THURSDAY, DECEMBER 15, 1910.

THE CAVENDISH LABORATORY.

A History of the Cavendish Laboratory, 1871–1910. Pp. xi+342. (London: Longmans, Green and Co., 1910.) Price 7*s*. 6*d*. net.

THE occasion of this book is the fact that on December 22, 1909, Sir J. J. Thomson completed the twenty-fifth year of his tenure of the Cavendish professorship of experimental physics in the University of Cambridge. As the editors state in their preface, the suggestion was made by some of the professor's immediate colleagues that the event should be celebrated in some way which would commemorate a tenure so long and so full of achievement. Hence this history of the laboratory over which Thomson has presided for the greater part of its existence.

The general plan has been to divide the time covered by the history into periods, each of which has been treated by an author intimately acquainted with its events. The result is a marvellously interesting set of records. If the history had been written by one hand only, it would no doubt have been more continuous and concise, but it would have lost materially in charm and in value. As it is, the reader can well imagine himself in the company of a number of friends who have played important parts in a campaign, and who now relate in turn what they did and saw. And, of course, the campaign has been full of important events. Every student of physical science has been aware in a general sense of what he owes to the forward movements made in the Cavendish Laboratory. Yet in all probability even those who are best acquainted with the history of modern physics will find evidence in this volume of a greater debt than they had imagined. The list of papers published from the laboratory, a list to be found at the end of the book, is simply astonishing; it shows important additions made to every branch of physics. The names of the authors and workers in the laboratory include those of nearly all the best-known English physicists of to-day, and of many from abroad. In their contributions to the book itself the various writers give us something which is welcome and valuable. They bring about us the atmosphere of the place. We see the continual and unwearying struggle with the difficulties on that road which Maxwell and Thomson and their fellow-workers felt sure was the road to success. We realise their hopes and disappointments and successes as they try one line of attack after another; we share in the triumph of the final unearthing of the electron and in the rapid progress which followed on that unique discovery.

The story of the building of the laboratory is told by Fitzpatrick and Whetham, who also write of the commencement of instruction in practical physics at a time when there was hardly a precedent in such work to serve as guide. Schuster describes the period of Clerk Maxwell, whose commanding genius set a standard for his professorship and his laboratory. Two passages of Maxwell's writing are quoted repeatedly in the book; they have clearly been acknowledged as directions to his successors. The one is drawn from his inaugural address, and defines the aims and methods of experimental inquiry. The other is a flash of insight, the product of his brilliant work on electromagnetic theory. He saw that the phenomena of the electric discharge when better understood would "throw great light on the nature of electricity as well as on the nature of gases and of the medium pervading space." It is remarkable how fully this has been realised and how each one of the three questions which he mentions has since been illuminated by investigations in the direction which he points out. Best of all, a great part of this work has been done in the Cavendish Laboratory under the guidance of the man in whose honour this book has been written. Glazebrook writes of the fine work which was done under Lord Rayleigh, work characterised by Rayleigh's recognition that the accurate determination of electric standard had become a pressing matter. In 1884 Thomson succeeded Rayleigh. Thomson gives, in a chapter which is all too short, a survey of the twenty-five years that followed. It is naturally one of the most interesting chapters in the book. We read his own account of his work and of the gradual evolution of his principal discoveries, of his fellow-workers, of the system of teaching at the Cavendish, and of the classes that grew so rapidly under his rule.

No doubt Sir Joseph Thomson could hardly be trusted to write the full history of the doings in the laboratory during his own occupation of the Cavendish chair. That has been done by four men—Newall, Rutherford, C. T. R. Wilson, and Campbell, each closely concerned in the inquiries of the period which he has discussed. Newall describes the years between 1885 and 1894, when the interest centres round the general attack on the problem of the electric discharge. Rutherford writes of the three years of intense activity, 1895–8, when the position was stormed, the electron was captured, and Röntgen's X-rays supplied such a ready means of investigating phenomena in which the electron was concerned. C. T. R. Wilson describes the events of 1899–1902, including the elaboration and use of the condensation method which he himself did so much to perfect. Campbell shows the attempts to apply the new knowledge to "the fundamental problem of modern physics, the relation between electricity and matter." He gives also an interesting sketch of the curious and difficult situation into which the knowledge has led us. Finally, Wilberforce writes of the development of the teaching of physics with a keen sense, both of the difficulties of the art and of their compensating humour.

Taking the book as a whole it is, in the first place, a very charming testimony to the regard which the workers in the Cavendish entertain for Sir Joseph Thomson. He must be a happy man to note the generous and affectionate appreciation so widely evident in the book. In the second place, it will be of perpetual interest to students of physics as a record of the inner life of the Cavendish during a strenuous and prolific period. It is still more. It is practically the history of the development of laboratory teaching and organised research in England, so far as physical science is concerned. In many ways it is reassuring.

If we consider the work done, the number of first-class investigations, and the importance of the deductions made from them, we have no reason to be ashamed of our country's contribution to the general advance. We can be proud that so many students have proved their worth in the Cavendish and left it to fill important positions elsewhere, proud, too, that students from abroad have so freely acknowledged their debt to its spirit of enthusiasm and generous comradeship in research. It is true that the book leads us to consider the general question of physical research in England, and that we then find conditions which are not completely satisfactory. We have still to fight for the recognition of the value of such research, and we must in some way improve on the disjointed nature of the career of the research student. Too often his only reward is a teacher's position in which he finds difficulty in exercising the powers he has educated. But we cannot enter on the consideration of such questions now; we are only concerned with a book which fulfils admirably the purpose for which it was written.

A NEW BOOK ON REPTILES.

Reptiles of the World. Tortoises and Turtles, Crocodilians, Lizards, and Snakes of the Eastern and Western Hemispheres. By R. L. Ditmars. Pp. xix+373+87 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1910.) Price 20*s.* net.

PRIMARILY intended as a general survey of the reptiles of the world treated in a popular manner, the handsome volume which has just appeared simultaneously in this country and in America, will prove of special value to all who keep these animals in captivity. The name of Mr. Ditmars is a guarantee of accuracy and originality in the treatment of a subject in which he excels over all others. The success with which he has managed for some years the largest collection of living reptiles in existence, viz., that in the New York Zoological Park, is well known. From early boyhood his enthusiasm for reptiles, especially snakes, has led him to study the habits of these reptiles, so repulsive to many, even among educated people, and his house has always been the headquarters of an extensive collection of snakes, large and small, innocuous and venomous.

The information he gives us is therefore thoroughly trustworthy, unlike what we find in so many so-called popular works, and we strongly recommend this book to amateurs who keep reptiles in captivity, as well as to those whose duty it is to look after them in public menageries.

The American species, of course, receive the lion's share in a treatise emanating from America, and in a publisher's note to this English edition the reader is asked to bear in mind that the species referred to by the author as musk turtles, mud turtles, pond turtles, box turtles, &c., are known in this country as tortoises, the term turtle being restricted to the marine, and sometimes a few of the larger river species. The reviewer would express the regret that the term Terrapin, used for some of the fresh- or brackish-water tortoises in America, has not been made to include these intermediate forms, which are neither true tortoises nor turtles. Further, the name sand lizard, applied to *Acanthodactylus boskianus* (p. 38) is misleading, as by sand lizard every English reader would understand our *Lacerta agilis*, which has always been known under that name. As is to be expected from an author who is not exactly a systematist—some may say all the better for the treatment of the subject in a popular style, the information as to the relationships and distribution of the animals dealt with, and the number of species in each genus, is not always quite up to date. Thus we notice that among the Chelonians the Carettochelydidæ are still included among the Pleurodirans, to which they were tentatively assigned before the skeleton was known, although it is now established that they belong to the Cryptodirans, in the neighbourhood of the Trionychidæ. The common snapping turtle is said to extend southward to Ecuador, whence it was first reported by the late Prof. Peters; but the reviewer was able to show, many years ago, that the snapping turtle of Ecuador is a distinct species, identical with the Central American *Chelydra rossignoni*. No allusion is made to the allied genus discovered a short time ago in New Guinea.

On the whole the author has adhered to the classification and nomenclature used in the British Museum catalogues (1885–96), but he has departed from the latter in the case of many North American types, which causes some confusion and a lack of harmony in the systematic treatment of the subject.

These are, however, very trivial defects. The great value of the work lies, as we have said, in the matter relating to the habits of the reptiles, both wild and in captivity, a subject on which the author is *facile princeps*.

