr. Folkmar may be described as Spencerian, though critically so. He rests much on Letourneau, and has studied in the following of Giddings, Lester Ward and other of the "new sociologists." He owes something to Guyau. He exhibits on the whole a sober judgment, and is frequently suggestive in his treatment even of well-worn topics. It is therefore the more to be regretted that he has almost buried good work among platitudes, second-hand matter and pretentious technical phraseology, doubtfully permissible in his *conférences* and inadmissible in the *litera scripta* meant to endure.

Terms such as *anthropographie* (of which different misprints occur, pp. 71, 72), *archéographie* (which means ancient geography), and *praxéologie* detract from the merit of Dr. Folkmar's graphic representation, upon the faces of a cube, of the sciences of man. His much use of the word "innervation," defined as meaning simply "a form of vibration of the nervous tissues," is a weakness of the same kind. Nothing, surely, is gained by declaring the question of the unitary origin of the race to be "on ultimate analysis the question of monogenism *versus* polygenism" (p. 127).

More serious in a work of scientific pretensions is what we take to be a missing of the main point with regard to polyandry in the remark (p. 188) that where it obtains many women must needs remain unmarried. That completeness of life can be determined with mathematical exactness (p. 319) needs proof. In an otherwise ingenious suggestion for a grading of scientific asseveration "impossible" (p. 67, line 24) *is* impossible, and "improbable," which is not improbably the right reading, will not balance the "probable" which has preceded.

In fine, though Dr. Folkmar's ability to supply a text-book of anthropology as he conceives it will not admit of question, and an essay from his pen developing, say, the conception which he would substitute for Mr. Spencer's ethical ideal might prove instructive, his present book suggests the high-class amateur who enters for the first time in a tournament of masters.

H. W. B.

The Principles, Construction and Application of Pumping Machinery. By Henry Davey. Pp. xvi + 295; 250 illustrations. (London: Charles Griffin and Co., Ltd., 1900.)

THE purpose of this book, as stated by the author, is to present information on pumps and pumping machinery in such a form as to make it useful to the practical engineer engaged in the application of pumping machinery in mines and for waterworks, or in other positions where large quantities of water have to be dealt with. This purpose has been fairly accomplished. The information given is of a thoroughly practical character and made plain by numerous illustrations, and the book cannot fail to be of great use either to the student seeking information or to the practical engineer engaged in works requiring pumping machinery.

The first chapter contains an interesting summary of the gradual development of pumping machinery. Cornwall may be said to be the land of the birth of large pumping installations. It was here that both Savery and Newcomen brought into use the power of steam for raising water from the mines, and their engines remained in use until Watt introduced the system of a separate condenser. It is not much more than a century and a quarter ago that Boulton and Watt commenced the manufacture of their engines for the coal-mines in Staffordshire and Warwickshire, but it was Cornwall that afforded the great field for the development of Watt's inventions. The progress of this development is interesting. The coal-mines were becoming deeper and very costly to drain. The proprietors were unwilling to incur the expense of removing the old atmospheric engines put down by Newcomen; and to meet this difficulty Boulton and Watt erected many engines at their own expense, taking as payment one-third of the

saving effected in raising the coal. At one mine where three of Watt's engines were erected the proprietors engaged to pay 800*l.* a year for each engine as a compromise for the third part of the saving in coal.

It was with the Cornish engine that the principles governing steam engine economy were first grappled with; and with the engines used for all purposes on land, pumping engines, even at the present day, are worked with the greatest economy of fuel, examples being given where the engines are worked with an expenditure of less than 2 lbs. per I.H.P. It is interesting to note the change of pressure at which steam is worked now, reaching to 150 lbs. on the square inch, as compared with the 5 lbs. used in many of the old Boulton and Watt engines. These engines were not confined to pumping water from mines, but were applied to reclamation purposes, many of the Boulton and Watt engines, made a century ago, being still in use in the fens of Lincolnshire and Cambridgeshire. These machines were noted for their massive construction and the excellency of the workmanship, as attested by the number of years during which they have done good service.

The other fourteen chapters into which the book is divided deal with descriptions of the various types of pumping engines in use; pumps and pump valves; pit work; shaft-sinking; hydraulic transmission of power in mines; valve gears; waterworks engines; trials of pumping engines; centrifugal and low lift pumps, with descriptions of some of the scoop wheels in use in Holland; hydraulic rams and pumping mains.

Elements of Hydrostatics. By S. L. Loney, M.A. Pp. viii + 248 + xii. (Cambridge: University Press, 1900.)

"ELEMENTS OF HYDROSTATICS" is a subject the limits of which are sufficiently well known to require little definition. In the present instance it includes a fairly complete treatment of centres of pressure of rectilinear areas and circles by what used to be called, at Cambridge, "three-day methods"—also sections on rotating liquids and on tensions of vessels and curves of buoyancy. The book will do admirably for the ordinary run of students preparing for examinations in this subject, and the copious problems and examples should commend it to science students; but there are one or two points in which improvement is desirable. "Whole pressure" has been too long a fetish of the third-rate schoolmaster, who "thinks he is wise when he is not." But instead of banishing this misleading idea to a few lines of small print (or, better, omitting it altogether), and replacing the term "whole pressure" elsewhere by "*resultant thrust* on a *plane* area," Prof. Loney makes confusion worse confounded by speaking, so far as we can make out, indiscriminately of "whole pressure," "whole pressure or thrust" and "whole thrust." Again, there is no reason why we should be left in the dark as to the precise distinction between a perfect fluid and an ordinary fluid, or the reason why the principles of hydrostatics apply with sufficient approximation to the latter; these points are hinted at, but might with advantage be stated more explicitly. The usual figure of the air-condenser, with its valves hanging in an impossible position, is once more reproduced.

There are, to our knowledge, many highly successful teachers who, in their ignorance, persist in their preference for misleading methods of dealing with such notions as "whole pressure," the "parallelogram of velocities," the "binomial theorem" and the like. There are few writers better qualified to prove that scientific accuracy is not incompatible with a successful text-book than Prof. Loney, whose name alone is sufficient to ensure a large circulation for his works. Why, too, does not the Cambridge University Press rise superior to pandering to the fancy of those mathematical masters who know no better?

Minéralogie Agricole. By F. Houdaille. Pp. 299, avec 107 figures dans le texte. (Paris: Félix Alcan, 1900.)

THE object of this little work is to provide agriculturists and others with a knowledge of the properties, physical and chemical, of the minerals important to man, either as constituents of rocks and soils, as fertilisers or as sources of materials used in the arts. The author assumes ignorance of physics, chemistry and crystallography on the part of the reader, and as the descriptive portion of the book would be unintelligible without some knowledge of these subjects, he attempts to give the necessary smattering in an introduction of eighty-nine pages. The laws of crystallography and modern views of crystal structure are dealt with in forty pages, illustrated by a number of indifferent figures, some of which, notably the rhombohedron of Fig. 8, entirely fail to produce on the eye the effect which the author presumably intended. In the chemical section the old equivalent notation is preferred to that usually accepted at the present day; thus, sodium carbonate receives the formula NaO,CO_2+10HO! A considerable portion of the space devoted to analysis is occupied by a picture of an elegant gentleman puffing languidly with a blow-pipe at a long candle fixed in an equally tall candlestick. The rest of the book contains a selection of facts about minerals which can be found in any treatise on descriptive mineralogy, together with some useful information as to methods of determining the permeability of soils and the percentage of calcium carbonate contained in them. We fear, however, that the work will hardly be found readable by any one who has not already had an extensive training in chemistry and mineralogy. It is therefore unlikely to be of much value to the class for whom it appears to be intended, nor can it be recommended to the serious student.

Engine-Room Practice. A Handbook for the Royal Navy and Mercantile Marine. By John G. Liversedge, R.N. Pp. xi. + 292. (London: Griffin and Co., Ltd., 1899.)

MR. LIVERSEDGE'S handbook will be found by all engineers to be a very useful supplement to the more technical treatises of Mr. Seaton and of Messrs. Sennet and Oram. It lays down the whole duty of a marine engineer, and more particularly of a naval engineer, from the day when he receives notice of his appointment; and it is throughout well-written, full, and admirably to the point. The running of the main engines and the care of the boilers are, of course, the chief concerns of the book; but the auxiliary machinery is also well looked after, and there are separate chapters on the electric light, the hydraulic, the refrigerating and the air-compressing plants. The chapter on adjustments and repairs seems to us of especial value, for while a successful repair at sea is often the outcome of what seems an inspiration, its success may at any time be assured by a knowledge of what has been done in similar cases.

We could wish, especially in the present season of divergent opinion on the matter, that the water-tube boiler had received somewhat greater attention. A few pages at the end of the book are specially contributed by Fleet Engineer Edwards, of H.M.S. *Powerful*, and perhaps it were unwise to do more until fuller experience has been gained; but we may expect to see the matter thoroughly taken up in later editions, for no unprejudiced observer can doubt that the water-tube boiler, in one form or another, has come to stay.

While Mr. Liversedge's book is primarily a professional handbook, it will be found, at the same time, to interest all who have any acquaintance with the engineering side of naval life, even though they may have but a superficial knowledge of the ordinary equipment of a ship's engine-room.

LETTERS TO THE EDITOR.

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

The Markings of Antilocapra.

IN NATURE of Oct. 11 (p. 586) Mr. R. J. Pocock says: "If the American prong-buck were an inhabitant of Africa, I presume that its conspicuous patterns . . . would be cited as evidence supporting the theory of recognition marks. But in the prairies of the United States there are no species that resemble it in size and form, so as to create confusion as to identity."

The prong-buck is so cited by Wallace ("Darwinism," p. 218), and a figure is given (p. 219) of a similarly-marked gazelle in support of the same theory. But the point of the whole matter rests on the aid given to the members of a herd in following one another, and has nothing whatever to do with the presence of allied species. I cannot understand how Mr. Pocock, who appears to have read Wallace's work, can have overlooked the point of the argument so completely. I have had the pleasure of seeing herds of prong-bucks (*Antilocapra*) in their native wilds (Pecos Valley, and near the Sacramento Mountains, New Mexico), and can readily understand how useful the markings must be in helping the animals to keep together in the dusk or dark, whereas it is not at all probable that they expect to escape observation on the open prairie by daylight. If these animals lived singly, there might be some plausibility in "Thayer's principle," as applied to them, but in herds they can be seen from afar off, and the same must be true of the African gazelles. Their safety is in flight, not inconspicuousness, and the necessity for keeping together when in flight is obvious.

The coyote or prairie-wolf (*Canis latrans* and allies), which also lives on the prairies and is gregarious, has the habit of barking incessantly at night, and this doubtless serves the same purpose as the markings of the prong-buck.

It might conduce to clearness if we divided what are now called recognition-marks into two categories, thus:—

(1) *Recognition-marks*, which assist members of a species in distinguishing their fellows from other species.

(2) *Guide-marks*, which assist members of a species in following one another. The markings of the prong-buck would then come under the head of guide-marks. T. D. A. COCKERELL.

East Las Vegas, New Mexico, U.S.A. October 30.

Curves without Double Points.

MR. BASSET'S objection to the term "non-singular" (see NATURE, Oct. 11, p. 572), arises from a misunderstanding. The ordinary use of the term by English-speaking mathematicians is natural and legitimate; it is applied to curves without double points when the curve in question is defined by a relation among the coordinates of its points. In the case of a curve defined in another manner, for instance by a tangential equation, "non-singular" could not possibly be used in the sense. In fact, the phrase which Mr. Basset denounces as "exceedingly infelicitous and misleading" is one which, standing by itself as Mr. Basset quotes it, strikes a geometrician as unfamiliar; "non-singular cubic curve," "non-singular curve of the *n*th order," are familiar to him, and are unobjectionable.

In the study of algebraic curves the word *node* is in common use to denote any double point; if it is necessary to distinguish the three chief kinds of double points, the words crunode, acnode, cusp are recognised; and, although the two first are not wholly satisfactory, yet their meaning is unmistakable. Further, we have adjectives nodal, crunodal, cuspidal, binodal, etc. If Mr. Basset's mode of investigation is such that the introduction of new technical terms is really unavoidable, may I suggest that the phrase *nodeless curve* concisely describes a curve without double points? HERBERT RICHMOND.

King's College, Cambridge, November 10.

Euclid i. 32 Corr.

HAMBLIN SMITH writes, these "corollaries were first given in Simson's edition of 'Euclid'" (edition 1872, &c.). J. Walmsley, "Introduction to Geometry" (1880, &c.), styles them Simson's corollaries. Hall and Stevens say these "theorems were added as corollaries to Prop. 32 by Robert Simson" (1888, &c.), and finally, Loney, in his edition of Todhunter's "Euclid," writes, "the corollaries were added by Simson." Many years ago it was pointed out to me that these corollaries, with many interesting applications, were given by Clavius in his edition of the Elements (1607), see pp. 105–108. On p. 107, he cites "ex Campano, si pentagoni singula latera producantur in partem utramque, ita ut quælibet duo extra pentagonum coeant, efficientur quinque anguli ex lateribus coeuntibus æquales duobus solum rectis." Clavius probably is not the first publisher of these results. R. TUCKER.

November 5.

Late Appearance of a Humming-bird Moth.

IN a garden in Lower Addiscombe Road (well in the town of Croydon), I saw a humming-bird hawk-moth to-day sporting over a bed of scarlet geraniums. It was as fresh as if newly emerged. This is the first time I have seen the insect so late in the year. Would it not have been called a "late appearance" even a month ago? It testifies strongly to the unusually open autumn here. J. EDMUND CLARK.

Lile Garth, Ashburton Road, Croydon, November 3.

SOME RECENT ADVANCES IN ZOOLOGY.

TO take stock from time to time of the progress made in its different branches is advantageous in the case of every science, but in none more so than in zoology, where specialisation is now carried to such an extent that the workers in one section have in general but little acquaintance with what their brethren are doing in another. This same subdivision of work renders it, however, extremely difficult for any single writer to give any adequate account of what has been effected during the last year or two in all the different branches of the science, the difficulty being enhanced by the circumstance that the one for 1898 is the latest volume of the "Zoological Record" that has at present been published. All that can therefore be attempted in the present article is to give a fairly full *résumé* of the more notable advances in the branches of zoology with which the writer is best acquainted, and to make mention of such discoveries in other sections of the subject as may have come under his notice.

Among the Mammalia, by far the most important discovery made of late years is the identification by Mr. J. P. Hill, of Sydney, of the existence of a rudimentary placenta in the Bandicoots (Perameles). From this it has been inferred that all Marsupials originally developed a placenta, which has become abortive in the more specialised members of the group. This discovery entails, almost of necessity, a modification in the generally accepted classification of the Mammalia. And instead of dividing the class into the three equivalent groups, Eutheria, Metatheria and Prototheria, Prof. H. F. Osborn has suggested that we should now take only the two divisions of Eutheria and Prototheria; the former being subdivided into Placentals and Marsupials, and the latter (as heretofore) including the Monotremes alone. Placentals and Marsupials may indeed be now regarded as divergent branches of a single stem; the latter being less primitive than are the Insectivora. On the other hand, Monotremes are so different from Eutherians that some zoologists even go so far as to consider them derived independently from Reptiles or Amphibians. In this connection, as tending to emphasise the intimate relationship between Marsupials and the primitive Carnivora, reference may be made to a paper by the present writer (*P.Z.S.*, 1899), in which it is attempted to show that both have a similar dental formula. It may be added that our knowledge of the anatomy of the Monotremes has been largely increased by the publication of the results of the work on the specimens collected by Dr. Semon, now in course of publication in the *Jenaische Zeitschrift*. Moreover, much interest

attaches to the account recently given by Herr Sixta of the precise manner in which the female Duckbill supplies her newly-hatched young with milk.

A special feature of the last year or two is the application of American modes of collection and investigation to the smaller mammals of Europe and Asia, with the result that a number of more or less well-defined local races have been established in the case of many familiar European species. Admirable examples of this style of work are afforded by Mr. Barrett Hamilton's studies of the Voles, Dormice, Squirrels, Harvest Mice, and Variable Hares of Europe and Asia. Attention may likewise be directed to the same gentleman's investigations with regard to the colour-change which takes place periodically in many northern mammals.