The varied contrivances by which reptiles secure their food, produce and rear their young, harmonise with their surroundings, &c., are fully dealt with, and in a thoroughly original manner. The size to which the largest crocodiles and snakes grow is also discussed, and only trustworthy records are adduced. The largest crocodile measures 30 feet, so does the largest python, the anaconda rather more than 25, the *Boa constrictor* only 11; but it must be borne in mind that the name *Boa constrictor* is often applied to pythons in menageries and by colonists in Africa.

On the subject of snakes swallowing their young, it is important to have the opinion of an observer of such wide experience as Mr. Ditmars. "The story of the female snake swallowing her young in time of danger," he says, "is purely fallacious. It has originated from observations of cannibal species making a meal of young reptiles" (p. 203). Apropos of cannibal species, we wish to direct attention to the important experiments made on the king snake (*Coronella* or *Ophibolus getulus*) of North America, a harmless species, which is apparently immune to the venom of such deadly pit-vipers as the rattlesnake, the copperhead, the mocassin, and the South American Lachesis, whilst it usually dies within an hour if injected with the poison of the old-world cobras.

Mr. Ditmars's observations and experiments on chameleons and other lizards with changing hues have

convinced him that the colour-changes which these reptiles undergo with such rapidity are not, as often believed, in harmony with their surroundings, but are regulated chiefly by light, temperature, excitement, fright, or health. We here reproduce a partial list of these experiments on the common chameleon :—

Specimen A. Placed in the sunlight so that but one side of the lizard was exposed to the rays.

Specimen B. Placed in the sunlight at an angle to entirely suffuse the reptile with the rays.

Specimen C. Placed in a dark box; temperature, 73° F.

Specimen D. Placed in a dark box; temperature, 50° F.

After fifteen minutes, the following results were noted :—

Specimen A. Was a dark brown on the side that had been exposed to the sun; the shadowed side was a pale brown, mottled with green.

Specimen B. A uniform brown, deeper than the dark side of specimen A.

Specimen C. When the cover of the box was drawn the lizard emerged in a brilliant coat of green.

Specimen D. Crawled sluggishly from the cold quarters. Its colour was a uniform slaty-grey.

One curious effect of sunlight and shadow was noticed. A specimen had been basking under a coarse wire grating. Becoming frightened at the approach of the observer, it changed its position. On the dark brown body was what had been the shadow of the grating, brilliantly imprinted in pale yellow. Within half a minute this pattern had entirely faded.

The book is copiously illustrated with reproductions of photographs taken by the author from living specimens, and most of them are of high excellence. In some cases, however, the reduction is too great, such figures as those of the European lizards and the glass-snakes and slow-worm (plates xxxia and xxxvii.) being, from this cause, practically useless. The snake figured on plate lxxvii as *Cerastes vipera*, and stated to measure about two and a half feet, is a hornless *Cerastes cornutus*. The author appears to be unaware of the existence of such hornless specimens, otherwise he would not have written (p. 328) that it is "impossible to mistake the horned viper," and that *C. vipera* is, but for the absence of horns, much like *C. cornutus*. A three-colour process figure of the rhinoceros viper, "the most beautifully coloured of all poisonous snakes," is given as a frontispiece.

G. A. B.

THE CALCULUS OF VARIATIONS.

Leçons sur le Calcul des Variations. By Prof. J. Hadamard. Tome premier. Pp. viii+520. (Paris: A. Hermann et Fils, 1910.) Price 18 francs.

NO one could be more competent than M. Hadamard to deal with the calculus of variations, and when this work is completed it will be a most valuable exposition of the present state of the subject. It is significant that in the first lines of his preface the author expresses the view that the calculus of variations is only a first chapter of the functional calculus (*calcul fonctionnel*) of Volterra, Pincherle, &c., and he gives, in fact, a short chapter on this new theory (pp. 281–312). But the analysis, in this volume, is mostly of a more familiar kind.

In fact, the first step in any actual case that naturally presents itself is still the classical one of Lagrange, by which we obtain a differential equation, or a set of differential equations. For simplicity, suppose the varied integral to be $\int f(x, y, y')dx$, then the differential equation is of the second order, and its solution is said to form a family of extremals. Supposing that the limiting values of x and the corresponding values of y to be given, then in the general case we may expect to find one extremal satisfying the terminal conditions. But it by no means follows that this curve really makes the given integral a maximum or minimum; an example due to Scheeffer is given on p. 45, which brings out the point very clearly. In this case the extremal found from the differential equation is $y=0$, and the corresponding value of the integral is 0; nevertheless, analytical curves can be drawn, as close as we please to $y=0$, which make the integral negative.

In any case, a solution obtained from an extremal is only a relative one; that is, the extremal gives a maximum or minimum value of the integral relatively to adjacent paths. And here it is important to define what we mean by *adjacent*, a fact first fully realised by Weierstrass, whose definition of adjacency of the pth order is given on p. 49. We may have, for instance, two curves each passing through the terminal points A, B, and as close together as we please, but one may be of continuous, the other of discontinuous curvature. Now, if we have a varied integral involving higher differential coefficients than y', we must exclude curves of discontinuous curvature, otherwise the problem becomes meaningless, and similarly in other cases.

After the limitations of the problem have thus been touched upon, book ii. deals with the first variation, and the conditions of the first order, including variable limits. Among other interesting points we have Weierstrass's transformation to homogeneous coordinates, a discussion of foci (points on the envelope of a family of extremals), and two very useful innovations due to M. Hadamard. If $\int f(x, y, y')dx$ is the varied integral, the *figurative* is defined to be the curve $f(x, y, y')=u$, in which u, y' are regarded as current coordinates, and x, y as constants. The *figuratrix* is defined as the polar reciprocal of the figurative with respect to $x^2+y^2=1$. By means of these curves the author is able to put various analytical conditions into a vivid geometrical shape. It may be added that book ii. contains the discussion of various classical problems, such as brachistochrones, least action, the Hamiltonian equations of dynamics, &c.

Book iii. introduces the second variation, and goes more deeply into the methods of Weierstrass, as well as those of Jacobi, Clebsch, Hilbert, Kneser, and others. We arrive ultimately at a statement, in various forms, of sufficient conditions for a minimum (pp. 389, 397), deduced mainly from the properties of a pencil of extremals, and a brief discussion of the necessary conditions, illustrated by examples (chapter iii.). The remaining chapters deal with variable limits, discontinuous solutions, Osgood's theorem in

connection with the strict minimum, and various other topics. Finally, there is a note on implicit functions.

Various interesting special theorems occur, by the way; as an instance, we have the theorem that if y vanishes for $x=a$ and $x=b$, the integral

$$\int_a^b \{(a-b)^2\left(\frac{dy}{dx}\right)^2 - \pi^2 y^2\} dx$$

is never negative.

It will be seen that this treatise is more for the advanced student than for the beginner; in fact, as the author expressly takes the theory of the differential and integral calculus for granted, the reader should be prepared with a good knowledge of analysis, including function-theory. In any case, the subject is intrinsically difficult, owing to the vagueness of the data when the problem is put in its general form; it is rather a matter of surprise that so much has been done, without unduly restricting the nature of the functions involved.

In conclusion, it should be stated that the treatise is based upon a course of lectures at the Collège de France, and that the *redaction* has been carried out by M. Fréchet, to whom M. Hadamard makes his acknowledgments. G. B. M.

HYDROELECTRIC ENGINEERING.

Hydroelectric Developments and Engineering. A Practical and Theoretical Treatise on the Development, Design, Construction, Equipment, and Operation of Hydroelectric Transmission Plants. By F. Koester. Pp. xxv+454. (New York: D. van Nostrand Company; London: A. Constable and Co., Ltd., 1909.) Price 21*s.* net.

HYDROELECTRIC power plants do not call for the same attention in this country as in America and on the European continent. Yet what English engineer who has visited such installations has not a store of vivid recollections and happy experiences? The mountains and the forests, the streams and the waterfalls—for the generating stations of hydroelectric plants are usually away out among the beauties of nature—all bring back memories of pleasant tours and the like, whilst so far from destroying the attractiveness of their surroundings by harnessing nature's forces in this way, the author of the present work maintains that the scenery has at times been made more interesting, when proper attention has been paid to the architecture and situation of the buildings. This opinion is well upheld by many of the splendid photographs reproduced so well in this large volume.

The title of the book, however, is certainly ambitious, and, criticised from this point of view, we fear that the treatment on the whole is too general and descriptive, even to the point at times of being meagre, to be of great service to those directly connected with hydro-power plant installations. This will be further understood from the table of contents, which comprises chapters on dams, headrace, penstocks, power plant, mechanical equipment, electrical equipment, electrical transmission, substations, line protection, and a long list of developments, any one of which could occupy such a volume by itself. Hence it is almost inevitable that only a bird's-eye view could be given when all these subjects were brought within the compass of one book. It may be recalled that this popular mode of treatment appears to meet with more favour in America than in countries this side of the Atlantic. With this one reservation, however, we have nothing but praise for the general excellence of the book, the care devoted to its arrangement, and the high quality of its illustrations.

To show that the writer is well up-to-date, it is only necessary to refer to a few of the new features in hydroelectric developments which are dealt with in their respective chapters:—Airshafts and equalising chambers in connection with pressure tunnels; seamless welded, flangeless, telescoping penstocks to facilitate shipment and to eliminate expansion joints; siphon system, in contradistinction to the inverted siphon; impulse wheels with draft tubes and multiple, non-water-wasting nozzles; compound turbine on a single shaft, the discharge of one being the supply of the other; rapid and complete turbine tests by certain methods and autographic recording device; 30,000-volt generators and their efficient protective devices against lightning. Unique combination of single and three-phase high-tension transmission systems from three-phase generators; wagon-panel switchboard systems; segregation and decentralisation of switchboards; continuous water-flow grounders and horngaps with micrometric setting. Two-legged transmission towers and line-crossing protection.

At the end of each chapter is appended a bibliography of works and papers to which the student may turn for further information; this compilation is by no means the least valuable feature of the book.

Occasionally the author's treatment includes matter where his judgment seems to have been less sound. Thus in discussing electric generators, he states there are three types—the inductor, the revolving armature, and the revolving field. But surely there is no reason for treating all these at equal length?—indeed, little harm would have been done if the discussion of the first two types had been omitted completely in describing modern high-tension machines, unless, of course, the author intended to enter into the province of the designer in order to bring out certain advantages in the older types which have recently become prominent. Nor is sufficient attention paid to the development of high-speed water-turbine sets of large output. It would have been well to have supplied a table giving outputs and speeds of modern turbine sets for the various classes of turbines.

Here and there an error has been allowed to remain in the text, whilst at times important questions, such as the effect of capacity in transmission lines, have been omitted.

Following a very useful and well-written chapter on line protection (lightning arresters), the last section of the book is devoted to a detailed description of eight modern American and European hydroelectric developments, which serve well to show the immense advance made in water-power installations during recent years.

STANLEY P. SMITH.

THE ORIGIN OF COAL.

Die Entstehung der Steinkohle und der Kaustobiolithe überhaupt. By Prof. H. Potonié. Fünfte Auflage. Pp. xi+225. (Berlin: Gebrüder Borntraeger, 1910.) Price 7.80 marks.

THE study of the probable mode of formation of coal and kindred substances has for many years engaged the attention of Prof. Potonié, who, as palæobotanist in the University of Berlin, and also as a member of the Geological Survey of Prussia, has had exceptional opportunity for such study, both in the cabinet and in the field. At the York meeting of the British Association in 1906, he laid before the Botanical Section his views on the origin of coal, and the following year issued the fourth edition of his little work, "Die Entstehung der Steinkohle, u.s.w."—an octavo of only forty-seven pages, which was briefly noticed in NATURE (vol. lxxviii., p. 86). In the new edition, recently published, the work has been considerably enlarged, and the title so modified as to indicate that it deals with the origin of caustobioliths generally.

Under this term *caustobioliths* are included all those rocks or mineral substances which are, directly or indirectly, of organic origin, and are combustible, whilst such organic rocks as are incombustible, like chalk, are distinguished as acaustobioliths. In order to explain the origin of the fossil deposits, the author has wisely given much attention to the corresponding recent formations, or what may be reasonably regarded as such. Three great groups of caustobioliths are recognised. In the first place, there are the rocks called *sapropelites*, formed from organic slime, or sapropel, resulting from the partial decay of aquatic organisms and their products in stagnant water. When the sapropel, in a sub-fossil state, becomes gelatinous, it is distinguished as saprocoll, whilst the Tertiary forms are described as saprodil, and the older varieties as sapanthracon. It is a disadvantage that the work is rather heavily weighted with an unfamiliar terminology, but it must be conceded that most of the terms are expressive, and in many cases undoubtedly convenient.

Cannel coal, boghead mineral and many so-called bituminous shales are regarded as sapropelites, whilst petroleum is considered by Prof. Potonié to be a product of the natural distillation of deep-seated sapropel rocks, which have been exposed to heat and pressure during processes of mountain-building.

Another great group of caustobioliths is formed by the humus rocks, which result from the accumulation of the remains of land-plants and bog-plants. This important class contains not only many brown coals, but our ordinary coals and anthracites. Whilst sapropel rocks, generally present a dull surface, or a silky lustre, and when heated yield much gas, the humus rocks, or at any rate those of Palæozoic age, are usually lustrous and yield a smaller proportion of gas. Coal which shows an alternation of bright and dull layers is regarded as a mixed caustobiolith, derived partly from humus, partly from sapropel.

To Prof. Potonié common coal is a rock which in most cases has been formed where it is now found, mainly by the fossilisation of deposits of peat, often in far-stretching swamps. Considering the modern tendency, especially in France, to regard most coal as a substance of allochthonous formation, it is interesting to find a distinguished specialist upholding the view of "growth in place," which until recently has been so much favoured in this country.

Peaty deposits, though not formed of transported material, may exhibit stratification, and humus matter may be partially dissolved in water and precipitated in layers. The coal-forming peat was probably in a pulpy condition. In certain cases, the author suggests that the appearance of stratification is explicable as the result of pressure acting in a direction at right angles to that of the lamination. Prof. Potonié holds that the flora of the coal measures indicates a tropical climate, and cites instances of the extensive growth of peat in tropical swamps, as in the fens of Sumatra, described by Dr. S. H. Koorders.

Distinct from both the sapropelites and the humus rocks is a small group of caustobioliths called *liptobioliths*, of which amber and pyropissite are examples. The liptobioliths consist chiefly of resinous and waxy substances, which by their resistance to decomposition are left after the decay of the other parts of the original organism.

Throughout the work the author gives numerous references to original authorities, but unfortunately in most cases without sufficient detail, the reference being usually limited to the name of the author and date of publication, such as "vergl. Uthemann, 1892." The student seeking further information would be grateful for a little more definite guidance.

F. W. R.

THE VOICE AND SINGING.

(1) *The Brain and the Voice in Speech and Song.* By Prof. F. W. Mott, F.R.S. Pp. xi+112. (London and New York: Harper and Brothers, 1910.) Price 2*s.* 6*d.* net.

(2) *The Abuse of the Singing and Speaking Voice: Causes, Effects, and Treatment.* By Prof. E. J. Moure and A. Bowyer, Fils. Translated by Macleod Yearsley. Pp. xi+130. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1910.) Price 2*s.* 6*d.* net.

(3) *The Voice. An Introduction to Practical Phonology.* By Dr. W. A. Aikin. Pp. ix+159. (London: Longmans, Green and Co., 1910.) Price 7*s.* 6*d.* net.

THERE are now many manuals dealing with the voice and with the management of the voice and singing. These are unequal in value, more especially as regards the description of the anatomy and physiology of the organs of voice and speech, and not unfrequently the writer strongly advocates a view peculiarly his own, and on which he founds his method of training. It is therefore of importance to have a description of the organs concerned in voice

and speech from the hand of an experienced physiologist, who is at the same time sympathetic with music and with the arts of speaking and singing. This we have in Dr. Mott's admirable little book (1). Nothing could be better than the description he gives of the whole mechanism, and in language that any intelligent person can understand. In particular, and as one would expect from a distinguished neurologist, Dr. Mott shows the intimate relations of the organs of voice and speech to the brain centres of hearing and of motion, both as regards the delicate movements of the mechanism of voice and of articulation, and as regards posture and other bodily movements. Teachers of the art of voice production, as in singing or in the articulation of words and sentences in public speaking, know little of this side of their subject, and we feel sure that much of Dr. Mott's information will be to them a revelation. A study of his book will in some respects modify their mode of teaching.

(2) Messrs. Moure and Bowyer's book is of a different character. It deals with voice production in singing, but more especially with the serious mistakes that may be made by methods of teaching, or by the strain put on voices by singers themselves, that cannot fail to injure the vocal apparatus. We would recommend that a student should, in the first instance, carefully study Dr. Mott's book, and then take up that of the French authors. In the latter there is first an interesting historical sketch of the teaching of singing, from the time of the Romans onwards. The church was the first educator of singers, to meet the requirements of the plain chant. Trills, tremillos, and shakes by and by embroidered the tones, and it is curious that for many years falsetto voices were in great request. The invention of the madrigal in the sixteenth century enriched vocal music and made greater demands on performers. Thus much was done before a physiological basis was laid by Garcia, after the revelations made to him by his invention of the laryngoscope.