Till recently the Edentates of South America have been regarded as a totally isolated group; but the material obtained in the Tertiaries of North America has enabled Dr. Wortman to state confidently that they

FIG. 1.—A flightless representative of the Scale-tailed Squirrels (*Zenkerella insignis*). (From Mr. De Winton's figure in the *Proceedings* of the Zoological Society for 1898.)

trace their origin from the Eocene group Ganodontia, as represented by Calamodon and Psittacotherium. The Rodents, too, have been brought into closer touch with more typical mammals by the discovery of their near relationship to the Eocene Tillodontia.

As regards systematic work, the discovery of a new Snub-nosed Monkey (*Rhinopithecus bieti*) in the upper valley of the Mekong is as interesting as it is unexpected; while of far more morphological importance is the description of a flightless representative of the African Scale-tailed Squirrels (Anomaluridæ), for which the name Zenkerella must be adopted. Of even greater interest is Prof. Ray Lankester's discovery (not yet published in detail) that the Bear-like Æluropus of Tibet has no close affinity with the Ursidæ, but is a near relative of the Raccoon-like Panda (Ælurus). Neither have the relationships of extinct forms been neglected, Dr. Major's discovery that the European Lemuroid Adapis agrees in the structure of the tympanic with the Malagasy Lemurs (and with them alone) being of great significance. The same writer's description of additional remains of the extinct Malagasy genera Megaladapis and Nesopithecus throws further light on the specialisation of the Lemuroids, and the apparent parallelism of the latter to Anthropoids. Here brief reference must also be made, even if all his conclusions be not accepted, to Prof. Hubrecht's investigations on the placentation of the Lemuroid genus Tarsius and its relationship to the higher Primates.

Reverting to extinct forms, it has to be mentioned that, apart from its other points of interest, the discovery of a portion of the skin of a Ground Sloth (Glossotherium) in Patagonia has revealed the unexpected fact that the ossicles with which the hide of these animals has long been known to be furnished are situated on its inner instead of its outer surface; the latter carrying a thick coat of long coarse hair.

The discovery some years ago that Wapiti occurred in Central Asia served to call attention to the similarity between the faunas of that region and North America, and the links between the two have now been drawn closer by the description of a species of the American Jumping Mice (Zapus) in Siberia. Another fact of importance from a distributional point of view is the discovery of representatives of the African Hyraces (Pliohyrax) in the Pliocene deposits of Samos and Greece, and apparently also in the Tertiaries of South America. And these discoveries promise to give rise to much discussion as to whether Africa or North America has been the main feeder of South America in the introduction of its fauna. With this is closely connected Prof. Osborn's suggestion that Africa has formed a great creative and dispersive centre of its own.

Mammals cannot be dismissed without a brief reference to the American "Report on the Fur-Seals of the Pribiloffs," which has added very largely to our knowledge of those animals and the diseases to which they are subject; while, it may be hoped, it will serve eventually to suppress altogether pelagic sealing.

Turning to Birds, perhaps the most important work (apart from the description of species and races, to which it is impossible to allude in detail) that has been done in England is by Mr. W. P. Pycraft, who has contributed a number of valuable papers on avian osteology to the *Proceedings* of the Zoological Society, as well as communications to other serials dealing with the general morphology of various groups of the class. Of the former papers, the most important is the one on the skeleton of the Penguins, in which it is shown that these birds are less aberrant than has been often supposed, and that their nearest relatives are the Petrels on the one hand, and the Grebes and Divers on the other. But of even greater value are the same author's observations on the morphology of the Owls (*Trans.* Linn. Soc., 1898), since they serve to indicate how many alterations will be necessary, even in avian genera, when pterylosis and internal characters are allowed their full weight in classification. The remarkable feature of "aquintocubitalism" in the bird's wing has likewise been elucidated by Mr. Pycraft in a paper published in the *Journal* of the Linnean Society for 1899; Mr. P. C. Mitchell having also written upon the same subject. The recent discovery of a new genus of Eagle (*Pithecophaga jefferyi*) by the late Mr. J. Whitehead in the Philippines is also decidedly worthy of mention. Of wider interest is the description by C. W. Andrews, in the *Transactions* of the Zoological Society, of the skeleton of the remarkable giant extinct bird from the Tertiaries of Patagonia, known as *Phororhachus*. This extraordinary bird is noticeable on account of the disproportionately large size of its skull, more especially the beak; and

when the peculiarities due to this specialisation are discounted, its affinities appear to be with the Seriema and Trumpeter of Brazil. It is, in fact, a gigantic representative of that group, occupying the same position in regard to its living allies as is held by the extinct Glyptodons and Ground-Sloths of the same continent to the modern Armadillos, Sloths, and Anteaters.

Among works dealing with avian faunas which have appeared recently, two have a special claim for mention on this occasion; the one being Dr. A. B. Meyer's "Birds of Celebes," and the other the late Mr. A. C. Stark's "Birds of South Africa." Both of these important works have received detailed notice in these columns.

From a distributional point of view, undoubtedly the most important discovery that has been made of late years among Reptiles is the determination of remains of the Australian Tertiary Chelonian genus Miolania in the Patagonian deposits, which was announced last year in this journal by Dr. H. P. Moreno. It serves not only to emphasise the evidence which has been adduced from other sources as to a former land connection between Australasia and South America, but also indicates that the strata in which its remains occur must be comparatively modern. Of very high morphological value are Mr. A. Dendy's observations (*Q.J. Micr. Soc.*, 1899) on the parietal eye of the New Zealand Tuatera (Sphenodon), in which evidence is brought forward to show that this organ was originally double, and that the single eye that now persists in a rudimentary condition is the left one of the primitive pair. In connection with this subject attention may be here directed to the remarkable discovery, made by Mr. H. M. Bernand, that in the Amphibia the cones of the retina of the eye, instead of being separate sensor organs, are merely stages in the development of the structures known as rods. But we have still another word to say with regard to the Tuatera, Prof. G. B. Howes having been recently engaged in working out the development of the skeleton in the embryo, and having had the good fortune to hatch specimens in this country. From his own researches, and those of Mr. Dendy, it is now known that there were three pairs of incisor teeth in the young state, and also that an amniotic tube was present, and that the olfactory passages became occluded during development.

Among Fishes several discoveries and observations of first-class importance have been made during the last few years, in addition to much systematic work. The discovery of a new species of freshwater fish belonging to the genus Galaxias at the Cape may not appear a circumstance of much importance, but it really forms one more link between the faunas of South Africa, Australasia and South America; the genus having previously been known only from the two regions last named. Allied to this genus is the family of African Beaked Fishes (Mormyridæ), hitherto known only by numerous species of the typical genus Mormyrus, and one of the very distinct Gymnarchus. The careful exploration of the fauna of the Congo by the officials of the Free State has, however, led to the discovery of the existence of a very large number of distinct generic types of this very curious family, all of which have been examined and described by Mr. G. A. Boulenger. The first living examples of the Bichir (Polypterus) have also been recently brought to this country, and much information has been at the same time acquired with regard to its mode of life and development. Of still more importance are Mr. J. G. Kerr's observations on the external features in the development of the South American Mud-fish (*Lepidosiren paradoxa*), which were communicated to the Royal Society in the spring of 1899. The young larvæ of this fish, which are tadpole-shaped, have very large external gills, and also a cement-organ very similar to that of embryo frogs, and Mr. Kerr was much struck with the extremely amphibian characters of the larvæ at an early stage of their existence. Among new forms special interest attaches to the discovery of a Shark (*Mitsurikina owstoni*) in Japanese waters, which indicates not only an entirely new generic type, but also, according to its describer, Dr. Jordan (*Proc.* Californian Academy, 1898), likewise a distinct family, whose nearest relationships are with the Carchariidæ. Equally interesting is the discovery in Chili of a new generic type of Lamprey (*Macropthalmia chilensis*), which was announced in 1897. The importance which Dr. Gaskell, in his papers on the origin of Vertebrates, attaches to larval lampreys from a phylogenetic point of view renders the discovery of a new member of this group full of possibilities.

It is too early at present to speak of the discoveries which are likely to occur from the detailed examination of the fishes of the Nile which is now in progress, but reference must be made to those from Lake Tanganyika, described by Mr. Boulenger (*Trans.* Zool. Soc.) in 1898. Although these yielded several new generic and specific types, they were in no wise comparable to the molluscs in general interest.

These latter, as is now well known, exhibit a remarkable resemblance in the form of their shells to certain Jurassic Gastropods; a resemblance which has led Mr. J. E. S. Moore, the energetic explorer of its waters, to suggest that the lake was formerly in direct communication with the sea, and that its so-called "halolymnic" fauna is of marine origin. Some support to this theory may possibly be found in the recent discovery that a peculiar type of Jelly-fish is one of the inhabitants of the lake.

Three other discoveries among Invertebrates call for special mention; one of these being the demonstration by Dr. Pelseener that adult bi-valve molluscs may possess true cephalic eyes, and the second the dredging in Indian waters of a hermit-crab (*Chlaenopagurus andersoni*), whose caudal extremity is protected by a bag formed out of a compact colony of small sea-anemones—truly a most extraordinary example of commensalism. The third discovery is that of a new member (*Harrimania*) of the group of Chordate Worms, or *Enteropneusta*, on the Alaskan coast, to which reference has been recently made in these columns.

So far as the interests of the human race are concerned, all other recent zoological discoveries are eclipsed by the investigations which have led to the demonstration of the relations existing between mosquitoes of the genus Anopheles and malaria. A definite statement that malaria is propagated by these annoying insects was made by Dr. B. Grassi (*Rend. Ac. Lincei*, vii. p. 234) in 1898, with due acknowledgment of previous suggestions on the subject; and since that date the columns of this journal have borne testimony to the zeal and care with which the work has been carried on, and the decisive results which have been obtained. In connection with this subject, brief mention must be made of the discovery of the generative elements in the intracorpuscular amœba-like bodies known as Hæmamœbidæ, which occur in the blood of certain animals and give rise to malarial fever, as well as in the allied Coccidiidæ, which are parasitic in Cuttle-fish. As is shown in two papers published in the July number of the *Quart. Journ. Microscopical Science*, sexual conjunction, or "zygosis," occurs among these lowly organisms; spermatozoa being represented by "microgametes," and ova by "macrogametes."

Finally, some reference must be made to the important work on distribution which has been accomplished during the last few years. In this connection it will suffice to refer to Mr. R. F. Scharff's "History of the European Fauna"; to Mr. W. L. Sclater's papers on the "Geography of Mammals," first published in the *Geographical Journal*, and reproduced in volume form with much

additional matter; to Dr. P. Matschie's "Geographische Fragen aus der Saugethierkunde," published in 1896; to Mr. R. I. Pocock's "Geographical Distribution of the Arachnida," which appeared in *Natural Science* for 1899; to Dr. Max Weber's paper on the "Origin of the Fauna of Celebes" (*Ann. Nat. Hist.*, 1899); and, lastly, to Prof. H. F. Osborn's "Correlation between Tertiary Mammal Horizons of Europe and America" (*Ann. N. York Acad.*, 1900). In several of these papers special stress is laid on the evidences of connection between the faunas of the southern continents which have been steadily accumulating during the last few years; while, as already mentioned, Prof. Osborn's communication is notable on account of his theory as to the indigenous origin of the African fauna. In another part of the world a most important change in the limits of two geographical regions has been suggested (first by Mr. Sclater and then by Dr. Weber), by the transference of Celebes from the Australian to the Oriental region. If this change, together with a similar transference in the case of Bali and Lombok, which has been advocated (partly on the suggestion of Dr. Blanford) by the present writer, be generally adopted (and it seems inevitable), we have to bid farewell for ever to the almost classic "Wallace's Line," as being one of those hypotheses which, although useful in their day, were not destined to immortality. R. L.

INSTRUMENTS OF PRECISION AT THE PARIS EXHIBITION.

"AT the commencement of the nineteenth century, the French and English makers of scientific instruments were far in advance of the Germans. True, the eighteenth century knew of prominent mechanicians . . . yet the French and English makers took the lead so as almost to supply the world's entire demand in scientific instruments. This predominance had the further consequence of causing young Germans to emigrate to France or England in order to thoroughly master their subject. Many a German mechanic of to-day owes to French or English masters a substantial portion of his knowledge. The prominence of the French and English instrument makers was mainly due to the support which, in both countries, the State bestowed upon technical art." . . . "In Germany it is only within the last twenty or twenty-five years that the State has espoused the interests of the home industry in scientific instruments; but such have been the efforts and the results, that her position has, at a blow as it were, changed in favour of Germany."

These words are taken from the special catalogue of the joint exhibition of German mechanicians and opticians at the Paris Exhibition, which claims, and claims with truth, "that in this department Germany occupies now a foremost position." As to the excellence of this joint exhibition, it is difficult to speak too strongly; rumour says that some, at least, of the judges wished to award it a Grand Prix among the nations. Had the rules of the Exhibition allowed it, such an award would have met with the universal approval of all physicists who have visited Paris.

Another brief quotation from the preface will explain the position more clearly. "After witnessing," the writers say, "the steady development of our mechanical and optical trade, we cannot but look with gratification upon the practical demonstration, at the Paris Centenary Exhibition, of the flourishing state of the scientific instrument trade in Germany; and a characteristic feature of the latter is the unity of its aims, which is traceable to the history of its development and to its ultimate connection with pure science. It appeared, therefore, desirable to depart from the usual custom of grouping the exhibits under various firms, and to place them in sections embracing certain classes of instruments, so as to demonstrate on broad lines and, as a whole, within a well-arranged though condensed area, the present position of German mechanical and optical art."

Accordingly this was done under the auspices of the German Association of Mechanicians and Opticians, and, with the help of the authorities of the Reichsanstalt and of the Standardising Commission, a most remarkable exhibit has been arranged; a catalogue has been prepared, covering some 250 small quarto pages, well illustrated, with a full account of the various instruments and references to sources of further information. This is published in German, French and English—why the English edition is printed in German type is perhaps somewhat of a mystery—and issued freely to visitors who wish to use it.

The preface to this catalogue, from which the above extracts are taken, gives an interesting account of the growth of this industry, from which it appears that in the last ten years the annual value of the instruments exported, including the optical glass used for lenses, has risen from something over 200,000*l.* to over 700,000*l.*

The general exhibition is arranged in ten sections, with various subsections; the special exhibit of the Reichsanstalt forms an eleventh section to itself. In each of these sections or subsections the exhibits of each maker form a class to themselves.

Thus Section V., optical instruments, has seven subdivisions. The exhibit of Carl Zeiss, for example, appears in five of these, as well as in Section II., astronomical instruments. By means of the table of contents and list of exhibitors, it is easy for a visitor to find either the apparatus of a special class or the exhibit of a particular firm as he will.

Section I. contains metrological and standardising apparatus, and here the exhibit of the Normal Aichungs Commission is most striking. The Commission is presided over by a director, and includes, we are told, three Government councillors, twenty-four technical officials, and ten clerks; the annual expenditure is 8500*l.* Contrast this with the staff of our Standards Department, and its expenditure, according to Whitaker, of 2877*l.* Specially noteworthy, perhaps, among the exhibits of the Aichungs Commission are the model of their great comparator, and the vacuum balance made by Stückrath for comparing masses from 200 grammes to one kilogramme. But a detailed description of the catalogue would take too much space, and would indeed be of no great value to a reader; the book itself will prove to a physicist a well of useful information; the exhibit, however, must be seen in its entirety if we wish to realise what our German cousins have done.

Not that the sight is one which brings great pleasure to an Englishman, and if he moves on to examine the English exhibit his thoughts cannot fail to be very grave. There is nothing which can be compared with the German show; some well-known firms have won well-deserved prizes; there are some few interesting pieces of apparatus from South Kensington, and here and there in the electrical department one comes across a case of instruments. For the rest, the visitor will find, not collections of scientific apparatus, but small portions—attractive portions, it is true, in many cases—of the windows of well-known opticians' shops. As much apparatus as is possible is packed together in a small space, there is much repetition, there is no organisation, there is no attempt to instruct the learner or to attract the man who comes with inquiries with a view to purchase; English mechanics and opticians have no unity of aim, and their art, with some few exceptions, is but loosely linked to pure science.