The description of the mechanism is not so thorough in the French book as that given by Dr. Mott, and it may give some superficial if not erroneous notions. The portion on the registers is well done, and more especially the description of the mixed or middle register. The chapter on "Vocal abuse" gives much valuable information. Both teachers and singers often forget that there should be a physiological harmony between different parts of the vocal apparatus. Pulmonary capacity, muscular power, the dimensions and delicacy of structure of the vocal cords, are all more or less related. Strong and sudden expiratory efforts made with the view of increasing the volume of the voice may injure delicate cords. A light tenor may make the mistake of trying to do what only a strong tenor can accomplish, or the tenor may even imagine he is a baritone. It is true that no laryngoscopic examination can enable a master to determine what his pupil is capable of doing, but a few trials, cautiously carried out with such solos for various voices as are given in detail on p. 104, would soon settle the question. Singers may also injure their voices by frequent displacement or change in the range of their voice. The same baritone in some circumstances may have to sing on successive days, or even on the same day, as a deep baritone or a high baritone of the Verdi type. Modern composers, and especially Wagner and his followers, have injured many voices by the demands they have made, as, for example, in *Tristan and Yseult*. They have been called "the executioners of the voice." Some singers never learn properly how to breathe, and by taking in too large a volume of air and expelling it with violence, by "bellowing," in fact, they may even produce emphysema of the lung. The chest voice is difficult to manage, and it may be much injured, by welding two registers, and thus destroying purity of tones. The scales showing the range of the registers on pp. 80–81 are very instructive.

There is an admirable chapter on some of the pathological effects of abuse. We find also an appendix showing the vocal ranges of varieties of voices, such as strong tenors, opera tenors, opera-comique tenors, baritones, high baritones, or Verdi baritones, basses, basso cantando, basso profondo, contralto, high soprano, mezzo-soprano, and dramatic soprano, and, to add to the interest of the list, the names of many of the distinguished artists of their day are given. The authors also point out, and illustrate by portraits, the relation that often exists between the physical appearance of the singer and the range and quality of the voice. There are some signs of haste in the translation; p. 15, line 4, should not "cause" be case? Second sentence on p. 21 not clear. It is difficult to understand the portion of the sentence at the top of p. 42. At middle of p. 42 insert "if" before he. As we have already indicated, the French Book is the complement to that of Dr. Mott, and both taken together leave little else to be written on the subject.

(3) This book is an admirable account of the mechanism of both speech and song. There is a full description of the physiological mechanism concerned in the formation of vowel tones and the sounds of consonants. The action of the vibrators (the vocal cords) and the management of the resonator (the cavities of the pharynx, mouth, nose, &c.), is illustrated by exercises which a reader can readily follow, and the rules to be attended to in the management of the breath are given with physiological explanations. Two notable features of the book are a pronunciation chart showing methods for the practice of English pronunciation, and figures termed by the author "Song diagrams," showing the capacity of the various kinds of voices, from deep bass to high soprano. Composers would do well to study the figures on pp. 138, 139, and 140, where they would see at once the exorbitant demands on the voices of great operatic singers made by certain composers, notably by Wagner and even by Beethoven. The effect of the prolongation of very high tones may be brilliant and striking, but their production must cause, in many cases, serious tear and wear to a fine voice. As a truly scientific exposition, dealing with a subject that has an important practical aspect, Dr. Aiken's book is to be strongly recommended.

JOHN G. MCKENDRICK.

OUR BOOK SHELF.

Die Wissenschaftlichen Grundlagen der analytischen Chemie. By W. Ostwald. Fünfte Auflage. Pp. xii+233. (Leipzig: W. Engelmann, 1910.) Price 8 marks.

THE appearance of a fifth edition of this well-known book affords gratifying evidence of the widespread recognition that the study of analytical processes from the theoretical point of view is a necessary adjunct to the practical work of the laboratory. At the same time, the continued demand for a book of this character is a striking testimony to the general utility of the ionic hypothesis in the consideration of the problems of analytical chemistry. In spite of the many attacks, persistent and vigorous, which have been made upon the theory of Arrhenius, it has to be admitted that its position as a working hypothesis is stronger to-day than it was at the time of issue of the first edition of this volume.

The changes to be found in the new edition are comparatively few. The principal novelty consists in a slightly modified treatment of the theoretical portion as a result of the introduction of the view that the stochiometric laws are, in a certain sense, a consequence of the methods which are employed for the preparation and identification of compounds. In this connection the conception of *phase* is introduced, and since a phase may be either a pure substance or a solution, the problem of differentiating between these two classes is obviously one which falls within the sphere of analytical work.

Little need be said of the section dealing with the applications of the ionic theory to specific chemical reactions. In the explanation of the action of the indicators used in acidimetry, it is now admitted that the indicator ion has probably a different structure from that of the non-ionised indicator molecule. Few changes have, however, been found necessary as a result of recent work, and the characters are retained which have earned for the book the right to be counted amongst the classics of the literature of analytical chemistry. H. M. D.

The "Wellcome" Photographic Exposure Record and Diary, 1911. Pp. 280. (London: Burroughs, Wellcome and Co., n.d.) Price 1*s.*

THIS little pocket-book is a veritable *vade mecum* of photography in tabloid form, and while the present writer never wishes to be without his copy when out with his camera, he is sure other workers, when they become acquainted with the contents of these pocket-books, will express the same sentiments.

There is no necessity to recapitulate in detail the literary portions of this book, but suffice it to say that they are of a very interesting and useful character, and besides dealing with the technical difficulties of exposure, development, &c., and colour photography, they include directions concerning negative-making, tank or stand developing, printing, toning, intensifying, and so on. In addition to the portion devoted to the recording of negatives exposed, there is ample room for memoranda to replace the use of an ordinary notebook. An important feature is the simple and effective exposure calculator attached to the inside of the cover, the correct exposure being read off under all conditions of light and subject by a turn of the scale. For this issue, this calculator is rendered even more simple for those who always employ plates or films of one speed. By the insertion of a special disc, which may be obtained gratis from the publishers, the exposure can be read off at a glance for any stop. This special disc will be particularly useful to those who expose yards of film in their Kodaks or other hand cameras.

It should be remembered that three editions of this "Record and Diary" are published, with corresponding data for the northern hemisphere and tropics, the southern hemisphere and tropics, and the United States of America. Handy in form, and bound in a neat green cover, it will find favour with most photographers.

Reason and Belief. By Sir Oliver Lodge. Pp. xiv+212. (London: Methuen and Co., Ltd., 1910.) Price 3*s.* 6*d.* net.

THIS is a contribution to the literature of reconciliation. The science and religion of the nineteenth century were hopelessly at variance, chiefly in consequence of the latter's claim to pronounce in matters of cosmology (*e.g.* Mr. Gladstone's "Impregnable Rock of Holy Scripture"). But the conditions are now different. Religion is being regarded as "an attitude of the soul to all that it knows of cosmic law"—in Myers's phrase—rather than as a matter of dogma; and science, also, is learning humility. Crude materialism is seen to be no complete solution of the riddle of the universe, for we do not know what "matter" is. Moreover, psychology is bringing to light certain phenomena which orthodox scientific theories do not seem to cover. The time, therefore, is ripe for a *rapprochement*; and among leaders of thought on the scientific side of the reconciliation movement, Sir Oliver Lodge is by far the most eminent and the most influential.

Man is a being who is temporarily clothed in matter, for purposes of education. He has lived before birth, and will live after "death," in modes only dimly conjecturable at present. If so, what difficulty is there in supposing that an exceptionally great and loving spirit, seeing the race's need, may voluntarily take a body of flesh, in order to teach his similarly incarnated brother spirits? This shows the way to a reconciliation of reason and belief on a cardinal doctrine of Christianity.

The volume is enriched with apt quotations from many sources—Wordsworth, Browning, Tennyson, Swinburne, Myers, Francis Thompson, &c. Its style is popular and clear, but the thought throughout is deep and suggestive. The latter part has an illuminating chapter on the scope of science, and also deals with the teaching of the Old Testament in the light of evolution, and with anticipated criticism. J. A. H.

Altitude Tables, computed for Intervals of Four Minutes between the Parallels of Latitude 0° and 30° and Parallels of Declination 0° and 24°, designed for the Determination of the Position-line at all Hour Angles without Logarithmic Computation. By F. Ball. Second edition. Pp. ix+245. (London: J. D. Potter, 1910.) Price 15*s.* net.

THE appearance of a second and improved edition of these tables is welcome on several grounds, but mainly as an indication of increasing accuracy in nautical calculations. We hope, too, that the demand for such tables may be regarded as a proof of the growing popularity of the method of determining the position of a ship at sea proposed by Captain Marcq St. Hilaire, of the French Navy. This method, though theoretically superior to that of finding the Sumner lines by the ordinary process, has not been generally adopted, on account of the slight increase in the computations required. Seeing that in the St. Hilaire method, the observations may be made at any time with equally good and consistent results, whereas in the ordinary method, observations taken near the meridian may have to be repeated nearer the prime vertical, the objections that have been alleged against the newer method on account of the length of the

observations ought not to be allowed to prevail. The sailor expects to find tables at hand that shall curtail the arithmetical processes to a minimum, and these tables, the main feature of which is to give readily and accurately, at sight, the altitude of the sun or of stars within the ecliptic limits, at least in the more frequented latitudes, will remove one of the objections that have been urged.

Other tables suggested by experience have been added in this edition in order to increase its utility and avoid the necessity of further reference. With these tables and a nautical almanac, it is said that the navigator can complete his task. We would, however, allow him a book of logarithms, for the tables given here are too restricted to serve any useful purpose. One might need to check the accuracy of some of the quantities supplied, though we have no reason to doubt the general accuracy of the tables, for which Dr. Crommelin and some of the staff of the Royal Observatory are responsible.

Metallography Applied to Siderurgic Products. By Humbert Savoia. Translated by R. G. Corbet Pp. xii+180. (London: E. and F. N. Spon, Ltd., 1910.) Price 4*s.* 6*d.* net.

THE Italian original of this little book was obviously intended to bring the more essential parts of the metallography of iron and steel within the reach of Italian metallurgists, but what motive there can be to justify the translation into English of such an elementary compilation it is not easy to understand, particularly as satisfactory original works in our own language are now available. In the book as it stands the feats of the author are largely disguised by the achievements of the translator, who appears to have invented an entirely new nomenclature not only for purely metallographic terms but for well-known and widely-used technical words. That the translator disclaims technical knowledge of the subject-matter of the book and begs for indulgence in regard to technical terms cannot, unfortunately, alter the fact that much of the book would be rendered unintelligible to the non-expert reader for whom it appears to be intended by such glaring translator's errors as the use of "tempered" for "hardened," mechanical "elaboration" for mechanical "working," "resolving" for "dissolving," "composite" for "compound" in its chemical sense, "soldered" for "welded," "strain of extension" for "tensile strength," and many others; perhaps the most amusing example of the translator's misinterpretation of the Italian words occurs in the description of the Le Chatelier thermo couple as consisting of "platinum and radiated platinum."

Apart from these serious defects, the subject-matter of the book is not free from errors; thus the text of p. 69 definitely suggests that "pearlite" is formed from molten steel, and indeed throughout the text the difference between the eutectoid pearlite and a true eutectic is not indicated. The most satisfactory portions of the book are those dealing with malleable cast-iron, where the author is evidently on his own ground, but, taken as a whole, the book cannot be recommended to students of metallography.

W. R.

Researches upon the Atomic Weights of Cadmium, Manganese, Bromine, Lead, Arsenic, Iodine, Silver, Chromium, and Phosphorus. By G. P. Baxter, and others. Pp. vii+185. (Washington: Carnegie Institution, 1910.)

THIS memoir, which is published through the munificence of the Carnegie Institution of Washington, is one of the many series of similar researches which we owe to the Harvard School of Chemistry. It comprises eleven separate investigations on the atomic weights of the elements enumerated in the title, the results of which have been published in American and German periodicals at intervals during the past six years.

In the form in which they are now presented a few minor alterations have been made, necessitated by a more precise knowledge of certain of the fundamental values upon which the determinations are based. Certain of the original papers have had their subject-matter rearranged. The eventual results have, however, already been incorporated in the last annual report of the International Committee on Atomic Weights, and are therefore readily accessible to all workers.

Practical Measurements. By A. W. Siddons and A. Vassall. Pp. xiv+60. (Cambridge: University Press, 1910.) Price 1*s.* 6*d.*

THIS book is a development of the course of physical measurements founded by Mr. Ashford at Harrow in 1896. Recently the earlier portions have been worked under the mathematical staff. The course follows closely the syllabus of the joint committee of the Mathematical and Science Masters' Associations. It is important that teachers should read the authors' observations on p. vii., as there is a danger that the work may lead boys to suppose that "science" and "measurement "are synonymous. The course is open to the serious objection that it provides a long series of measurements which are purposeless from the boy's point of view. Thanks to the experience and shrewd observation of the authors, the book may serve as a trustworthy aid to mathematical teachers who are undertaking, for the first time, the control of classes engaged in laboratory work. Such teachers will find their routine work improved as well as lightened by its use. To sum up, the book provides a well-planned drill of a not too interesting kind, and makes it possible to insist on the work being properly done by the boy who desires to have a too easy time.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland: A Record of the Work Done in Science, Literature, and Art During the Session 1909–1910 by Numerous Societies and Government Institutions. Compiled from Official Sources. Pp. iii+370. (London: Charles Griffin and Co., Ltd., 1910.) Price 7*s.* 6*d.*

THIS is the twenty-seventh annual issue of a widely known and very useful work of reference to which attention has often been directed in these columns. We have noticed several additions to the list of societies and associations, the work of which is described. It seems strange, however, to find in a volume issued at the end of 1910 particulars of the Winnipeg meeting of the British Association in 1909 and no references to the meetings of the association at Sheffield this year.

Cambridge. Described by N. Barwell. Pp. 64. *Norwich and the Broads.* Described by W. Jerrold. Pp. 56. *The Heart of Wessex.* Described by S. Heath. Pp. 64. All pictured by E. W. Haslehust. (London: Blackie and Son, Ltd., 1910.) Price 2*s.* net each.

THESE latest additions to the series known as "Beautiful England" are likely to be popular guide-books to the districts with which they are severally concerned. Mr. Haslehust has been successful in giving in his pictures delightful impressions of the different counties, and visitors will be glad to have the volumes to remind them of the beauties of the holiday resorts they have frequented. The descriptions are gossipy and entertaining.

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.]*

Morphological Method and the Ancestry of Vertebrates.

THERE has just reached me the Proceedings of the Linnean Society for October, containing the report of an interesting discussion upon the "Origin of Vertebrates" which took place at meetings of the society in January and February of this year. Apart altogether from statements as to matters of fact which seem to be open to challenge, this discussion appears to me to raise points in regard to the methods employed by the morphologist which are of practical importance to those interested in the science of morphology.

The remarks made by Dr. Gaskell and his supporters make it apparent that there exist wide differences between what they accept as the correct principles of morphological research and those which are accepted by other working morphologists. Personally, I have been devoting myself for some time past to researches dealing with the evolution of vertebrate structure, and my impression is that there can be no wider gulf than that existing between the working principles apparently adopted by Dr. Gaskell and those adopted by myself and many other morphologists. If the principles of morphological speculation employed by Dr. Gaskell are sound, it seems to follow that those held by the majority of morphologists are absurd, and that the work based upon them represents in great part wasted labour. I will endeavour to throw into relief some of these radical differences of opinion as to general principles which appear to separate many of us from Dr. Gaskell and his friends. I feel all the more impelled to do so when I read the words of a distinguished physiologist who took part in the discussion:—"I am convinced that the principles on which he [Dr. Gaskell] has proceeded are the only ones which will lead to a solution of the problem." I fully realise that there are physiologists who would feel it rash to express themselves so decidedly as to what are, or what are not, the correct principles upon which to work in a science other than their own. Nevertheless, it seems quite clear that Dr. Gaskell's views—though they may not appeal to many who are specialists in vertebrate morphology—do produce a strong impression on many workers in other departments of biological science.