A visitor who visits Paris to look for the most recent forms of scientific apparatus must have the conviction

forced on him that it is to Germany he must go for his goods.

And the conviction is strengthened by the organisation provided for giving information as to the goods exhibited. The German exhibit is under the skilled care of Dr. Robert Drosten, with some three or four scientific assistants. One or more of these gentlemen is always ready to give information about special instruments. When I visited the exhibition I asked for a catalogue, and inquired if I could examine more closely certain special instruments. By all means, was the reply, and Herr Drosten gave me several hours of his time opening cases, taking apparatus out, looking up special catalogues, and loading me with information. At the end of this time we were both tired, and he suggested that if I found, on looking over the catalogue and my notes, that I had omitted anything, I should come again. I returned next morning, and spent nearly as long a second time.

Or take, again, my own experience with the splendid exhibit of comparators and dividing engines of the Société Genevoise des Instruments de Précision.

There was a notice in the case that M. Schwartz, at the Bureau, would give information. On asking for M. Schwartz, and explaining that I wished to examine certain things with care, he came at once, opened the cases, and answered my many questions in the most courteous manner; some information which I wanted as to certain instruments not made by the Society he could not give me. It has since been sent me, at his request, from Switzerland.

So also with some American measuring and testing apparatus; the cases were opened, and I was allowed to handle the apparatus; one gentleman gave me a very full demonstration of the use of a new testing machine, which combines a multitude of ingenious devices.

Contrast this with the English exhibit; a courteous commissionaire was, when I saw it, in charge of the whole; there were some notices as to where to apply for price lists of some of the firms exhibiting; the nearest approach to a catalogue was a set of cards hung on the wall relating to the excellent exhibit of the Scientific Instrument Company. These I found of real value, but they could not be carried away for reference.

Again the same conclusion is forced home; the Germans have organised their exhibit and are far ahead; few, if any, of the English firms will profit through the exhibition by an increase in their trade; German trade must grow as a result of a show which has been visited by thousands of men of science. The 700,000*l.* of 1898 will rapidly increase.

And why should this be so? Is it our insular ignorance and our unreadiness? In everything, this great exhibition shows the advance of our continental rivals. It is probably true that, in the special circumstances of the exhibition, many prominent firms declined to exhibit. The results will prove conclusively that they made a mistake. Why should I exhibit? said one manufacturer; last time I sent the best of my goods and won a prize, and the French immediately put on heavy duties against them. It is an argument that may have some weight, but does not apply forcibly to scientific apparatus; besides, the French are not the only customers. No; the reason lies deeper. British pluck and doggedness, the individual skill of the British workman, which, on the average, is far above that of his foreign *confrère*, the traditions of British ascendancy in the past, can all do much, but we have not realised—shall we realise them in time?—the efforts our continental rivals are making to rob us of that ascendancy. It is true, as a recent writer in the *Westminster Gazette* puts it, speaking of trade with South Africa, that

"We must be prepared to face the truth that, unless the British manufacturer bestir himself for the supply of this great African community, a great deal of business which, in the natural course of events, should go to him will certainly have to be diverted to Germany and America."

The first step towards curing the disease is to recognise its presence; and how slow we are to do that.

The German catalogue and the exhibit are striking evidences of the services rendered to German trade by the Reichsanstalt.

"The greatest share of the impetus given to the manufacture of scientific instruments," says the catalogue, "is due to the Imperial Physical and Technical Institute. . . . This institution has already done great service, and a large proportion of recent progress is due to its stimulating and helpful influence."

An inspection of the exhibit fully bears this out. We in England have for some time past hoped that the National Physical Laboratory would do for English science all the Reichsanstalt has done for Germany.

It is now two years since the Treasury accepted generally the conclusions of the report of Lord Rayleigh's Committee on the establishment of such a laboratory, and one year since the first meeting of the General Board, and for months the whole scheme has been at a standstill because certain of our rulers attach more weight to the protests of some who object to the selected site than to the deliberate opinion of those whom they have invited to organise and control the laboratory.

It is admitted that the establishment of the laboratory is of national importance. Various difficulties are allowed to delay its erection; meanwhile the Germans go ahead.

Up to the middle of the century our methods were sufficient; that condition of things has ceased. The organised application of science and scientific methods to trade and commerce, indeed to all the affairs of life, is absolutely essential if we are to continue to prosper. Will England realise this truth before it is too late?

NOTES.

THE evening discourses at the meeting of the British Association at Glasgow next year will be given by Mr. Francis Darwin, F.R.S., and Prof. W. Ramsay, F.R.S. The lecture to working men will be delivered by Mr. H. J. Mackinder.

HUXLEY'S life and work is an inspiring subject for a lecturer, and Lord Avebury had no difficulty in interesting the audience which assembled at the Museum of Practical Geology on Tuesday to hear him discourse upon it. The address was the first of the annual lectures established by the Anthropological Institute in memory of Huxley; and as Lord Avebury was a close and intimate friend of the master, he very appropriately inaugurated the series. Readers of NATURE are familiar with a large part of Huxley's work, but a few points mentioned by Lord Avebury will bear repetition. Huxley's Friday evening lectures at the Royal Institution rivalled those of Tyndall in interest and brilliancy; yet he said himself that at first he had almost every fault a speaker could have. He was one of the foremost of those who brought people to realise that science is of vital importance in their lives, that it is more fascinating than a fairy tale and more thrilling than a novel, and that any one who neglects to follow the triumphant march of discovery, so inspiring in its moral influence and its revelations of the beauties and wonders of the world, is deliberately rejecting one of the greatest interests and comforts of life. Apart from his professional and administrative duties, Huxley's works fall into three principal divisions—science, education and metaphysics. Of his contributions to science the Royal Society's catalogue enumerates more than one hundred, and every one of them, in the words of Prof. Parker, "contained some brilliant generalisation, some new and fruitful way of looking at the facts." The value of his

services to education cannot be over-estimated. He maintained that no boy or girl should leave school without possessing a grasp of the general character of science, and without having been disciplined more or less in the methods of all sciences. As regards higher education, he was a strong advocate for science and modern languages, though without wishing to drop classics. There were two things which he said he really cared about—one was the advance of natural knowledge, and the other the bettering of the condition of the masses of the people. How well he furthered both scientific and national progress is known to all of us.

PROF. A. CALMETTE, director of the Pasteur Institute at Lille, who is giving the Harben lectures this year, at the Examination Hall of the Royal College of Physicians and Surgeons, has taken the plague as his subject. In his first lecture, delivered on November 7, he pointed out that plague now menaces all the maritime nations of the globe, and it has become necessary to take rigorous measures to stop its extension. The progress of hygiene and the knowledge acquired during the last five years on the etiology, treatment and prophylaxis of the affection enables it to be combated very efficaciously and its centres to be rapidly circumscribed. It is known that the plague bacillus is found in the buboes and sputa of the patient, that it is also frequently found in the blood, that it has the form of a short bacterium, slightly ovoid, that it is easy to stain by the ordinary laboratory methods, and that it can be cultivated on the usual media. Mice, rats and guinea-pigs show the greatest susceptibility to plague. It has long been remarked that in localities where the plague appears mice and rats die in great numbers, and from the most ancient times, and even to-day, the Chinese and nomadic peoples inhabiting the northern slopes of the Himalayas, so soon as they notice an abundance of dead rats, remove elsewhere to avoid the epidemic they know must be at hand. Of other animals the pig and ox are said to be subject to the plague, but observations show that they cannot take the disease, at least spontaneously. Nor can birds easily contract it; the vultures that devour the corpses of the plague-stricken in the Towers of Silence in the suburbs of Bombay suffer no ill after their funereal repast, though they may distribute plague microbes through their excreta. A monkey was found to contract the plague spontaneously when placed in a cage side by side with another monkey; in this and similar cases the infection was apparently carried by flies or by fleas and other parasites of the skin.

IN connection with the International Exposition at Paris, a number of balloons recently ascended from Vincennes with the object of testing which could remain in the air for the longest period. *La Nature* gives the following results:—Count Henri de la Vaulx descended, after a journey lasting 35h. 45m., at Korostichew, in Russia, the distance from the starting-point being 1925 kilometres, and the greatest altitude 5700 metres. M. Jacques Balsan descended after a voyage of 27h. 5m., having attained a maximum altitude of 6540 metres, and reached a distance of 1345 kilometres from the starting-point. M. Jacques Faure descended in Germany, 950 kilometres from the starting-point, after a journey of 19h. 24m. Upon these results, and those of previous contests, the grand prize in aeronautics has been awarded to Count Henri de la Vaulx.

M. DE FONVIELLE informs us that Dr. Janssen has asked the Aero-Club at Paris to organise a series of three balloon ascents on the nights of Tuesday, Wednesday and Thursday of this week, in order to see whether the Leonids make an appearance or not.

A PAN-AMERICAN EXPOSITION will be held at Buffalo, New York, from the beginning of May to the end of October next year. There will be a large building for electrical exhibits, and in it will be the service plant, for the transformation and distribution of the 5000 horse-power transmitted from Niagara Falls, for lighting and power purposes; a collective exhibit of historical interest, containing illustrative models and apparatus showing important advances in the art; and the commercial exhibit, showing articles possessing distinctive merit, whether consisting of workmanship, novelty or usefulness.

THE opening meeting of the new session of the Society of Arts, the 147th since the foundation of the society in 1754, will be held on Wednesday evening, November 21, when an address will be delivered by Sir John Evans, K.C.B., F.R.S., vice-president and chairman of the Council. For the meetings previous to Christmas the following arrangements have been made:—November 28, Major Ronald Ross, "Malaria and Mosquitoes;" December 5, Prof. H. S. Hele-Shaw, F.R.S., "Road Traction;" December 12, Prof. Frank Clowes, "The Treatment of London Sewage."

AT a recent meeting of the committee of the Liverpool School of Tropical Medicine it was unanimously resolved to invite Dr. R. Fielding Ould, Dr. Balfour Stewart and Dr. A. S. Grünbaum to become assistant lecturers. These gentlemen have already assisted the work of the school in many different ways. On the motion of Mr. Alfred L. Jones it was resolved that the best thanks of the school are due to Drs. Annett, Dutton, and Elliot for their very valuable services in West Africa whilst members of the second malarial expedition of the school. These gentlemen have just returned, bringing with them a quantity of valuable material for future work.

RENEWED interest in the mosquito theory of the propagation of yellow fever, propounded by Dr. C. I. Finlay, of Havana, is aroused by a paper read at the recent meeting of the American Public Health Association at Indianapolis, by Surgeon Walter Reed and Assistant-Surgeons J. Carroll, A. Agramonte and J. W. Lazear. From experiments and observations made in Cuba, in the course of which Dr. Lazear died from yellow fever apparently conveyed to him by an infected mosquito, the following conclusion is arrived at:—"The mosquito serves as the intermediate host for the parasite of yellow fever, and it is highly probable that the disease is only propagated through the bite of this insect."

THE *Times* states that the whaler *Eclipse*, which arrived at Dundee on November 7 from Davis Strait, landed Dr. Leopold Kann, who has for eighteen months been connected with a scientific expedition to the Arctic regions. The expedition, which consisted of Dr. Kann, Mr. Robert Stein, of Washington, U.S.A., and a Boston taxidermist named Mr. S. Warmbath, left Sydney, Nova Scotia, in July 1899, on board the Peary relief ship *Diana*. The Peary expedition was seen in the beginning of August 1899, in three divisions. At that time Lieutenant Peary had been badly frostbitten, having lost several toes, and being only ably to walk with difficulty. The party, which had a large number of sledges and Eskimo dogs, was determined to make a dash for the North Pole.

ARRANGEMENTS have been made for the issue, by the Cambridge University Press, of a journal devoted to the publication of the best original work on hygiene. The periodical will be entitled *The Journal of Hygiene*, and will be issued quarterly. It will be edited by Dr. G. H. F. Nuttall, in conjunction with Dr. John Haldane, F.R.S., and Dr. Arthur Newsholme. The scope of the new journal will be similar to that of the *Archiv für Hygiene* and *Zeitschrift für Hygiene*, and the aim will be to become the chief medium for original workers in hygiene among English-speaking people. The first number of the journal will appear on January 1, 1901.

IN several parts of Germany considerable attention is being paid to electrical appliances that can be used on the farm. Mr. Hughes, U.S. Consul at Coburg, reports that near Ochsenfurt, in Bavaria, a company, composed of land-owners and small farmers, has been organised for the establishment of an electrical system for use on their farms and in villages. The power is to be generated by steam and water, and the current to be distributed from a central station to the places at which it is wanted. Sub-stations are to be established at given points, with the necessary apparatus for connecting with the farm or other machinery, and also for lighting purposes in the houses, offices, roads, and village streets.

FROM the U.S. *Experiment Station Record* (vol. xii., No. 1), we learn that an interesting step, looking to the advancement of agriculture in the Russian Empire, has recently been taken, on the recommendation of the Ministry of Agriculture and Imperial Estates, in the inauguration of a system of commissioners of agriculture to preside over the agricultural affairs in their respective provinces or governments, and to seek to promote and improve the agricultural conditions in general. Provision has been made for such commissioners in twenty different governments of the Empire, and the funds for their maintenance became available with the beginning of the present year. These commissioners will have charge of all public measures relating to agriculture and rural affairs, and will exercise supervision over all local agricultural institutions maintained by the government. They will inquire into the agricultural needs of their respective governments, and will recommend government aid for such local or private enterprises as merit special encouragement. Connected with the commissioners' offices will be corps of agricultural specialists and instructors, who will be assigned to the work by the Ministry of Agriculture and Imperial Estates. They will go out among the landowners and peasants for the purpose of collecting data regarding the actual conditions of various branches of agriculture, to diffuse general information on agricultural topics, and endeavour to improve the methods and practices in vogue. The inauguration of this system would seem to be a distinct mark of progress. Taken in connection with the recent decrees regarding the establishment of additional agricultural experiment stations and systems of agricultural education, already referred to, it should materially improve and modernise the practice of agriculture in Russia.

A SIMPLE method of recording the speed of motor cars and other vehicles has been devised by M. L. Gaumont, and accounts of the device appear in *Cosmos* and *La Nature* of November 3. The instrument consists simply of a camera with a double shutter, by which two exposures are made of the same plate, separated by a known interval of time. On developing the photograph two images are obtained of the moving object, and, by measuring the distance between them, the dimensions of the car being supposed known and also measured on the plate, it is easy to calculate the speed of the car at the instant when the photograph was taken. The object is to assist the authorities in regulating the speed of these vehicles and checking furious driving.

THE Cancer Society has just issued its annnal report, from which we learn that one of the great aims of the Society has been to direct public attention to the insidious danger threatening in the increase of cancer. During the past year the Committee have sent out Dr. Arthur C. Duffey to the United States to report on the equipment of the newly-erected Cancer Laboratory at Buffalo, and on his return a detailed report was issued to all the medical schools and to the Press. A prize of fifteen guineas, offered by Miss Scott for the best original essay on the present state of cancer science, has been awarded to Dr. Alexander Fraser, of Manchester. An elementary pamphlet by Dr. Herbert Snow, laying down maxims for the avoidance and early recognition of cancer, has been issued, together with numerous other publications bearing on the subject.

DR. QUIRINO MAJORANA contributes to the *Atti dei Lincei* an account of experiments dealing with the behaviour of carbon at high temperatures and pressures. In M. Moissan's experiments on the transformation of diamonds, the partial crystallisation of the carbon was attributed to (1) the high temperature of the central mass, (2) the solubility of the carbon in the metallic mass, and (3) the pressure. Dr. Majorana, finding that in his previous experiments the crystals obtained were much smaller than those produced by Moissan, has conducted a fresh series of experiments in which he has maintained the carbon at a pressure exceeding, and a temperature equalling, that employed by Moissan, for a considerably longer period of time, without producing so marked an increase of density. From this he considers it probable that the solubility of the carbon in the surrounding medium is one of the principal factors in the crystallisation.