What are the principles which must be followed in speculations regarding phylogeny if these speculations are to be trustworthy? It is clear, in the first place, that whenever possible such speculations should rest upon a tripod basis of comparative anatomy, embryology, and palæontology. It is clear, further, that in fashioning each foot of the tripod certain definite rules must be adhered to if the foot is to be sound and sufficient to support the weight which is to rest upon it. For example, in making use of the data of palæontology, we have to bear in mind, firstly, that the geological record, and still more our knowledge of that record, is and must always be of the most fragmentary character, and, secondly, that in all phylogenetic speculation it is unsafe to trust to data dealing only with one single set of organs, whether these be the skeletal organs—alone, as a rule, available to the palæontologist—or any other system of organs. In the case of comparative anatomy and embryology we must bear in mind that a feature has a *prima facie* greater importance or not according as to whether or not it occurs in a more or less "primitive" group. Then, again, in both comparative anatomy and embryology it is necessary to devote great care and attention to the sifting out of features which are mere adaptations to modern environmental conditions from those which are ancestral. Finally, it has to be borne in mind that in comparative anatomy we are beset by the same kind of difficulty as that of the protozoologist when he tries to piece together isolated observations on dead material into a connected life-history, while in embryology, on the other hand, the facts, such as they are, appear to be presented to us all ready arranged in their phylogenetic sequence. These general principles apply to all phylogenetic speculations, and morphologists are probably all in agreement regarding them.

Now as regards the phylogeny of the Vertebrata. When a student under Sedgwick at Cambridge I began to realise that perhaps the most clamant need in vertebrate morphology was for a broadening of its observational basis, particularly in regard to the embryology of the more primitive forms of vertebrates. There seemed general agreement that the elasmobranchs, crossopterygians, lung-fishes, and urodele amphibians were all "primitive" groups as compared, *e.g.*, with teleostean fishes, reptiles, birds, and mammals. It seemed clearly indicated that if we were to have the general ideas of vertebrate embryology upon a trustworthy basis it was essential that the development of the crossopterygian ganoids and lung-fishes should be worked out to a similar degree of detail to what had been accomplished in the case of the other groups. My own research work during the last fourteen years has been directed according to this ideal, and has been devoted to the study of the morphology of the four relatively primitive groups mentioned above, together with, of course, the cyclostomes. As I fail to see how there can be any other scientific method of approaching the problem of vertebrate phylogeny than that which starts from a comprehensive study of such surviving forms as are admitted to be the more primitive, I may be excused for venturing to offer these remarks regarding the discussion at the Linnean Society.

One of the points raised in the discussion is the very important one, upon which I have elsewhere expressed opinions—the relations of physiology and morphology. No one has, I dare say, a greater horror than I have of that type of zoologist sometimes referred to as the "mere" morphologist—the zoologist who fails to keep before him at every moment of his work that he is dealing with living functional organisms, who fails to realise that at every stage of its evolution an organ must, in the first place, be able to function. I have at various times criticised evolutionary speculations, *e.g.* on the evolution of renal organs, or of the vertebrate limbs, or on the inadequacy of natural selection, because they seemed to ignore important physiological or functional considerations. While taking the greatest care to keep physiological considerations before us, we must, however, not forget that the *facts* upon which the evolution theory is based are morphological facts. We know nothing as yet of "recapitulation" in physiology; we have in the rocks no record of physiological change; even the science of comparative physiology is still in its infancy. The whole record of evolution is and must necessarily be mainly, if not entirely, a morphological record.

Another principle which is of much importance in morphological work is this: the greatest care must be taken to make the observational basis of speculation as broad as possible. The fewer the organs or the organisms that are made use of the less trustworthy are the conclusions drawn. *E.g.* a detailed study of the radiate eye of an insect and of a stalk-eyed crustacean brings to light the most striking resemblances, so much so that if we only knew one genus of each group and only the eye structure in that genus we should be inclined to suppose the two genera to be closely allied. I need not say that a study of the general morphology of the Antennata on the one hand and the Crustacea on the other indicates that they have been evolved separately from a simple ancestral form which existed probably long before the radiate eye had become evolved. The same kind of principle holds in regard to organisms. The detailed study of the structure of two animals may bring to light the most astounding resemblances in details of structure, and it may, nevertheless, be the height of rashness to attribute the resemblance to genetic affinity unless there exists collateral evidence which supports the view. Yet Dr. Gaskell says, "my object throughout has been by the study of Ammocœtes to find out a clue to the past history of these extraordinary early forms of fish." Is the ordinary zoologist like myself completely in error when he thinks that for "Ammocœtes" there should have been written the words "cyclostomes, crossopterygians, elasmobranchs, lung-fishes, and amphibians" in formulating

Dr. Gaskell's programme of work at this immense problem of the ancestry of vertebrates?

Personally, were I concentrating in this way on the study of Ammocœtes, I should be constantly oppressed by an uneasy feeling of absolute uncertainty as to the extent to which the cyclostomes are primitive in their structure and to which specialised for their extraordinary habits, unique amongst vertebrates. Certainly we should expect *a priori* that vertebrates that took to such a mode of life would tend to become extremely specialised. We do not even know for certain whether they are derived from jaw-possessing ancestors, though we cannot help suspecting that a vertebrate taking to the cyclostome mode of life would tend to lose its hinged jaw and become, therefore, cyclostomatous.

Another cherished principle of morphological research receives a rude jar in Dr. Gaskell's sentence, "to me and to all my friends who are accustomed to deal with the vertebrate nervous system the explanation I have given is so self-evident and natural that it is impossible to look at the matter in any other way." Are myself and other teachers of morphology talking nonsense when we urge upon those commencing research work that the frame of mind which they must endeavour to avoid at all cost, if their work is to be of value, is that in which they come to regard their working hypothesis as "so self-evident and natural that it is impossible to look at the matter in any other way"?

An important principle is that enunciated by Dr. Gaskell when he says that "each higher group of animals has arisen in succession from the highest race developed up to that time, by highest meaning the group possessing the best developed central nervous system." Apart from the trivial point that many would differ from Dr. Gaskell in their estimate of the trustworthiness of the palæontological statements by which this principle is illustrated, the principle itself seems to many a somewhat doubtful one. I take it by "high development" we mean, roughly, "complexity of organisation." Now organisation is upon the whole adaptive to functional activity. A highly organised animal is, as a rule, one the details of the structure of which are highly specialised in relation to environmental conditions. Such adaptive specialisation of the various organs renders their possessor peculiarly liable to suffer from changes in environmental conditions. It seems probable that changes of environmental conditions form one of the chief factors in compelling evolutionary change. It is at such periods that natural selection is most accentuated: the adaptable survive, the unadaptable are exterminated. It appears quite credible that when important geological or other environmental changes come about it is those forms the organisation of which shows the most complete linking up to the preceding set of conditions which are exterminated, in other words, that it is *not* the highest existing forms which proceed to evolve into a state of adaptation to the new set of conditions.

Apart from general principles, there are many important statements as to fact which seem to me to call for comment. Amongst these, for example, I read that "the evidence of the rocks points to the Silurian age as the time when the vertebrate first arose." To me it is simply incomprehensible how any biologist can really believe that the scales and teeth, comparable in complexity with those of existing fishes, occurring in Silurian formations, can be taken as having any bearing whatever upon the question of the first appearance of vertebrates. There are indeed, I think, many who feel compelled to admit that the period of evolutionary time intervening between the first appearance of the simplest chordates and the appearance of these Silurian fishes may well have been as great or greater than that which has intervened between the Silurian times and the present day.

Dr. Gaskell refers to zoologists "accepting as a commonplace the manufacture of a new organ for breathing air instead of water in the transition from the fish to the amphibian." He also says that the evidence seems to him stronger that the vertebrate alimentary canal has been formed from a pre-existing respiratory chamber "than that an alimentary canal should have taken on a respiratory function in its anterior end." I would only remark that anyone who studies the evolution of the adult vertebrate from the embryo can see for himself, as a matter of fact, that the anterior end of the alimentary canal does develop a set of gill clefts, *i.e.* a mechanism which in fishes is respiratory. Further, the only morphologist who has had the opportunity of studying the development of the lung in the lowest lung-bearing vertebrates asserts that the homology of the lung or swim-bladder of fishes with the lung of the higher vertebrates appears to him to be beyond question, and he takes the view that the lung, instead of developing "in the transition from fish to amphibian," was in all probability already present in the ancient common ancestral form from which teleostomatous fish, lung-fish, and all the higher vertebrates have been derived.

Dr. Gaskell refers to the old idea that the infundibulum of the vertebrate brain represents the œsophagus of the invertebrate, and that the suprainfundibular part of the brain represents the supraœsophageal ganglia. Such an idea would only be of value as a scientific hypothesis if based upon the facts of the earlier stages of brain development in the more primitive groups of vertebrates. I have personally studied the development of the brain in elasmobranchs, crossopterygians (Polypterus), actinopterygian ganoids (Amia, Lepidosteus), lung-fishes (Ceratodus, Lepidosiren, Protopterus), and urodele amphibians. The phenomena seen in these forms do suggest certain conclusions as to the general morphology of the vertebrate brain, as that the hemispheres are primitively paired or that the primary subdivision of the brain is into two rather than into three parts ("vesicles"). They do not suggest, however, any such view as that referred to. On the contrary, they appear to me to indicate that the part of the central nervous system which in the annelid or arthropod has become the supraœsophageal ganglia has in the vertebrates completely disappeared.