A SERIES of papers dealing with the properties of pozzolana, and its use in mortars and cements exposed to the action of sea-water, is contributed to the *Gazzetta chimica italiana* by M. O. Rebuffat. In one of these papers the author discusses the reactions of the several silicates of alumina entering into the composition of pozzolana, with especial reference to the production of artificial cements of this character. In connection with the action of sea-water, the principal results are that sea-water transforms the cement of mortars containing pozzolana into a hydrated silicate of alumina containing small quantities of lime and magnesia and quantities not negligible of alkalis. The silicate, by its composition, is altogether unaffected by the salts of sea-water. Seeing that in mortars immersed in sea-water the lime, after binding the mortar together, ultimately disappears completely, the use of mixtures of cement and pozzolana is not recommended. The author advocates the old plan of screening the pozzolana, and deprecates the use of finely ground pozzolana mixed with sand.

PROF. R. SISSINGH, of Amsterdam, has published a short treatise on the general properties of images formed by direct pencils traversing a system of spherical surfaces. This treatise contains a simplification of the proofs applicable to an optic system formed of lenses centred on the same axis. The theory now offered is essentially physical in character; at the same time, the ordinary geometrical properties of images are also established, and the optical properties of the eye are considered. Prof. Sissingh takes no account of aberration other than chromatic aberration. The monograph is reprinted from the *Verhandelingen* of the Royal Academy of Amsterdam, and published by Johannes Müller, of Amsterdam.

WE have received from Sir Charles Todd, Government Astronomer of South Australia, a report upon the Rainfall of the Colony during 1897, showing the monthly and yearly values at 415 stations, together with the number of days on which rain fell, the greatest fall in one day, and the mean of the rainfall for a number of previous years. The rains during the year were irregular and, on the whole, below the average over the whole colony; in October a dry spell set in, which lasted during the rest of the year, and practically ruined the agricultural prospects. As an instance of the lengthy drought to which places in the interior are subject, Charlotte Waters in 1896 had 2·84 inches only, and 1·16 inches in 1897. A valuable table is given, showing the yearly rainfall at Adelaide for 59 years from 1839 to 1897, and the years when the amount was above or below the general average (20·886 inches) for the whole period.

WE learn from the U.S. *Monthly Weather Review* that the Russian Meteorological Office has published a comprehensive meteorological atlas, to commemorate the fiftieth anniversary of the foundation of the Central Physical Observatory by the Emperor Nicholas I. on April 1, 1849. It contains eighty-nine charts and fifteen graphical tables, and exhibits the prominent features of the climate of the Russian Empire from Warsaw on the extreme west, to Bering Strait on the east, and from Teheran on the south, to the Arctic Ocean. This range of 40° of latitude and 160° of longitude represents one of the most extensive meteorological systems in the world. The mean values of all the principal elements are exhibited in monthly and annual charts, the rainfall being shown for seasons. One of the charts shows the number of days during which snow lies on the ground; the region of the maximum number of days (190) extends from Archangel east-south-eastward beyond the Ural. From this region the number of days diminishes until we reach sixty days on the northern shores of the Caspian Sea, and twenty days on the north-western shores of the Black Sea. The paths of cyclones and types of weather in Russia, in so far as the latter depend on barometric conditions, are shown by five charts. The whole work is pronounced by the U.S. Weather Bureau to be a magnificent production, and illustrative of the activity of this vast meteorological service.

THE *American Museum Journal*, of which we have received the third part, appears to be a publication well worth the attention of museum authorities in other countries. It is issued monthly, and is stated to be a popular record of the progress of the American Museum of Natural History; the present part, which is well illustrated, containing fifteen pages of text. The first article is an obituary notice of the late Mr. J. M. Constable, the Vice-President of the museum. This is followed by a record of recent donations to the library, and this again by a reference to an exhibit displaying the fauna of New York, which has been recently added to the museum and appears to have attracted much attention from the public. Other articles describe the development of the museum, the work and progress of the Department of Public Instruction, and the work which has been recently accomplished in the anthropology of the Pueblo and Cave-dwelling Indians of New Mexico and the adjacent territories.

THE feature of the *Entomologist* for November is the continuation by Dr. Max Standfuss of the account of his experiments in hybridisation among the Lepidoptera, and the effects of temperature on those insects; the paper being illustrated by a plate of abnormally coloured butterflies. As regards these abnormalities (several of which occur occasionally in nature) produced by temperature variation, the author considers that they are not atavistic. A large proportion of them are infertile, and the majority of those which bred produced normal offspring, only the most abnormal female transmitting more or less of its newly acquired characters to its progeny. Although the experiments, on account of disease, were incomplete, their result, so far, seems to demonstrate that the possibility of perpetuating the abnormalities depends on the degree to which these depart from the ordinary form.

THE *Transactions* of the New Zealand Institute for 1899 contains thirteen papers on zoology, seven on botany, and five on geology, the great majority relating to the colony itself. Of especial interest is the record, by Prof. Benham, of the occurrence of a species of Balanoglossus in New Zealand waters, while a note on the freshwater crayfishes of the colony, by Dr. C. Chilton, will attract the attention of students of the crustacea. The practical extermination of the great purple coot (*Notornis mantelli*) is attributed by Mr. R. Henry very largely to rats, which, by eating the wild grain and seeds, prevent the bird from obtaining its proper nutriment. It will be news to many ornithologists that, about twenty years ago, the ship *Gleaner* came into Greymouth with a strange bird on board which turned out to be either the New Zealand or the Australian giant coot, and had reached the vessel at a distance of 400 miles from the shore. These birds were supposed to be practically incapable of flight.

WE have received from the U. S. Department of Agriculture, No. 19 of the "North American Fauna," which describes the results of a biological reconnaissance of the Yukon river region. The memoir is divided into three sections, of which the first is devoted to a general account of the region, while the second and third respectively treat of the mammals and the birds. For the latter Dr. L. B. Bishop is responsible, the two former sections being the work of Mr. W. H. Osgood. Although the whole area belongs to what American writers term the boreal zone, it has been found possible to divide it into several formal districts, the *tundra* being assigned to the Arctic province, while the Yukon Valley itself comes mainly within the Hudsonian division, but also contains a distinct Canadian element. In addition to several which have been described a short time previously, the memoir notices three birds and nine mammals which are regarded as new. It seems, however, pushing refinements of distinction a little too far to regard the two forms of reindeer met with in Alaska, as well as the elk, as distinct species.

PART ii. of vol. lxviii. of the *Zeitschrift für wissenschaftliche Zoologie*, which has just reached us, contains two papers; one, by Herr Samter, an elaborate dissertation on the development of the crustacean *Leptodora hyalina*, the other, by Herr S. Metalnikoff, an account of the anatomy and histology of the worm *Sipunculus nudus*. Both communications are exquisitely illustrated.

TO the August number of the *Journal* of the Bombay Medical and Physical Society, Dr. N. F. Surveyor contributes an illustrated account of the parasitic invasions to which the eggs of the cockroach are subject. These include two Hymenoptera, several kinds of moulds, probably several beetles, possibly another cockroach-like insect, and the parent itself. The importance of the subject will be apparent when it is stated that several of the parasites of the cockroach may pass a portion of their existence within the body of man himself.

IT has been shown by Dr. C. L. Griesbach, the Director of the Geological Survey of India, that the Trias of the Himalaya contains several well-marked horizons of Cephalopods not only in the Muschelkalk, but above and below it. The rich series of specimens collected in recent years has been submitted to Dr. Edmund Mojsisovics of Vienna, and he has written an elaborate memoir on the Upper Triassic species ("Palæontologia Indica," Ser. xv. Himalayan Fossils, vol. iii., part I., 1899). This memoir has been translated into English for the Indian Survey by Dr. and Mrs. A. Foord. The main portion of the work is naturally devoted to a description of the species, which are ranged under genera, whose characteristics can be understood only by those palæontologists who devote particular attention to the subject. Among the genera familiar when General Strachey first discovered Triassic fossils in the Himalaya, *Ceratites*, *Nautilus* and *Orthoceras* alone appear, but a host of others, needful to express the results of modern discrimination, find place in the volume. Of most interest to geologists are the general results arrived at by Dr. Mojsisovics. He refers to the local character of the Indian Upper Triassic fauna, but observes that there can be no doubt of the former existence of an open connection of the sea between the Indian and Mediterranean provinces. The Indian Trias province forms an integral part of

the "Thetys," or great Trias sea, named by Ed. Suess, which extended from the Mediterranean eastwards through Central Asia, and included the Germanic shallow sea. Some remarks are also made on the Arctic-Pacific Trias Province.

THE geology of Bad Nauheim and its thermal salt-springs form the subject of an interesting article by Mr. A. Vaughan Jennings (*Geological Magazine*). He notes the fact that, sixteen centuries ago, Bad Nauheim was a Roman sanatorium, its fame arising from the small natural springs of thermal water. During the present century several borings have been made to largely increase the supply of water; the last one, made in 1855, was carried to a depth of 180 metres. The water appears to be pent up in a basin of Devonian rocks covered by Tertiary strata. The author discusses the source of the water, its temperature and saline ingredients.

THE Essex Field Club has issued, as No. 4 of its museum hand-books (price 2*d.*), a sketch of the crag formation of East Anglia, by Mr. W. H. Dalton.

WE have received Nos. 21 and 22 of *Spelunca*, or *Bulletin de la Société de Spéléologie*, which contains a variety of information about caves and water-channels, with notices of recent publications.

THE growth and retreat of Norwegian glaciers is dealt with by Mr. J. Rekstad (*Norges Geol. Undersogelse*, No. 4). He draws attention to the evidence of great fluctuations in the amount of ice extending over periods of at least two hundred years, and remarks that these periods of general increase or decrease are accompanied by minor oscillations in the glaciers.

MR. R. BULLEN NEWTON has described some marine mollusca from the Upper Trias in the Malay Peninsula. These include the well-known and widely distributed *Chlamys* (*Pecten*) *valoniensis*, as well as species of *Pleurophorus*, *Myophoria*, &c., which indicate the horizon of the Rhætic beds (*Proceedings*, Malacological Soc., Oct. 1900).

THE newly-appointed Government Geologist of Queensland, Mr. W. H. Rands, has forwarded a copy of the annual progress report of the Geological Survey for 1899. He takes occasion to express the general feeling of regret at the resignation of his predecessor, Mr. R. L. Jack. The report, which deals mainly with copper, gold, and coal properties, includes contributions by Mr. B. Dunstan on the occurrence of oriental ruby in northern Queensland, and on fire-clay.

CANON SCOBELL contributes to the *Proceedings* of the Cotteswold Club (vol. xiii. part iii.) some interesting notes on the common fields at Upton St. Leonard's, and these are accompanied by a view of lynches, which indicate the ancient system of ploughing in strips and terraces. In some excursion notes Mr. S. S. Buckman deals with river features in the phraseology used by Prof. W. M. Davis. He refers also to the tunnel near Chipping Sodbury on the South Wales direct railway, to the water therein encountered, and to the probable effects consequent on its diversion by pumping.

TO the *Bulletin* of the American Geographical Society, vol. xxxii., 1900, Mr. R. L. Barrett contributes an interesting account of the Sundal drainage system in central Norway. The author explains the curious "reversal of drainage" which has occurred in this region, and deals with the question of the "hanging valleys" and erosion by overflowing glaciers.

IN a paper brought before the Academy of Sciences of Cracow, Mr. L. Marchlewski has described a new derivative of chlorophyll. This substance, which its discoverer has named phyllorubine, differs considerably from the previously known phylloporphyrine, another chlorophyll derivative. While the spectrum of the latter is distinguished from that of other chlorophyll derivatives by having no band in the red region, phyllorubine forms no such exception. The new substance has not yet been obtained in the crystalline state.

THE action of chemical solutions on the lower forms of life is the subject of two papers in German in the *Journal* of the College of Science, Imperial University of Tokio—one, by N. Ōno, dealing with their effect on the growth of algæ and fungi, while the other, by Prof. Atsushi Yasuda, treats of the adaptability of infusoria to concentrated solutions. The former author finds that certain poisons in a highly diluted state favour the growth of the lower algæ, that smaller "doses" are required with algæ than with fungi, that mercury chloride and copper sulphate in certain degrees of dilution favour the growth of fungi (a remarkable result, seeing that corrosive sublimate in stronger concentration is used as a preventive of mildew), and that spore-formation is retarded by certain chemicals. Prof. Yasuda, on the other hand, finds that infusoria are affected by a much lower degree of concentration than algæ and fungi, even the most resistive species, *Euglena viridis*, being unable to exist on any but relatively weak solutions. An account is given of the physiological changes which take place in the organisms as the degree of concentration is varied.

A PRELIMINARY note on the fungi collected in the Belgian Antarctic Expedition is contributed to the *Bulletin de la Classe des Sciences* of the Belgian Academy by Mesdames Bommer and Rousseau. Almost all of these come from Tierra del Fuego. One species alone was found in Dango Land, *i.e.* the Antarctic region proper; but this species has not been classified, as it is represented only by a sclerotium, without carpophore. Among the fungi of Tierra del Fuego, out of fifteen species collected ten were new.

DR. GEORGE NEWMAN'S book on "Bacteria," published a year ago in Mr. John Murray's Progressive Science Series, and reviewed in these columns (vol. lx. p. 434, September 7, 1899), has met with the success which its excellence deserves. A new edition has been issued, with additional matter, including new chapters on tropical diseases and on the bacterial treatment of sewage.

THE second volume of the new edition of the well-known "Gardener's Assistant," which has been revised and entirely remodelled under the direction and general editorship of Mr. William Watson, of the Royal Gardens, Kew, has just been issued by the Gresham Publishing Company. The work, so far as it has gone, is thoroughly in touch with the spirit of modern gardening, and should be in the hands of every practical horticulturist.

MESSRS. WILLIAMS AND NORGATE'S *Book Circular* is known to many men of science as a useful guide to foreign scientific works, containing not only the titles and other publisher's particulars, but also notes describing the scope and character of the contents. Eight of these circulars, referring to works published during last year and this, have now been issued in volume form, and the book thus produced is a handy catalogue of important scientific publications which have lately appeared.

ANOTHER part of Engler's "Monographieen Afrikanischer Pflanzen-familien und-Gattungen" has been received; and in it Dr. K. Schumann deals with the African Sterculiaceæ. The work is being prepared, regardless of expense, under the auspices of the Berlin Academy of Sciences, and is published by W. Englemann, Leipzig. The trustees of the British Museum (Natural History) have just published a new part of the "Catalogue of the African Plants collected by Dr. Friedrich Welwitsch in 1853–61." This is the fourth (and concluding) part of Mr.

W. P. Hiern's description of the dicotyledonous plants collected by Dr. Welwitsch, the first having been published at the end of 1896.

THE *Bibliotheca Geographica*, edited by Dr. Otto Baschin for the Berlin Geographical Society, is known to be a most complete annual and international bibliography of geographical literature. The sixth volume of this catalogue contains the titles of papers published during 1897, classified into the usual groups according to subjects, and with an authors' index. It is thus possible to find, without the slightest difficulty, what papers upon any particular district or branch of geography were published in 1897, or to look up the list of publications of any writer on geographical subjects. The volume contains 444 pages, and it does credit to the editor and the society under whose auspices it has been prepared.

THE additions to the Zoological Society's Gardens during the past week include a Lioness (*Felis leo*) from East Africa, presented by Major T. Soutar, Cameron Highlanders; a Sooty Mangabey (*Cercocebus fuliginosus*, ♂) from West Africa, presented by Major G. McMicking, commanding C.I.V. Field Battery; two Ostriches (*Struthio camelus*), a Nilotic Crocodile (*Crocodilus niloticus*) from East Africa, presented by Mr. G. Marsden; an Egyptian Jerboa (*Dipus oegyptius*) from North Africa, presented by Mrs. R. Gurney; a Barn Owl (*Strix flammea*), British, presented by Lady Hutt; a Leopardine Snake (*Coluber leopardinus*), a Tesselated Snake (*Tropidonotus tessellatus*), European, presented by Mr. W. J. Wintle; a Grey-cheeked Mangabey (*Cercocebus albigena*, ♂), a Sooty Mangabey (*Cercocebus fuliginosus*, ♀) from West Africa, a Moustache Tamarin (*Midas mystax*) from the Upper Amazons, a Yellowish Capuchin (*Cebus flavescens*) from South America, two Tenrecs (*Centetes ecaudatus*), a Short-nosed Tenrec (*Ericulus setosus*), a Long-nosed Tenrec (*Hemicentetes semispinosus*) from Madagascar, a Festive Amazon (*Chrysotis festiva*) from Guiana, two Tui Parrakeets (*Brotogerys tui*), a Hawk-headed Parrot (*Deroptyus accipitrinus*) from Brazil, deposited; two Grey Squirrels (*Sciurus griseus*, var.) from North America, purchased; a Bosch-bok (*Tragelaphus sylvaticus*, ♂), eight Mocassin Snakes (*Tropidonotus fasciatus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF THE INFRA-RED SPECTRUM OF THE SOLAR CORONA.—In a recent issue of the *Comptes rendus* (vol. cxxxi. pp. 658-661), M. Deslandres describes some of his latest experiments in connection with the detection of the solar corona at ordinary times without the intervention of an eclipse. All the methods adopted prior to 1894 had been modifications of spectroscopic examination, using either the visual or ultra-violet rays, and were probably unsuccessful owing to the great proportion of these radiations existing in our general sky illumination, thereby diluting the small direct coronal light. In 1894 M. Deslandres found evidence that the sky radiation was very poor in the infra-red region, while the corona emitted this light abundantly, and this has since been investigated by Prof. Hale, in 1895, without producing any confirmatory results. M. Deslandres here suggests, however, that this non-success may have been due to those experiments having been made near the period of maximum sun-spot activity, at which time the corona is much more uniformly distributed round the limb than at periods of minimum.

During the last eclipse, in May 1900, the author, in conjunction with M. Charbonneaux, found that the infra-red coronal radiation was some one-half or one-third the radiation of the same part of the sky after the eclipse, and the work has since been continued daily at the Observatory of Meudon with the same apparatus. This consists of a mirror 0·30 metre aperture and 1·50 metres focus, a slit spectroscope with crown lenses and prisms, a sensitive Melloni or Rubens thermopile, and a very sensitive Deprez d'Arsonval galvanometer. The slit of the spectroscope was 12 mm. long and 1 mm. wide, the prism train being so arranged that the thermopile only received the infra-red radiation from $\lambda 1^{\mu}$ to $\lambda 1^{\mu}\cdot 8$. The slit has also been replaced by circular apertures 0 4 mm. and 1 mm. diameter.

The interesting conclusion is that, at all times of the day, the sum of the deviations along the equatorial region has always been greater than the corresponding sum of the readings in a polar direction. As it is improbable that the diffuse heat of our atmosphere would be unequally distributed over the small area corresponding to the angular diameter of the sun, this difference can only be attributed to the effect of the corona; the present time being a minumum of spots, the greater action along the equatorial region is in agreement with the known conspicuous equatorial extensions of the coronal streamers and the comparatively small polar plumes. Many variations in the disposition of the apparatus have been made to discover any possible systematic errors, but the results have throughout remained the same.

In contrast with the above report should be considered the preliminary statement of the results obtained by the expedition organised by Prof. S. P. Langley from the Smithsonian Institution during the same eclipse (*Astrophysical Journal*, vol. xii. pp. 69-76). The light given from a 17 inch siderostat mirror passed to a concave speculum 50 cm. diameter and 1 metre focus. Arrangements were made whereby either the full image of a part of the solar surroundings could be allowed to fall on the bolometer strip, or the light previously passed through a prism, thus sifting out any particular radiation for action on the bolometer.

Settings on the inner corona gave a distinct *negative* deflection with respect to the zero of the instrument, but this was numerically less than the deflection given by a setting on the centre of the dark moon; this shows that the coronal radiations were recognised by the bolometer, giving some 5 mm. deflection greater than that of the dark moon.

The fact of the negative deflection, however, indicates that the radiation reflected by the earth's atmosphere during the partial phase is vastly more intense than that of the corona. Also "the corona is effectively cooler than the bolometer, and appears, therefore, neither to reflect much light from the sun, nor, chiefly by virtue of a high temperature, to give light of its own, but seems rather to be giving light in a manner *not associated with a high temperature*, or at least with the preponderance of infra-red rays usual in the spectra of hot bodies."

ANNUAL REPORT OF THE MELBOURNE OBSERVATORY.—In the thirty-fourth annual report of the Melbourne Observatory, Mr. P. Baracchi, the acting Government astronomer of Victoria, summarises the work accomplished at the institution during the period March 1, 1899, to March 31, 1900. With the 8-inch transit circle the total number of right ascension observations was 3311, and of north polar distance 2406. Of the latter, 1435 were on stars selected from the astrophotographic catalogue plates, to serve as fundamental stars for the reduction of these plates. 786 observations of heliometer stars were made at the request of Dr. Gill, and have been sent to him for comparison. The computations for the third Melbourne General Catalogue of 3100 stars are about two-thirds completed. The astrographic work has made considerable progress, the two series of catalogue plates and the series of chart plates with single exposure of one hour having been completed with the exception of a few scattered regions. Catalogue plates for regions above 80° of declination are being duplicated, and the second series of chart plates, with triple exposure of 30 minutes each, has been commenced, giving three images of each star about 8″ apart. The measurements of the catalogue plates taken at this observatory and the Sydney Observatory have been made at Melbourne, and the progress made is stated in a joint report by Messrs. H. C. Russell and P. Baracchi. The first twelve months of the existence of the measuring bureau (commencing November, 1898) were occupied in preliminary instrumental experiments and training of observers, but during the last four months systematic measurement has been carried on Several new micrometers have been obtained, one by Repsold, similar to that used by Dr. Gill at the Cape. This has double slides, and thereby permits quicker measurements. At present two observers, relieving each other for alternate periods of one hour, measure in a day about 500 stars with the Repsold and about 400 with the local micrometer. As the total number of stars on the Sydney and Melbourne plates is probably 1,500,000, it is estimated that with three efficient measuring machines, and six observers employed from six to seven hours daily, the whole may be accomplished in some six or seven years. The photoheliograph, great telescope

and other equatorials have only been used on special occasions and for visitors, 594 of whom inspected the observatory during the year.

The automatic photographic registration of terrestrial magnetism was obtained with only 34 hours interruption during the year; absolute measurements were made on seven occasions, and instrumental constants, &c. determined.

The series of cloud photographs has been continued, 77 additional pairs of plates being taken from the roof of Parliament House and the observatory grounds respectively. These are now being measured and discussed in connection with visual observations.

ABNORMAL STARS IN CLUSTERS.—Prof. E. E. Barnard has for some time been engaged in micrometrical determinations of the positions of a number of the individual stars in the great globular clusters M 3, M 5, M 13, M 15, and M 92, and in the course of the work has noticed several peculiarities, the most striking of which is the fact that some of the stars in these clusters shine with a much *bluer* light than the majority of their neighbours, thus producing a remarkable difference between their photographic and visual magnitudes. So striking is this that the images in some cases are so large as to suggest variability (*Astrophysical Journal*, vol. xii., pp. 176—181). Comparisons have been made with a negative enlarged four times from an original of M 13 Herculis, taken with the Potsdam 13-inch photographic refractor in 1891.

The two stars, Nos. 148 and 131 of Scheiner's catalogue of this cluster are practically equally bright to the eye as seen in the sky; but on the photograph No. 148 has an image four or five times larger than No. 131.

Other neighbouring stars, however, register photographically the same relative brightness as determined visually. This led to the minute examination of No. 148 with high magnifying power, when it gave the impression of some object less sharp than stars near it, suggesting the idea of a small planetary nebula. Other stars showing the same abnormal features are detailed, and a numbered sketch of a portion of the cluster given for identification.

Prof. Barnard says he has found similar cases in other clusters, *e.g.* M 5 Libræ. A suggestion by Prof. Hale that a photograph taken through a yellow screen should not show these peculiarities was tested on the 40-inch Yerkes refractor and proved correct, the stars previously mentioned coming out on the photograph with almost the identical relative brightness they show visually in the same telescope.

The suggestion is made that these stars are of similar nature to the condensation or nucleus of the annular nebula in Lyra, perhaps bearing the same relation to the other stars of the cluster that the nucleus of that nebula does to the ordinary stars of the sky. It would appear, therefore, that the possibility of these abnormal stars being of the nature of nebulæ brings up again the question of nebulosity in the globular clusters.

RECENT STUDIES OF INFRA-RED REGION OF SOLAR SPECTRUM.—In the current issue of the *Comptes rendus* (vol. cxxxi. pp. 734-736), Prof. S. P. Langley describes the result of his recent work on the bolometric study of the solar spectrum in the infra-red. At the date of his last communication to the French Academy, in 1894, the knowledge of the region beyond $\lambda = 1\mu$ was very imperfect, but now, thanks to the great improvement of his bolometer, which is capable of detecting a variation of temperature as minute as the millionth part of a degree, the map of the calorific rays has been carried to $\lambda = 5{\cdot}8\mu$. The article is illustrated by a heliogravure of the calorific spectrum from $\lambda = 0{\cdot}76\mu$ to $\lambda = 5{\cdot}3\mu$, both the galvanometer record and the "line" integration being given. More than 600 lines are recorded, each of which has been studied separately and obtained by from six to twenty independent observations. Prof. Langley calls special attention to the observations of the *telluric* infra-red spectra, which have been studied during all seasons from 1895-1900. Systematic variations have been observed in them which appear to have some relation to the season in which they occur, and, although small, are very distinct.

THE ZODIACAL LIGHT.—*The Observatory* for November contains the first part of an article giving in a concise form the complete history of the zodiacal light. In this number the history is brought up to the year 1855, being derived mainly from two sources; (1) the article by M. E. Lefébure in *Ciel et Terre*, April, 1894; (2) a Review by Prof. C. E. Brame in the *Popular Science Monthly*, October, 1877.

THE NAPLES ZOOLOGICAL STATION.[1]

THE Zoological Station at Naples is so well known, either by personal experience or by repute, to zoologists the world over, that it may seem to some that any further account of it is quite unnecessary. But the institution has lately extended its scope and increased its equipment so as to appeal to workers in other lines of biology; and, moreover, as certain Associations and Universities in this country and elsewhere give annual grants towards defraying the expenses of special researches at Naples, it is due to scientific men in general that they should be kept informed from time to time of the conditions under which such work is carried on.

About ten years ago the then chairman of the British Association Naples Committee visited Naples, and gave an interesting report (NATURE, February 1891, p. 392) on the condition of the Zoological Station, in which he dwelt mainly upon the history, constitution, finance and publications; it will, therefore, be best that I should now draw attention chiefly to the present facilities for work at this world-renowned laboratory, and to the additions and improvements effected during the last decade. I am indebted to Prof. Dr. Anton Dohrn, the director, and to the secretary, Mr. Linden, for much information given me during my recent visit.

Since Dr. Sclater's visit in 1890 additional accommodation has been obtained by a re-arrangement of the roof of the main building. This gives space for a second laboratory, a supplementary library, and various smaller rooms used as chemical and physiological laboratories, for photography and bacteriology. A good deal of the research in recent years, both on the part of those occupying tables and of the permanent staff, has been in the direction of comparative physiology, experimental embryology, and the bacteriology of sea-water, and all necessary facilities for such work are now provided.

The number of work-places, in some cases separate rooms, known technically as "tables," is about fifty-five, and of these about thirty-four are rented annually by States, Universities, or Associations. Germany takes about ten of these, and Italy seven. There are three American tables, and three English (rented by the Universities of Cambridge and Oxford and the British Association respectively); consequently there are generally about half a dozen English and American biologists at work in the station; but Dr. Dohrn interprets in a most liberal spirit the rules as to the occupancy of a table, and, as a matter of fact, during my recent visit there were, for a short time, no less than three of us occupying simultaneously the British Association "table," and provided with separate rooms.

A work-table is really a small laboratory fitted up with all that is necessary for ordinary biological research, and additional apparatus and reagents can be obtained as required. The investigator is supposed to bring his own microscope and dissecting instruments, but is supplied with alcohol, acids, stains, and other chemicals, glass dishes and bottles of various kinds and sizes, drawing materials and mounting reagents. Requisition forms are placed beside the worker on which to notify his wishes in regard to material or reagents, he is visited at frequent intervals by members of the staff, and all wants are supplied in the most perfect manner. The recent addition of carefully planned filter-beds, by means of which half the sea-water in circulation in the tanks can be filtered and separated from the rest, has materially increased the facilities for some classes of experimental work.

The staff of the station consists of:—

(1) Dr. Anton Dohrn, the founder and director.

(2) Seven or eight scientific assistants—viz. Dr. Eisig, administrator of the laboratories; Dr. Paul Mayer, editor of the publications; Dr. Giesbrecht, assistant editor and supervisor of plates; Dr. Gast, assistant editor and supervisor of microscopic drawings; Dr. Schöbel, librarian; Dr. Lo Bianco, administrator of fisheries and préparateur; Dr. Hollandt, temporarily in charge of the microscopic sections department—all of them well-known men, each eminent in his own line of investigation. The post of assistant in the physiological department, formerly held by the late Dr. Schoenlein, is now vacant.

(3) In addition to the foregoing there are:—The secretary, Mr. Linden; two artists and the engineer.

(4) Also about thirty attendants, collectors and others em-

[1] Abridged from the "Note by the Chairman" of the Naples Committee in the report presented to the British Association at Bradford, September 1900.

ployed in the laboratories, in the collecting and preserving departments, aquarium and elsewhere.

This seems at the first thought a very large staff, but the activities of the institution are most varied and far-reaching, and everything that is undertaken is carried to a high standard of perfection. Whether it be in the exposition of living animals to the public in the wonderful tanks of the "Acquario," in the collection and preparation of choice specimens for Museums, in the supply of laboratory material and mounted microscopic objects to Universities, in the facilities afforded for research, or in the educational influence and inspiration which all young workers in the laboratory feel—in each and all of these directions the Naples station has a world-wide renown. And the best proof of this reputation for excellence is seen in the long list of biologists from all civilised countries who year after year obtain material from the station or enrol as workers in the laboratory. Close on 1200 naturalists have now since the opening of the Zoological Station in 1873 occupied work-tables, and as these men have come from and gone back to practically all the important laboratories of Europe and America, from St. Petersburg to Madrid, and from California to Japan, Naples may fairly claim to have been for the last quarter of a century a great international meeting-ground of biologists, and to have exercised a stimulating and co-ordinating influence upon biological research which it would be difficult to over-estimate.

The opportunities for taking part in collecting expeditions at sea are most valuable to the young naturalist. Dredging, plankton-collection and fishing are carried on daily in the Bay of Naples by means of the two little steamers belonging to the station, and a flotilla of fishing and other smaller boats. Many of the Neapolitan fishermen are more or less in the employ of the station, or bring in such specimens as they find in their work. The collecting organisation, under the charge of Dr. Lo Bianco, is now sufficient to provide from fifty to sixty workers at a time with all the material requisite for their varied researches.

But although the work of the Naples Zoological Station is thus many-sided, the leading idea is certainly original research. An investigator goes to Naples to make some particular discovery, and he goes there because he knows he will find material, facilities and environment such as exist nowhere else in the same favourable combination. The British Association Committee consider it most important that these opportunities for research should be open to British biologists in the future as they have been in the past, and it is on this ground that they confidently recommend the policy of sending selected investigators to Naples each year—a practice which has led to such satisfactory results in the past, and is full of promise for the future.

W. A. HERDMAN.

THE BRADFORD MUNICIPAL TECHNICAL COLLEGE.

DURING the recent Bradford meeting of the British Association many members availed themselves of the opportunity of inspecting the splendid Technical College which commenced a new era under the auspices of the Municipal Council twelve months ago. A description of the organisation of the college, and the work of its various departments, is given in the current number of *The Record of Technical and Secondary Education*, from which source, and the *Bradford Observer*, the following particulars have been derived. We are indebted to the Editor of the *Record* and to Mr. J. Nutter, secretary of the school, for the accompanying illustrations.