Dr. Gaskell refers to those views which "turn the animal topsy turvy, making the back of the invertebrate correspond to the ventral surface of the vertebrate." As a matter of fact, the only two stages of vertebrate ancestry which may be regarded as established with a fair degree of probability are:—(1) a protozoan stage recapitulated in the unicellular zygote, and (2) a cœlenterate stage repeated in the diploblastic stage of Amphioxus and in the corresponding stages of lampreys, elasmobranchs, crossopterygians, lung-fishes, and amphibians. We know, of course, nothing of the details of structure of the diploblastic ancestor, but it has been suggested by Sedgwick and others that these ancestral forms passed through a stage resembling in its general features the existing actinozoan. This idea, which in my opinion is still a perfectly reasonable working hypothesis, affords an adequate explanation of developmental phenomena otherwise extraordinary and ununderstandable, such as the occasional occurrence of a mid-dorsal slit dividing the central nervous rudiment and notochord into lateral halves. It would clearly be unfair to state that such a view is "doomed to failure" because it makes the back of an invertebrate correspond to the ventral surface of a vertebrate. The view does not assume the reversal of the body. It merely refers back vertebrates and cœlomate invertebrates to a common ancestor in which there was no ventral or dorsal surface—a form in which there was a certain amount of concentration of the nervous system in the region round the primitive mouth or protostoma—and suggests that in certain of the descendents of this ancestral form the normal position of the body is with the neural surface beneath or ventral (annelids, arthropods, molluscs), while in others (vertebrates) it is such that the neural surface is uppermost or dorsal.

A strong point about this view is that it suggests a possible origin of the segmented character of the mesoderm of the vertebrates. It is generally agreed that the mesoderm is of enterocœlic nature, and it was emphasised long ago by Sedgwick that just such a segmentation of enterocœlic pouches is already present within the phylum Cœlenterata in the Actinozoa.

Prof. Starling in the discussion said:—"To an onlooker like myself the striking resemblance between the earliest fishes and the Arthropoda . . . is striking evidence in favour of Gaskell's theory." Morphologists, unfortunately, have as yet no knowledge of the earliest fishes. They are acquainted only with certain dermal skeletal structures and a few impressions which give a vague

notion of the general form of certain Silurian "fish-like" forms. Assuming, however, that it is the case that to the onlooker there is a striking resemblance between the earliest fishes and the Arthropoda, it is necessary to point out that striking resemblance in superficial characters provides a type of pitfall which the morphologist has at an early stage in his education to school himself to avoid. He comes across cases of amazing resemblance, *e.g.* in pairs of "mimetic" butterflies, between a marsupial and a placental mammal, between the organ of vision of one of the higher insects and that of one of the higher Crustacea, between the skeleton of a flagellate and that of a radiolarian, and he learns to recognise that superficial resemblance may, and frequently does, provide a cloak for fundamental unlikeness. It is, in fact, one of the main parts of his business as a morphologist to find out whether in each particular case the striking resemblance so apparent to the onlooker is an expression of resemblance in fundamental points of structure or whether, on the other hand, it is merely superficial.

I think I have now said enough to make apparent how greatly some of us who devote ourselves to the problem of vertebrate phylogeny differ from Dr. Gaskell and those with him in what we regard as the necessary principles in accord with which morphological work must be done. As regards Dr. Gaskell's main thesis, that vertebrates are descended from arthropods, we take the position that what is known of the morphology of vertebrates in general, and of arthropods in general, does not justify the regarding of that view as a reasonable working hypothesis. Were Dr. Gaskell to increase by several fold his mass of detailed anatomical resemblances between an undoubted arthropod and an undoubted vertebrate, we should feel ourselves confronted, not by a demonstration of near genetic affinity, but rather by a fascinating puzzle in the way of convergent evolution. It would take up too much space, and perhaps serve little purpose, to indicate the general considerations, the cumulative effect of which is to force zoologists into the position I have indicated. I may, however, just indicate one feature, the character of the skeleton, which, as it happens, is a highly characteristic feature alike in the arthropods and in the vertebrates. In the Arthropoda we find one of the finest evolutionary inventions existing in the animal kingdom—a supporting skeleton formed out of waste products of metabolism, and so spread over the surface of their body as to form an armour effectively protecting the delicate living tissues of the body from the most varied kinds of dangers. That a group of free-living arthropods should have given up this magnificent protective device is not, of course, incredible, but before being accepted as probable it would have to be supported by an overwhelming mass of evidence.

What evidence do we, in fact, find as to the nature of the skeleton of the primitive vertebrate? We find in the vertebrate that the skeleton in the earliest stages of its development consists of a cellular rod cut off from the dorsal wall of the gut and running longitudinally along the median plane of the body. This rod, the notochord, which still persists as the main axial skeleton in the adults of some of the lowest vertebrates, occurs during embryonic development, not merely in a few vertebrate forms, but in every lower vertebrate the embryology of which has so far been investigated. There is not a single exception. Could evidence be more overwhelming that the ancestral vertebrate was a creature with a skeleton in the form, not of a hypertrophied cuticle, but of a cellular notochordal rod formed from the wall of the gut? Dr. Starling would object that "no palæontological evidence seems to be brought forward in favour of this hypothesis." The answer is a perfectly simple one. Palæontology can from the nature of the case offer us hardly any evidence whatever in regard to structures composed of soft, perishable organic material. By far the greater part of the tissues and organs with which the morphologist deals are composed of such soft, perishable materials, and all these structures, upon the *cumulative* evidence of which (taken in conjunction with the much smaller amount of evidence obtained from the skeleton) he bases his conclusions, are almost entirely absent from the geological record. I might go farther and point out that a highly developed, highly rigid skeleton is in itself a product of long-continued evolutionary change. Each animal possessing such a skeleton is the descendent of a long line of soft protoplasmic forms in which the skeleton had not yet become evolved, and these ancestral forms have, so far as palæontology is concerned, vanished for ever from our ken. It is upon the study of the comparative anatomy and embryology of existing forms alone that we have to depend when we endeavour to form a picture of what these ancestral forms were like.

The foregoing paragraphs are not meant as a criticism of Dr. Gaskell's hypothesis. They are merely meant to direct attention to an extraordinary want of agreement as to methods or principles of morphological research. It is clear that work in any department of science must be done according to some definite set of principles if it is to be of any appreciable value. In morphology, as in other sciences, there are certain generally accepted principles. It seems to me not unreasonable to ask that workers who take up morphological research should either accept these general principles and be guided by them, or, if they find themselves driven to formulate a new and better set of principles, that they should at least state these clearly and give their fellow-workers the opportunity of judging in what respects they are better and more trustworthy than those in ordinary use. Unless this is done there is apt to be caused an irritating waste of time and energy. There is, further, the danger that important work may be rejected without adequate examination, not because of its inferior quality, but simply because of the difficulty in the way of discovering common factors between it and work on the more ordinary and orthodox lines.

J. GRAHAM KERR.

The University, Glasgow.

Mendelian Expectations.

MR. LEWIS BONHOTE has confirmed Mr. R. Staples Browne's statement that the web-foot in pigeons is a simple Mendelian recessive, but he finds that when webbed birds from two different strains are crossed an irregular result is obtained, viz. four normal and one webbed. Moreover, mating the first crosses yielded results in almost every case contrary to Mendelian expectations, normals throwing webs and webs throwing normals (NATURE, December 1, p. 160). Similar results have been obtained with West Highland terriers, in which white is apparently recessive to yellow. The offspring of pure-bred white terriers belonging to the same strain are white, but the offspring of pure-bred white terriers from different strains are sometimes yellow. Further, a hybrid (yellow) which produced more than 50 per cent. of white pups to a white dog of her own (Inverness) strain produced only yellow pups to a white dog of a different (Poltalloch) strain.

The explanation of these "irregular" results seems to be that the normal toes, presumably latent in webbed pigeons, and the yellow coat, presumably latent in white terriers, are restored when two strains having a somewhat different history are interbred, *i.e.* mingling the blood of two strains induces reversion. Because "points" are lost when two strains are crossed, many breeders are extremely reluctant to introduce new blood even when their stock is obviously deteriorating from in-and-in breeding. Recently a very successful breeder assured the writer that nothing in the world would induce him to use the blood of another strain to improve his white Highland terriers, and it is notorious that breeders of sheep and cattle have once and again allowed their flocks and herds to lapse owing to their reluctance to infuse fresh blood from other strains. Further, Von Oettingen has pointed out that, in the case of the English racehorse, the more remotely related the parents the less chance there is of the offspring winning races.