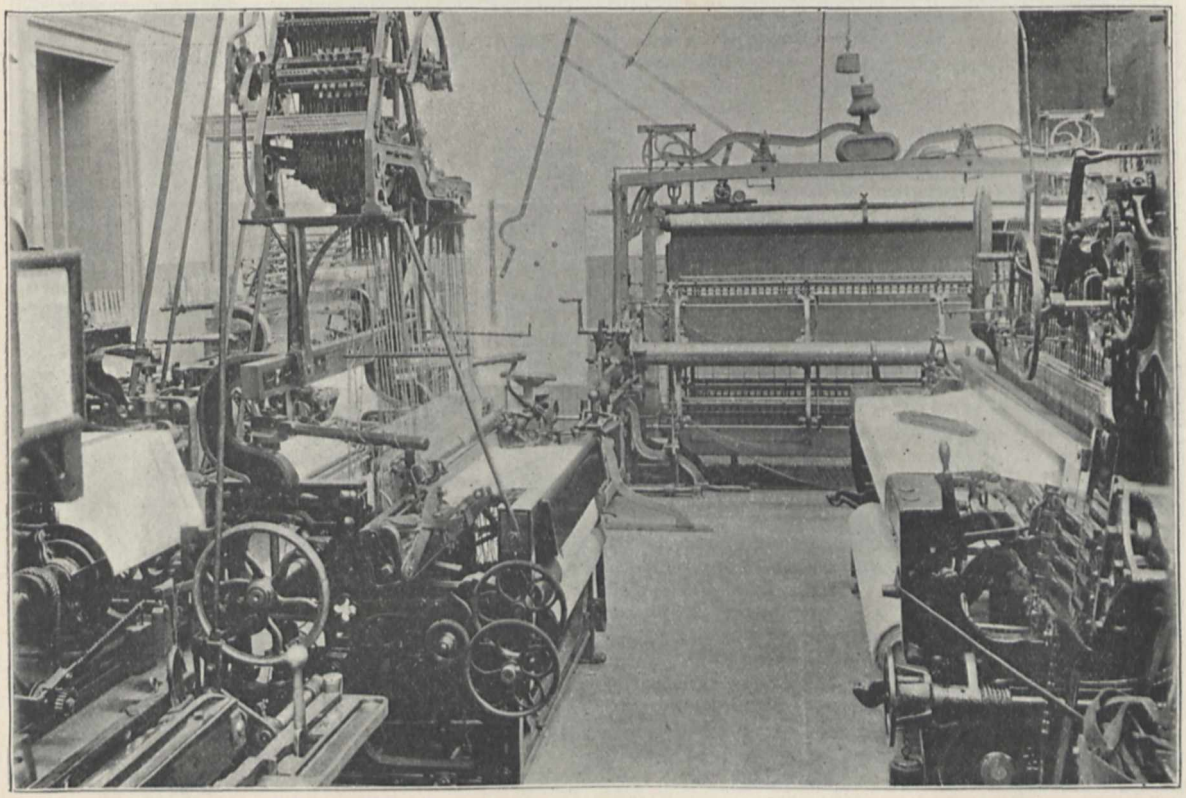


FIG. 1.—Department of Textile Industries, Bradford Municipal Technical College—power loom shed, showing dress goods and coating looms and embroidery frame.

The management of the college is now in the hands of the Technical Instruction Committee of the Bradford City Council, and the scheme defining the objects of the college is as follows:—"The general object of the foundation shall be the maintenance of a technical college under the Technical Instruction Acts for persons above 14 years of age, subject to the provision that no secondary day school or school of science shall be carried on in the college, but that day and evening classes may be held in the subjects of art, and of manual, scientific or technical instruction connected with the trades and manufactures of Bradford and the neighbourhood, to which none shall be admitted under the age of 15 years, except on the recommendation of the governing body of

the school in which they have been taught, and in no case under the age of 14 years; in advanced commercial subjects at day and evening classes, to which none shall be admitted under the age of 16 years."

Department of Textile Industries.

In the textile industries department, which is directed by Mr. A. F. Barker, the idea that a satisfactory knowledge of the subject can be gained at evening classes has been given up as fallacious. A three years' course of study for day students has been mapped out, and students who enter must take at least two years of the course, though it is preferable that the whole should be gone through. In addition, a one-year course of textile-mechanics has been arranged, and a special textile and dyeing course is also available for those who desire to carry their studies still further. Such evening classes as have been arranged are all specialised courses for the benefit of those who, having passed through the day classes, are now engaged in the textile trade. In the day classes the teaching of the subject is subservient to the training of the student: in the evening classes means are afforded the already well-grounded student for gaining all possible up-to-date knowledge of his particular branch of the trade. One item in the arrangements deserves special mention, as it is an anticipation of the great development which will eventually take place. Lectures on the preparation of wool and its treatment until it reaches the yarn stage are included in the three years' day course, and for the evenings a course of twenty-five lectures by acknowledged experts in the various branches has been arranged. This is in preparation for the carrying out of the full plan of the committee to remodel the textile industries department by providing plant for the practical teaching of the whole of the operations involved in the production of cloth from the raw material. The Cloth-workers' Company have recently carried out a similar scheme at the Yorkshire College. The idea, which as far as possible will be worked to, in providing new buildings and machinery, is to make the college a model factory in which, subject to obvious limitations, work will be carried out on an economical and commercial scale. In the "model factory" each department would balance the other. For instance, there would be a sufficiency of spinning frames to supply the necessary yarn to the looms, and so on throughout. Many important advantages would follow such a scheme. It would add interest to the work, and the students, in addition to gaining skill in the various operations and knowledge of the scientific laws which govern them, would also get an insight into mill management, a practical acquaintance with manufacturers' book-keeping, and a grasp of the economic problems involved.

Department of Chemistry and Dyeing.

Mr. W. M. Gardner is in charge of this department. In addition to the work in the chemical laboratories and experimental dyehouse, it is intended that in the future a practical dyehouse, fitted with typical machinery—including finishing machines—shall be provided, in which the students may be introduced to practical work. An experimental dyehouse for trade research work will also be an important feature in the future. The complete course in chemistry and dyeing occupies three years. The first year's work consists largely of chemistry and physics; the second includes chemistry, but dyeing is specially studied; and in the third year the work is to be still more specialised, and the students will be engaged during a part of their time in the dyeworks of the city. The course is made as complete as possible by the inclusion of physics (with special reference to chemical questions and to colour) and engineering (with special reference to dyeworks machinery). The work of this department in the future, and especially when the new buildings are available, will cover a much wider field than the dyeing trade, and will deal with all the chemical industries of the neighbourhood, but the same principle will operate, and every new branch that is opened and every fresh class that is started will have a direct bearing upon some local industry. Some of the new lines of work are supplementary to the other departments. Thus, teaching in bacteriology forms part of the

FIG. 2.—Dyehouse of the Department of Chemistry and Dyeing, Bradford Municipal Technical College.

civil and sanitary engineering classes, and metallurgy—for which a laboratory is to be built and a lecturer appointed—will be taken by mechanical engineering students. Botany, biology and microscopy are sciences which have a direct bearing on many of Bradford's industries, and they have also been taken up. The evening classes consist of specialised courses in chemistry and dyeing for advanced students and persons already engaged in trade.

Engineering Department.

The work of the engineering department, which is under Mr. G. F. Charnock, is divided into four sections, viz. (1) civil engineering, (2) mechanical engineering, (3) electrical engineering, and (4) building trades and architecture, the last named being in conjunction with the art department. Some much-needed additions to the machinery are to be made. Several new machine tools have been ordered, and, as opportunity offers, it is intended to substitute the newest examples for all machines of an old-fashioned type. The new syllabus in civil engineering has been framed to meet the requirements of the various professional bodies. A special feature is to be made of sanitary work, and some attention, including laboratory work, will be given to the new methods of sewage treatment. The mechanical engineering department has an increasingly important part to play in the industrial life of Bradford, and by no means the least important part of the work of this department will be to assist in training up a class of men suitable for the position of power superintendent in mills and factories. In the development of new ideas the department has also its place. The systematic study of mechanism and the method of designing mechanical motions would enable many a good idea which would otherwise be lost to its inventor to be worked out to a successful issue. Almost every technical school of any note on the Continent and in America has its collection of models systematically arranged to lead up from the simplest motions to the most complicated contrivances, but Bradford as yet can give the inventor no such aid.

Arrangements have been made for the proper teaching of electrical engineering, and a laboratory has been fitted up for practical work.

A room has also been reserved as a mathematical laboratory, and is fitted with apparatus and models to render the teaching as concrete as possible. Special attention is given to the slide rule, and there is a useful collection of measuring instruments. A calculating machine and other similar apparatus have also been provided.

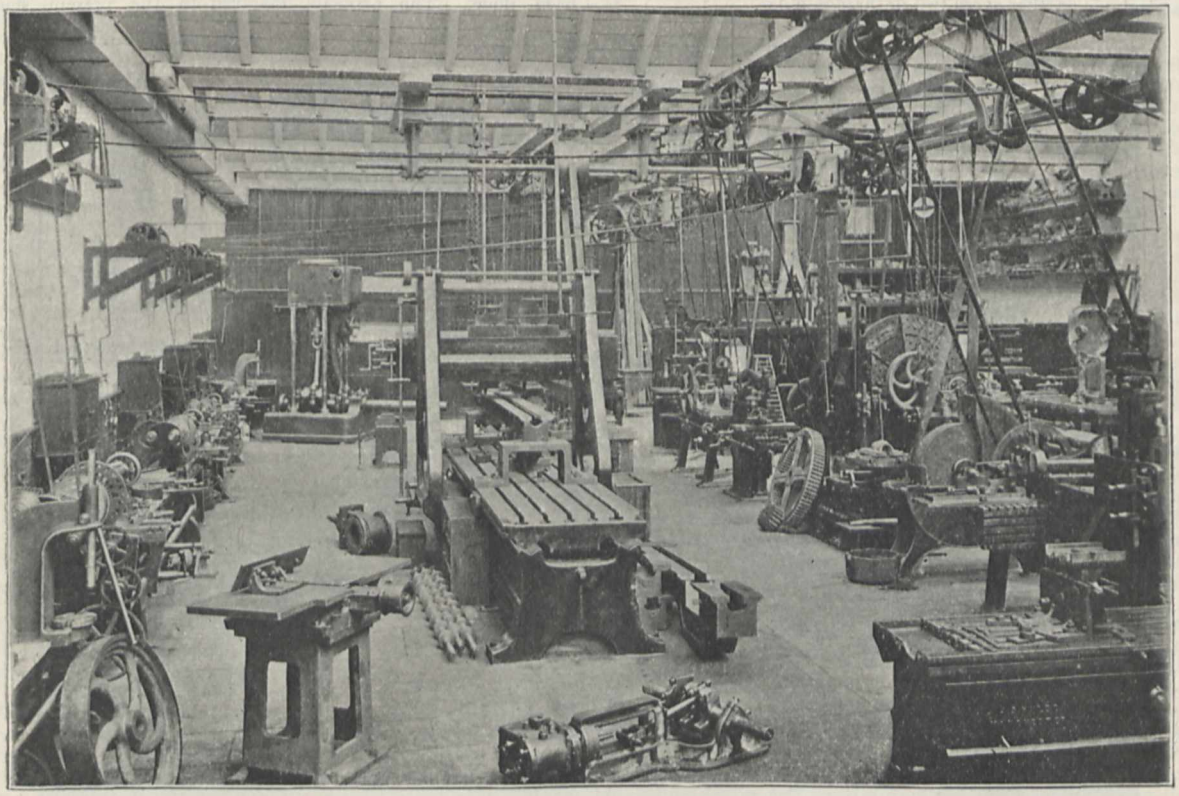


FIG. 3.—Workshop of the Department of Civil and Mechanical Engineering, Bradford Municipal Technical College.

A SUSPENDED RAILWAY.

THE curious railway represented in the accompanying illustration from *La Nature* runs from Vohwinkel to Barmen, through Elberfeld, along the Wupper Valley, in Rhenish Prussia. It is now working regularly, and was to have been formally opened recently by the Emperor of Germany, but the ceremony was postponed on account of the illness of the Empress Frederick. Brief descriptions of the railway have been given in several periodicals, and an illustrated account appears in the October number of the *English Illustrated Magazine*, from which some of the following particulars have been derived.

The total length of the railway is about 8¼ miles, of which more than three-quarters is over the river Wupper. The railway is supported above the river on A-shaped trestles, with the sides rising from each bank, and are placed at intervals of 30 metres. In the highway, along the roads, the supports take the form of an inverted U. The lower part of the latticed girders at the top of the supports contains the rail from which the carriages are suspended. Upon the upper face of this rail runs a two-wheeled truck or trolley containing the electric motors. Two of these trucks, placed nearly thirty feet apart, are supplied to each carriage. From each truck a heavy hook, fastened to the roof of the carriage, projects round the rail, as

shown in Fig. 1. Although the trolley runs on a single rail, it is prevented from falling over by the hook, and also by the fact that the centre of gravity is immediately below the wheels. The railway is a double track, one line for the up and the other for the down trains.

The curve of the track has an average radius of 90 metres ; at Vohwinkel, however, there is a curve with a radius of 30 metres, and in one place the radius of curvature is much less than this. At each terminus of the line the track is built in the shape of a large loop, so that the arriving carriages may pass round to the departure platforms. The inclines are slight, the greatest gradient being 4·5 in 100.

The cars are propelled electrically, by current conveyed by means of a sliding contact from generating stations to motors on the trucks supporting the cars. Each truck has a motor of 30 horse-power, and works at a pressure of 600 volts. The cars themselves are about thirty feet long and are of the corridor pattern. There are two cars to a train, and each can carry fifty passengers. No less than nineteen stations are provided in the length of eight miles traversed by the line, and the trains succeed one another every two or three minutes.

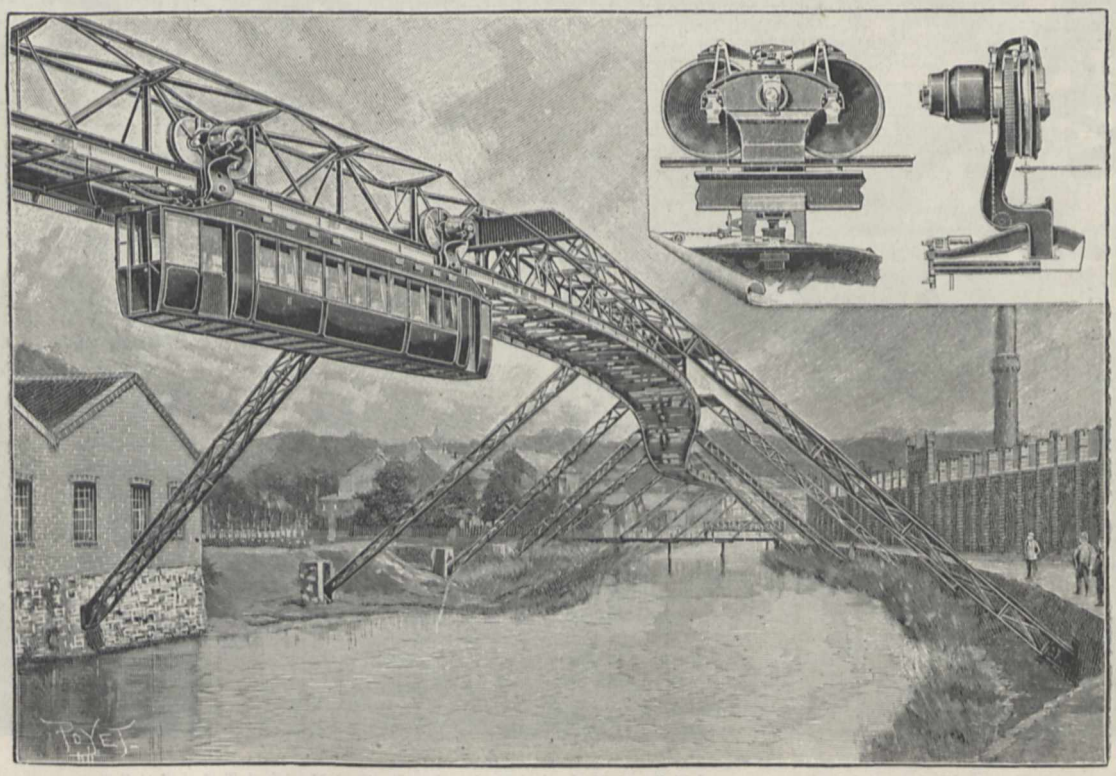


FIG. 1.—General view of a part of the Wupper Valley Railway at Elberfeld. The system of suspension of the trucks is shown in the small figure.

Each car is fitted with a Westinghouse pneumatic brake, a hand brake and an electrical brake, so that it is well under control. The cost of the railway, comprising stations, permanent way, and rolling stock, is stated to have been 56,000*l.* per mile. The proprietor of the railway was Herr Eugene Langen, of Cologne, who died before the line was completed.

OUTPUT AND VALUE OF BRITISH MINERALS.[1]

THE most striking fact recorded in the mineral statistics for 1899 is the enormous output of coal, viz., 220,094,781 tons, showing an increase of 18,040,265 tons compared with the previous year. This country is now producing twice as much coal as it did in 1870, and probably nearly four times as much as in 1850. Durham and Yorkshire together are now yielding about as much coal as the whole of the United Kingdom half a century ago.

The unsatisfactory part of the particulars is the deficiency of detail concerning our most important minerals, coal and iron ore. County outputs are given, but no further descent into local details is permissible, because the Coal Mines Regulation Act prohibits the publication of the individual annual returns. While a statement is made of the output of every little lead or tin mine, it is impossible to state officially which of our colliery companies can be compared, for instance, with such great undertakings as those at Anzin and Lens on the other side of the Channel. Is it wise that no particulars should be kept of the gradual depletion of our great national treasure? The total yearly shrinkage is recorded, but no account is kept in our official statistics of each individual vault which is being drained of its riches.

The Mineral Statistics Committee in 1894 recommended the amendment of the Statute and the publication of the output of individual collieries, but at present nothing has been done. The anomaly involved in the present state of things is specially marked in the case of our iron ores. The law prohibits the publication of the returns of *stratified* ironstone, but allows it in the case of *unstratified* iron ore. Consequently, full details are given of the amount of ore produced by each iron mine in Cumberland, whilst information concerning the output of individual mines in the Cleveland district has to be withheld from publication.

Apart, however, from the question of the production of individual mines, the total output for the year, amounting to more than 220 million of tons and showing an increase of about 9 per cent. on the output for the previous year, points to the urgency which the question of the exhaustion of the coal supply is rapidly assuming. While it is impossible, in an annual report on the mineral output, to undertake the task of estimating the amount of coal still remaining in the British Isles, and of attempting to arrive at any conclusion as to the time that may elapse before its exhaustion begins to be felt, it may perhaps not be out of place to call attention to the practical importance of

[1] Reprinted from a report by Prof. Le Neve Foster, F.R.S., on the output and value of the minerals raised in the United Kingdom in 1899, the amount and value of the metals produced, and the exports and imports of minerals. Published by the Home Office.

checking its present thriftless use. Prof. Perry pointed out a few weeks ago to the members of the British Association for the Advancement of Science that the best steam engines are utilising only one-twelfth of the energy available by the combustion of the fuel, while the ordinary steam engines utilise a far less proportion. Whether our coal supply is sufficient to last for some centuries, or whether, as is the opinion of many competent authorities, a serious coal famine will begin to be felt within the lives of the present generation, economy in the use of coal is unquestionably of the utmost importance, and the investigation of the best means of effecting such economy would repay even a large expenditure, whether by the Government or by industrial corporations and technical societies. If the result of such inquiry were merely to effect an economy of one per cent. in the consumption of coal this would mean an annual saving to the coal consumers of this country of nearly 1¾ million tons, worth at last year's prices about £625,000.

Such an investigation might also deal specially with the question of the supply of coal for the Navy. At present certain classes of coal, which with little or no effort on the part of the stoker can be burned without the production of smoke, are specially used for steamships and are often known by the name of "steam coal." If any means can be devised, by investigation and experiment, by which other classes of coal can be burned smokelessly, as is surely possible, our ships will no longer be dependent upon one class of fuel, the naval coal bills will be lessened, and the danger of the failure of coal available for naval purposes will arise only when the total coal supply of the country approaches the point of exhaustion.

Another matter of interest in the present statistics is the increase of the exportation of coal. The quantity of coal exported in 1899 (exclusive of coke and patent fuel) was more than 41 million tons—an amount more than the whole output of coal in any country in the world except the United States and Germany. Of this export more than three-sevenths in quantity and almost half in value is from the South Wales ports. In 1898 and also in 1897 the export was only a little over 35 millions. For the purpose of comparison it is better to take the year 1897, as the quantities dealt with in 1898 were disturbed by the coal strike. Compared with the former year there has been an increase of nearly 6 millions in the total export, and this increase is almost entirely in the export to foreign countries, the export to the British Colonies and Possessions having increased by only 200,000 tons. The countries whose purchases of coal show the largest increase are Russia (which has increased its purchase by nearly 1½ millions), France (more than 1 million), Sweden (¾ million), Italy and Holland. The exports to Germany, Spain, Egypt and South America show only a small increase. The export to the United States is inconsiderable, amounting only to 119,000 tons, chiefly to ports on the Pacific. Among the British Colonies and Possessions there is a considerable increase in the export to India, and some increase in that to South Africa; elsewhere the tendency is rather to decrease.

It must not be assumed that the whole of the coal exported to foreign countries was consumed by foreign nations. Some of it was merely shipped to foreign ports and there utilised for re-coaling English steamers. What proportion was so employed does not appear from any statistics that are available, though possibly some indication may be gathered from the amounts sent to Malta, Gibraltar, and Aden, which in 1899 were respectively 418,000, 326,000, and 176,000 tons.

As regards minerals other than coal, the increasing importance of aluminium may be noted. The output of this metal now amounts to 550 tons, with a value of 71,125*l*. The output thus approaches in quantity nearly to that of copper, while the value is considerably greater. In spite of higher prices, copper, lead and tin show diminished outputs.

The total value of all minerals raised approaches 100,000,000*l*. sterling, the increase of 20,000,000*l*. compared with 1898 being mainly due to the enhanced value of coal. With our present output, a rise of one penny in the price of coal represents nearly one million of money.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An election to an Isaac Newton Studentship in astronomy and astronomical physics will be held next term. The studentship is worth 200*l*. a year for three years. Candidates must be Bachelors of Arts who are under twenty-five on January 1, 1900.

Mr. H. F. Baker, F.R.S., of St. John's College, has been appointed University Lecturer in Mathematics.

At the biennial election to the Council of the Senate on November 7, the following new members were returned: Dr. Ryle, Dr. Taylor, Prof. Ridgeway, Mr. R. F. Scott, St. John's.

Science states that a bronze medallion with a likeness of Prof. Sylvester will hereafter be awarded as a mathematical prize at the Johns Hopkins University.

DR. LORENZ, of the University at Halle, has been made director of the physical and technological institute of the University of Göttingen.

THE following appointments have recently been made at University College, Sheffield. Dr. S. R. Milner, late junior demonstrator in physics at Owens College, to be demonstrator and assistant lecturer in physics. Dr. T. S. Price to be additional demonstrator in chemistry.

MR. E. J RUSSELL, assistant lecturer and demonstrator at the Owens College, has been appointed lecturer in chemistry at the South-Eastern Agricultural College in succession to Mr. H. H. Cousins, who has been appointed agricultural chemist to the Government of Jamaica.

CALENDARS of University Colleges are all built upon much the same pattern, but each has some noteworthy characteristics. For instance, we see that the Durham College of Science, Newcastle-upon-Tyne, like one or two similar institutions, has a marine biological laboratory available for its students at Cullercoats. The agricultural department has been well organised, and is entrusted with the scientific direction of the farm acquired for the purpose of demonstration and experiment by the County Council of Northumberland. Opportunity is afforded to qualified students to undertake original work in all departments, and the students are permitted to visit chemical and other works in the district. Prof. Louis is to deliver a special course this session for the instruction of persons proceeding to any of the gold-fields. The course will deal with prospecting for gold, the methods of extraction of gold from its ores, and the assaying of gold ore and bullion. A scheme is on foot for the establishment of a new northern university based on the Durham College, on the model of that founded at Birmingham upon Mason College.

A SCHEME of agricultural education, which Mr. A. N. Pearson has drawn up for Victoria, in connection with the Royal Commission on Technical Education, is founded on the principles which are now accepted to form the only permanent basis for scientific instruction: viz. that natural knowledge only comes by individual experience in the school of nature. Many elementary facts of agriculture lend themselves readily to educational purposes, and by employing them in a proper way it is possible to give young pupils an intelligent view of natural processes which will be of value in the practical work of later life. With a few seeds it is easy to study germination and the growth and structure of root and stem. Simple examinations of soils may follow, and then determinations of the composition of plants. After this, there would be but a short step to an elementary knowledge of the chemical composition of soils and of commercial plant foods, and the pupil could make intelligent use of the latter, either in growing pot plants, or in cultivating small garden plots. Mr. Pearson gives in his report a scheme for the education of youths in agricultural colleges and farm-schools, and he shows that he is inspired with the spirit of true education. By adopting such a scheme of work as he suggests, the Government of Victoria will show foresight for the future welfare of the colony, and will make its methods of agricultural instruction equal to the best.

FATHER A. L. CORTIE, S.J., discoursed on the teaching of science in Catholic Schools at the last conference of Catholic Colleges on Secondary Education; and his paper is given in full in the official report just received. The fundamental note of his remarks is that classics and mathematics ought to be the foundation of our educational structure, and the "finish and polish of a course of science" should be put upon it afterwards. It is suggested that scientific men wish to oust the classics, and substitute a merely commercial and scientific education as the mental training of the boy intended for trade and the practical walks of life. This, however, scarcely expresses the real state of the case, for many scientific men are familiar with classical literature and would be sorry to see it neglected. But can the same be said of classical men as a rule: are they inclined to give science a proper

place in their educational curricula? A glance at the Time Table of any Public School, and of most Grammar Schools, or at a list of scholarships available at Universities, will show that science is the Cinderella in secondary schools, and its presence is more tolerated than encouraged. When science (rationally taught, of course) takes so many hours of a boy's school work as classics, it will be time to suggest that the languages of ancient Greece and Rome are being ousted. Father Cortie's views as to the plan and method of science teaching may be judged from the final remarks from his paper :—"Our aim in teaching science, as in teaching every other subject to the boys committed to our charge, ought to be chiefly directed to training the mind, and not to the imparting of a number of isolated and disconnected facts. I would advocate in the first place a preliminary course of classical and literary training before joining the science classes, and secondly that in the science course itself the training should be neither wholly didactic, nor yet wholly experimental, or Heuristic, to employ the term so much in fashion at present, but a judicious mixture of both. A cultured mind should be the outcome of our training, in science, as in other subjects. And for true culture, a knowledge of facts, in lieu of knowledge of principles and methods, is worthless."

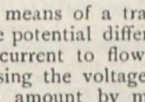
SOCIETIES AND ACADEMIES.

LONDON.

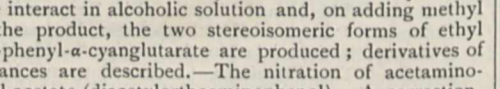
Physical Society, November 9.—Prof. A. W. Reinold, F.R.S., Vice-President, in the chair.—Dr. R. A. Lehfeldt read a paper on "Electro-motive force and osmotic pressure." This paper is an attempt to explain a difficulty in the interpretation of the ordinary logarithmic formula for the E.M.F. between a metal and solution, pointed out by the author at the Dover meeting of the British Association. An expression for the E.M.F. of a concentration cell is obtained thermo-dynamically upon the assumption that the electrolyte is only partially dissociated. A partition is used which is permeable to water but not to the salt or its ions, and the conclusion follows that the E.M.F. depends, not on the osmotic pressure of the metallic ions, but on that of the solution as a whole. A graphical representation is given plotting osmotic pressure against dilution, assuming Boyle's law to hold, and it is shown that the E.M.F. is not proportional to the integral $\int PdV$ but to the converse integral $\int VdP$. Assuming, further, that the osmotic pressure changes according to Van der Waals's equation, the E.M.F. is greater than that calculated from Boyle's Law. If the electrolytic solution pressure is calculated from the integral $\int PdV$ it comes out 10^{19} atmospheres; but if from the converse integral, the value obtained is about 20,000 atmospheres. A comparison between actual E.M.F.'s and those derived from the equation given by the author should afford, if the formula is correctly deduced from the assumptions made, a measure of how far the osmotic pressure deviates from that indicated by Boyle's law. Experiments upon concentration cells have been made by Helmholtz, Wright and Thomson, Moser, Lussana and Goodwin; but as their work was performed upon cells with migration of ions, the calculation of the osmotic pressure is rendered uncertain by the introduction of the transference ratio. Accordingly the author has measured the E.M.F.'s of cells without migration, using zinc as electrodes and chloride and sulphate of zinc as salts. The E.M.F. was measured by the compensation method, using a post office box through which a current was sent by an accumulator. The accumulator kept up a constant potential difference, and was standardised daily by means of a Clarke cell. The experimental results agree with the calculated over the range centi- to deci-normal, showing that the deviation from the value given by the logarithmic formula is accounted for by the incomplete dissociation of the salts. The osmotic pressures are then calculated from the E.M.F.'s and the values of PV plotted. They show irregularities due to the combined effect of the decreasing dissociation of the salt and the increasing departure from Boyle's Law. Dividing the product PV by Van't Hoff's factor, determined from conductivity, values are obtained showing variations similar to those observed in the behaviour of gases when subjected to high pressure. Mr. Whetham said there was one form of membrane which is quite permeable to water and yet does not allow either salts or the ions to get through. He referred to the free surface of the solution itself. The water being volatile can get out, but the salt cannot. Dr. Donnan said the author seemed to have discovered things well known; for instance, the integral $\int VdP$ is generally taken as proportional to E.M.F. He expressed his interest in the explanation of the difficulty in the logarithmic formula. Dr. Lehfeldt, in reply, said Goodwin had used the integral $\int VdP$ but had not made any numerical calculations by means of it. —Mr. R. J. Sowter read a paper on "astigmatic lenses." An astigmatic lens is one which so acts on rays of light falling on it as to produce, in general, two focal lines in the refracted ray system. A lens derived from a quadric surface is the general elementary type of astigmatic lens, and in the paper an ellipsoidal lens is selected and considered. The focal lines are parallel to the elliptic axes, and correspond to the lens powers in these directions. These powers are proportional to the inverse squares of the axes. A curve drawn through all points on a lens where the material thickness is constant may be said to determine a natural aperture for that lens. A method of natura apertures is employed to establish the various relation set out in the paper. An ellipse is the natural aperture for an ellipsoidal lens, a circle for a spherical lens, and an infinitely long rectangle for a cylindrical lens. It is shown that two cylindrical lenses crossed at right angles are equivalent to an ellipsoidal lens, and the power of the combination in any direction is the same as that of the ellipsoidal lens in that direction. It is also shown that two obliquely crossed cylindrical lenses are equivalent to an ellipsoidal lens, or to two cylindrical lenses of definite powers crossed at right angles, or to a cylindrical and a spherical lens; for a spherical lens may be replaced by two equal cylindrical lenses crossed at right angles. Prof. S. P. Thompson said he had never seen the treatment of an ellipsoidal lens before, although the extreme case of a paraboloidal lens had been considered. The author's method was, as far as he knew, new, and would be very convenient to work with. Mr. A. Campbell then read the following papers :—(*a*) "On a phase-turning apparatus for use with electrostatic voltmeters." Electrostatic voltmeters are particularly insensitive at the lower parts of their ranges, the divisions closing in very much towards the zero point. When measurements of small direct-current potential differences have to be made, it is an easy matter to add to the voltage to be measured a constant voltage large enough to bring the deflection to an open part of the scale. If the small voltage to be measured is an alternating one, it is necessary that the auxiliary voltage should alternate with the same frequency, and be in phase with it. The apparatus described enables the phase of the auxiliary voltage to be turned until it agrees with the one to be measured. The phase difference referred to is not the time lag but the angle whose cosine is the power factor and may be called the power lag. The method is to get two independent equal voltages, U_1 and U_2, differing in power phase by $\frac{\pi}{2}$, and to add together suitable fractions of these, such as $U_1 \sin\phi$, $U_2 \cos\phi$. The resultant is equal to U_1, but with the power phase turned through ϕ. The unknown small voltage is connected in series with an auxiliary voltage and a voltmeter, and the phase of the latter voltage is turned until the maximum deflection is obtained. (*b*) "On a method of measuring power in alternating current circuits." The circuit in which the power is to be measured is connected in series across the supply circuit with a small non-inductive resistance. By means of a transformer the small voltage on this resistance may be transformed into one whose power phase is π behind the voltage on the resistance. This is added to the voltage on the circuit to be measured, and then reversed and added again. The difference of the squares of these effective resultants is shown to be equal to a constant into the power to be measured. If there is any direct current, it must be measured separately by a Weston voltmeter or other suitable instrument. (*c*) "Note on obtaining alternating currents and voltages in the same phase for fictitious loads." When testing instruments for the measurement of large amounts of electrical power or energy, it is usually desirable to do so by means of fictitious loads, or by applying to the instrument under test current and potential difference representing the required load. In order to obtain a fictitious non-inductive load with alternating currents, the potential difference and current should be in the same phase. The current for the

instrument under test is got by means of a transformer worked on a hundred volt circuit. The potential difference in the same phase is got by allowing the current to flow through a non-inductive resistance and increasing the voltage at the ends of the resistance to the required amount by means of another transformer.—The Society then adjourned until November 23.

Chemical Society, November 1.—Prof. Thorpe, President, in the chair.—The following papers were read:—Action of alkalis on nitro-compounds of the paraffin series. Part 2: The reactions and constitutions of methazonic acid and the formation of isoxazoles, by W. R. Dunstan and E. Goulding. On treating nitromethane with alkalis, a mono-basic acid, methazonic acid, $C_2H_4N_2O_3$, is produced; when heated with acids or alkalis it decomposes into carbon dioxide, hydrogen cyanide, and hydroxylamine. The authors attribute the constitution



to methazonic acid.—Hexachlorides of benzonitrile, benzamide and benzoic acid, by F. E. Matthews. Chlorine water in presence of light converts benzonitrile into a crystalline hexachloride, $C_6H_5Cl_6.CN$, which, when heated with sulphuric acid at 170—180°, is converted into the hexachloride of benzamide; the latter is oxidised by fuming nitric acid yielding benzoic acid hexachloride, $C_6H_5Cl_6.COOH$.—The influence of solvents on the rotation of optically active compounds, 1, by T. S. Patterson. As the result of experimental work on ethyl tartrate, the author traces the variation of rotatory power with solvent to the variation of the asymmetry of the molecule owing to changes of the internal pressure in the solution.—The action of heat on ethyl sulphuric acid, by W. Ramsay and G. Rudorf. Ethyl hydrogen sulphate yields, when heated, sulphur dioxide, carbon dioxide, carbon monoxide and ethylene, as gaseous decomposition products.—Contributions to the knowledge of fluorescent substances: (1) The nitro-derivatives of fluorescein, by J. T. Hewitt and B. W. Perkins. Anhydrous dinitrofluorescein is not fluorescent in soda solution; the authors are unable to confirm von Baeyer's analytical numbers for tetranitrofluorescein, and suggest the composition $C_{20}H_{10}(NO_2)_4O_6$ for this substance.—Derivatives of ethyl α-methyl-β-phenylcyanglutarate, by W. Carter and W. T. Lawrence. Ethyl cinnamate and ethyl sodiocyanacetate interact in alcoholic solution and, on adding methyl iodide to the product, the two stereoisomeric forms of ethyl α-methyl-β-phenyl-α-cyanglutarate are produced; derivatives of these substances are described.—The nitration of acetaminoorthophenyl acetate (diacetylorthoaminophenol). A correction, by R. Meldola and E. Wechsler.—Rhamnazin and rhamnetin, by A. G. Perkin and J. R. Allison. The authors show that rhamnazin is a methoxyrhamnetin and that rhamnetin has the following constitution:—



—Luteolin, 3, by A. G. Perkin and L. H. Horsfall.—Genistein, 2, by A. G. Perkin and L. H. Horsfall.—The colouring matter of the flowers of *Delphinium consolida*, by A. G. Perkin and E. J. Wilkinson. The yellow colouring matter in these flowers is present as a glucoside, and has the composition $C_{15}H_{10}C_6$; it yields phloroglucinol and *p*-hydroxybenzoic acid on fusion with potash.—Note on Gallinek's amidomethylnaphthimidazole, by R. Meldola and F. W. Streatfeild.—The amount of chlorine in rain-water collected at Cirencester, by E. Kinch.—Researches on the alkyl-substituted succinic acids: (3) Dissociation constants, by W. A. Bone and C. H. G. Sprankling. The authors have determined the dissociation constants of a number of new dialkyl-substituted succinic acids, and show that as the mass of a normal alkyl-substituting group increases the dissociation constant also increases; in the case of 'iso' substituting radicles, however, there is a structural effect opposed to that of mass.—The reaction between ethyl alcohol and hydrochloric acid, by T. S. Price. The author has determined the velocity of reaction between ethyl alcohol aud hydrochloric acid, and finds that the velocity increases very rapidly with rise of temperature.

Royal Microscopical Society, October 17.—Mr. Carruthers, F.R.S., President, in the chair.—Dr. Hebb brought before the notice of the meeting samples of stains for microscopic specimens, prepared by Messrs. Burroughs, Wellcome and Co. The stains were in a solid form, each "soloid," as they are termed, containing a definite amount of the staining reagent. The advantages of this form of preparation are simplicity and economy.—Messrs. R. and J. Beck exhibited a new pattern students' microscope. It was of the continental form, and was chiefly noticeable for its cheapness, which was attained without sacrifice of quality by adopting an improved method of manufacture. It was called the "London" microscope, and had rack and pinion coarse adjustment, perfect micrometer screw fine adjustment, vulcanite top stage, iris diaphragm in sliding tube, and spiral substage fitting.—Mr. F. W. Watson Baker gave an exhibition of slides and models illustrating the structure and development of the skin.—The Secretary announced that Mr. Millett had forwarded Part ix. of his report on the Foraminifera of the Malay Archipelago, which would be taken as read; the paper appears in the current number of the *Journal* of the Society.

MANCHESTER.

Literary and Philosophical Society, October 16.—Prof. Horace Lamb, F.R.S., President, in the chair.—Prof. H. B. Dixon, F.R.S., gave a summary of the results of experiments, conducted by himself and Mr. F. W. Rixon, on the specific heat of gases at high temperatures. As part of a larger investigation, the authors have determined directly the specific heat of carbonic acid, up to 400° C., at constant volume. The gas is screwed up in a mild steel cylinder, which is heated in a gas-oven running on rails. The oven and cylinder can thus be brought quickly over the calorimeter, into which the cylinder falls through trap-doors forming the bottom of the oven. The transference is thus effected with a minimum loss of heat. The difficulties arising from splashing and from escape of steam are overcome by dropping the cylinder into a glass tube dipping some distance below the water. The glass tube breaks at a crack made in the neck, and thus ensures a complete immersion of the hot cylinder at a good depth in the water, which closes over the cylinder in a cataract. A similar experiment being performed with the empty cylinder, the difference gives the heating effect of the gas. The results given below for CO_2 show that the method, which, it is hoped, may yet be improved, is a workable one:

Initial temperature of gas	Final temperature	Mean	Specific heat
115	16	65·5	·200
192	16	104	·211
298	21	159·5	·288
398	21	209·5	·356

The authors are now measuring the specific heat of nitrogen in the same way.

PARIS.

Academy of Sciences, November 5.—M. Maurice Lévy in the chair.—On the velocity of light, by M. Perrotin. A redetermination of the velocity of light by Fizeau's method. The distance between the two stations was nearly 12 kilometres, and the mean result of about 1500 observations by two observers was 299,900 kilometres per second.—On the latest results obtained in the study of the infra-red part of the solar spectrum, by M. S. P. Langley. The author has been able to extend his previous researches on this subject in two directions, firstly by increasing the sensibility of the bolometer, and secondly by taking the observations at a great altitude, about 13,000 feet. By reason of the remarkable purity of the atmosphere at this height, a region of the spectrum has been discovered beyond the extreme point attained by previous observers. The tables now issued contain about 600 lines, 400 of which are new. The paper is accompanied by a whole page illustration.—Remarks on the preceeding communication, by M. J. Janssen. Attention is drawn to the effect of season upon the lines observed. By working at a high altitude some telluric lines may be eliminated.—On a class of algebraic surfaces, by MM. G. Castelnuovo and F. Enriques. On the topographical correction of pendulum observations, by M. J. Collet.—Acetals of polyvalent alcohols, by M. Marcel Delépine. Determinations of the heats of combustion of the formals and acetals of glycol, erythrol and mannitol.—Constitution of the nitro-derivatives of ethyl dimethylacrylate, by MM.

L. Bouveault and A. Wahl. The nitro-derivative previously described is split up by ammonia, giving acetone and ethyl nitro-acetate.—On the simultaneous presence of saccharose and gentianose in the fresh root of the gentian, by MM. Em. Bourquelot and H. Hérissey.—Note on a new glucoside extracted from the seeds of *Erysimum*, belonging to the Cruciferæ, by MM. Schlagenhauffen and Reeb. A description of the isolation, chemical and physiological properties of a new glucoside isolated from Erysimum, to which the name erysimine is given.—The distribution of the sexes in the eggs of pigeons, by M. L. Guènot. It is shown that the view commonly held concerning the distribution of the sexes in the two eggs of the pigeon is not supported by experiment, the relations found corresponding perfectly with those calculated from the law of chances.—Contributions to the study of the phenomena of metamorphosis in the Diptera, by M. C. Vaney.—Sexual reproduction in *Ophrycystis*, by M. Louis Léger.—On the parasitism of *Ximenia americana*, by M. Edouard Heckel.—On gaseous projectiles proposed for the prevention of hail, by MM. G. Gastine and V. Vermorel.

NEW SOUTH WALES.

Linnean Society, August 29.—The President, the Hon. James Norton, in the chair.—Descriptions of some new *Araneidae* of New South Wales, by W. J. Rainbow. This paper contains descriptions of four new species, and one well-marked variety of a previously described form. Of the forms described, one is referable to the genus *Dysdera*, Latr., and is consequently a new generic record for Australia. For this species the author proposes the name *D. australiensis*. Other forms described are *Tama eucalypti*, *Araneus parvulus*, *A. singularis*, and *Dicrostichus furcatus*, Camb., var. *distinctus*.—Studies on Australian Mollusca, Part ii., by C. Hedley. Several new marine shells from Queensland and New South Wales are described, including species of *Chlamys*, *Puncturella*, *Terebra*, *Leucotina* and *Liotia*. Two plates which accompany the article illustrate these, together with species named by Tenison-Woods, Brazier and Beddome, but not before figured. The genus *Menon* published in Part i. is shown to be reducible to *Chileutomia*, Tate and Cossmann, hitherto known only as an Eocene fossil. Notes on habits, geographical range and synonymy of known forms conclude the article.—Notes to accompany figures of Boisduval's types of six species of Australian *Curculionidae*, by Arthur M. Lea. With the co-operation of Monsieur P. Lesne, of the Paris Museum, the endeavour is made to clear up matters relating to the following species:—*Cryptorrhynchus dromedarius*, *C. lithodermus*, *C. fuliginosus*, *C. ephippiger*, *Gonipterus recticulatus* and *G. notographus*. The types are in the Brussels Museum, and have been examined by M. Lesne, who has forwarded his notes and sketches.—Contributions to the morphology and development of the female urogenital organs in the *Marsupialia*, Nos. ii.–v., by Jas. P. Hill.—Descriptions of two new species of Phytophagous Hymenoptera referable to the families *Oryssidae* and *Tenthredinidae*, with notes on other saw-flies, by Gilbert Turner. A species of *Oryssus*, a genus not hitherto recorded from Australia, and one of *Clarissa* are described, both from Mackay, Q. In the same locality the author has also collected five species of *Perga*, one of *Hylotoma*, four of *Pterygophorus*, and one of *Clarissa*.—On the measurement of bacteria, by R. Greig Smith. The measurement of the breadth of bacteria by the eye-piece micrometer is uncertain because the unit of measurement (one division) is generally larger than the object measured. The author has tabulated a number of diagrammatic bacteria, the breadth of which is expressed in terms of the length.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 15.

ROYAL SOCIETY, at 4.30.—Argon and its Companions: Prof. Ramsay, F.R.S., and Dr. Travers.—Data for the Problem of Evolution in Man. VI. A First Study of the Correlation of the Human Skull: Dr. Alice Lee and Prof. K. Pearson, F.R.S.—Mathematical Contributions to the Theory of Evolution. IX. On the Principle of Homotyposis and its Relation to Heredity, to the Variability of the Individual and to that of the Race. Part I. Homotyposis in the Vegetable Kingdom: Prof. K. Pearson, F.R.S.—A Chemical Study of the Phosphoric Acid and Potash Contents of the Wheat Soils of Broadbalk Field, Rothamsted: Dr. B. Dyer.

LINNEAN SOCIETY, at 8.—Contributions to the Comparative Anatomy of the Cycadaceæ: W. C. Worsdell.—On a New Parasitic Copepod: Miss Alice L. Embleton.

CHEMICAL SOCIETY, at 8.—The Bases contained in Scottish Shale Oil: F. C. Garrett and Dr. J. A. Smythe.

FRIDAY, NOVEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Capacity of Railway Waggons as affecting Cost of Transport: D. Twinberrow.

ANATOMICAL SOCIETY, at 4.30.—Notes on the Hair-slope in Man: Dr. Walter Kidd.—The Origin of the Vertebrate Eyes and the Meaning of the Second Pair of Cranial Nerves: Dr. W. H. Gaskell, F.R.S.

TUESDAY, NOVEMBER 20.

ZOOLOGICAL SOCIETY, at 8.30.—Contributions towards a Knowledge of the Osteology of the Pigmy Whale (*Neobalæna marginata*: F. E. Beddard, F.R.S.—A Description of *Wynyardia bassiana*, a Fossil Marsupial from the Tertiary Beds of Table Cape, Tasmania: Prof. Baldwin Spencer.—On some Crustaceans from the South Pacific. Part V. Arthrostracans and Barnacles: L. A. Borradaile.—List of Mammals obtained by Dr. Donaldson Smith during his Recent Journey from Lake Rudolf to the Upper Nile: Oldfield Thomas.

ROYAL STATISTICAL SOCIETY, at 5.—On the Distribution of Population in England and Wales, and its Progress in the Period of Ninety Years, from 1801 to 1891: T. A. Welton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed*: The Metropolitan Terminus of the Great Central Railway: G. A. Hobson and E. Wragge.—*Paper to be read, time permitting*: Machinery for the Manufacture of Smokeless Powder: Oscar Guttmann.

WEDNESDAY, NOVEMBER 21.

SOCIETY OF ARTS, at 8.—Opening Address of the 147th Session, by Sir John Evans, K.C.B., F.R.S.

GEOLOGICAL SOCIETY, at 8.—On a Monchiquite from Mount Girnar, Junagarh (Kathiawar): Dr. J. W. Evans.—On some Altered Tufaceous Rhyolitic Rocks from Dufton Pike (Westmorland): Frank Rutley.—On the Geology of Mynydd y Garn (Anglesea): C. A. Matley.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—An Improved Mounting for the Lens and Bowl of the Campbell-Stokes Sunshine Recorder: Richard H. Curtis.—Weekly Death Rate and Temperature Curves, 1890-1899: W. H. Dines.—Seasonal Rainfall of the British Islands: Henry Mellish.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—Exhibition of Slides illustrating the Structure of Shells.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 22.

ROYAL SOCIETY, at 4.30.—*Probable* papers: Further Note on the Spectrum of Silicium: Sir N. Lockyer, F.R.S.—On Solar Changes of Temperature and Variations in Rainfall in the Region Surrounding the Indian Ocean: Sir N. Lockyer, F.R.S., and Dr. W. J. S. Lockyer.—The Histology of the Cell Wall, with Special Reference to the Mode of Connection of Cells: W. Gardiner, F.R.S., and A. W. Hill. Part I. The Distribution and Character of "Connecting Threads" in the Tissues of *Pinus sylvestris* and other Allied Species: A. W. Hill.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Telegraphs and Telephones at the Paris Exhibition, 1900: John Gavey.

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