If crossing two strains is liable to lead to reversion, we can understand why in some hands breeding is such a lottery, why, *e.g.*, the offspring of two record racers or trotters are sometimes complete failures. The English thoroughbred breed is made up of several distinct types, each of which is now and again represented by a Derby winner. When two fleet but not too closely related members of the same type are mated, the result may prove highly satisfactory, but when the sire belongs to one type and the dam to another, and when, in addition,

the parents are so remotely related that they are separated by seven or more "free generations," the chances are (unless one of the parents is highly prepotent) that, notwithstanding the great merits of the immediate ancestors and the expectations of Mendelians, the offspring will revert to mediocrity. Hence it is not enough that breeders should "mate the best with the best, avoiding close affinities"; they must avoid crossing distinct strains even when the members of one strain closely resemble those of another. This implies that, in addition to knowing the pedigree of their stock, breeders should know as much as possible of the wild races from which modern varieties and strains were originally derived.

J. C. EWART.

Arctic Plants from the Valley Gravels of the River Lea.

I HAVE recently found a plant-bearing bed in the Low Level River-Drift of the Lea valley at Ponder's End. It is exposed in an excavation worked by the Great Eastern Railway Company, and I am indebted to Mr. Horace Wilmer, engineer to the company, for permission to carry on my investigations.

The plant-bearing bed is found at a depth of 14 to 18 feet below the surface. It is embedded in stratified gravel and sand, which presents much evidence of tumultuous accumulation. In immediate association with it are found tusks, teeth, and bones of the *Elephas primigenius*, *Rhinoceros antiquitatis* (if we are no longer permitted to call it *tichorhinus*!), and other Mammalia.

The pit is situated on the present floor of the valley of the Lea at a level of about 35 or 40 feet above the Ordnance datum.

In correlation with the archæological stages, the plant-bearing bed of Ponder's End is later than the Mousterien epoch. In fact, it is separated from this epoch by such a wide interval that it is in all probability post-Palæolithic. On the other hand, it is unquestionably pre-Neolithic, although the interval in this case appears to be comparatively short. There is thus little doubt that it comes within the period of the archæological hiatus between the Palæolithic and the Neolithic ages.

It is by far the most important plant-bearing bed that has hitherto been found upon this horizon within the area occupied by Palæolithic man in this country. It occupies a position not represented on the well-known sites of Hoxne or Hitchin. The only bed, so far as I am aware, which can be placed on the same horizon is that at the Admiralty Buildings, Westminster. This, however, only yielded two species of plants, one of them being the Arctic form *Betula nana*.

I am at present engaged upon working out the botanical material from this bed—a laborious task, occupying a large amount of time. I am submitting this to Mr. F. J. Lewis, who has very kindly undertaken its identification. A considerable amount of material has already been examined, and, so far, Mr. F. J. Lewis has succeeded in identifying ten species of plants, with four others doubtful. Three of this number, namely, *Salix herbacea*, *Betula nana*, and *Sibbaldia procumbens*, are distinctively Arctic, while most, if not all, of the remainder have a high northern range, although they are not confined to those regions. Mr. F. J. Lewis defines the assemblage as Late Glacial.

The researches of Mr. Clement Reid in beds associated with the Palæolithic deposits have shown that there have been many oscillations of climate in the south of England since the deposition of the Chalky Boulder Clay. With the evidence of this new bed before us there can be no doubt that the Palæolithic age was closed by a partial return to glacial conditions, succeeding an epoch, or epochs, when temperate conditions prevailed. This conclusion is in agreement with the results of recent work upon the mammalian fauna of the Pleistocene age.

This is not the place to enter further into this discussion. Enough has been said to indicate the importance of this bed in throwing further light upon the climatic changes of the Pleistocene age. It certainly suggests that the archæological hiatus is to be directly associated in the south of England with a final return of glacial conditions of climate.

If this view be sound, as I believe that it is, it seems to be perfectly justifiable to define Palæolithic man as interglacial, even although the last glacial phase above indicated could not, of course, compare in severity with those which preceded it.

S. HAZZLEDINE WARREN.

Sherwood, Loughton, Essex.

A New Theory of the Descent of Man.

IT is probable that some readers may fail to appreciate Prof. Klaatsch's "New Theory of the Descent of Man" at its proper worth owing to the technical terms and obscure descriptions used in the account published in NATURE of November 24 (p. 118). The theory is simply this. The Neanderthal man and the gorilla have continuous supraorbital ridges and similar markings for the insertion of muscles on their skeletons; the Aurignac man (who could pass as a fairly high type of modern humanity) has not a continuous supraorbital ridge, in which he presents a very superficial resemblance to the orang, and has certain muscular impressions on his skeleton somewhat similar to the orang's.

On this basis, which must be admitted to be "flimsy" in the extreme, Prof. Klaatsch builds his new theory and supposes that the gorilla and Neanderthal man are co-descendants of one branch, the orang and the Aurignac man of another. If one were to apply the principles used by Prof. Klaatsch to the canine in place of the human world, then we should say that the rough-haired Newfoundland is a co-descendant of a rough-haired bear, while the smooth-haired mastiff has arisen with the sleek leopard. An explanation is thus given of the points in which the Newfoundland and the bear, the mastiff and the leopard, have in common; but what of the hundred characters which the Newfoundland and the mastiff possess in common, and which separate them from the bear and leopard? Prof. Klaatsch ascribes these to "convergence phenomena." At least that is how he accounts for the fact that the Neanderthal and the Aurignac men have all the features common to humanity; one arose *via* the gorilla and the other arose *via* the orang, but both arrived at the same structural goal so alike that most of us regard them as the same species.

The theory, owing to the demand it makes on "convergence phenomena," passes somewhat beyond the limits of rational speculation. Prof. Klaatsch's theory has failed to gain the support of his able colleagues in Germany, and is not likely to receive serious consideration in this country.

A. KEITH.

Royal College of Surgeons, December 10.

The Cocos-Keeling Atoll.

IN reply to Mr. Wood-Jones's letter (NATURE, December 1), I would say that I still consider that his arguments against Sir John Murray's theory go in support of it.

Mr. Wood-Jones suggests the reason for the precipitation of calcium carbonate, *when it has once begun*, going on until the solution contains less than the normal quantity; what I wished to emphasise was that precipitation does not *begin* until more calcium carbonate than is normally present first passes into solution, *i.e.* that no crystals can be formed in the interstices of the massive corals in the lagoons until some of the dead coral is dissolved. There *is*, therefore, *proof* of solution in the lagoons of atolls.

In an early discussion on the same subject Sir John Murray pointed out that the processes of the solution of the carbonate of lime of dead shells and skeletons by sea water, and of its secretion by the living organisms, are going on side by side wherever there are life and growth, death and decay. In some regions secretion is in excess, and there is a formation of calcareous deposits; in others solution is equal to secretion, as in the red clay areas of the ocean; in others solution may be in excess of secretion, as in the larger and more perfect coral lagoons.

In small coral atolls the periphery is large relatively to the size of the lagoon, and the secretion of lime and the formation of coral sand are greatly in excess of the solution that takes place, hence the lagoon becomes filled up.

In large atolls, on the other hand, the periphery is small relatively to the size of the lagoon; there is less secretion and formation of coral sand by the living outer surface than is removed in solution from the lagoon, which is, in consequence, widened, deepened, and reduced to a more or less uniform appearance.

MADGE W. DRUMMOND.

Challenger Office, Villa Medusa, Boswell Road, Edinburgh, December 6.

Positions of Birds' Nests in Hedges.

ABOUT a year ago I wrote to NATURE (December 16, 1909) giving certain facts which I had noticed with regard to the position selected by birds when building. There seemed to be good reasons for such selection, but I wanted to know whether the conditions I had noticed were local or general. The letter sent to NATURE by Mr. A. R. Horwood showed that similar conditions were found in Leicestershire, Shropshire, and Surrey. Of the information which reached me directly, one letter deserves mention.

Mr. Francis G. Cousins enlisted some of the boys of the Johnstone Schools, Durham, as observers. Out of eight nests, the positions of which are given in the terms of my letter, two only faced north, one faced north-west, four south-east, and one south. I quote the following note sent by these observers:—"In the north-east of the district, with fairly open country, the nests faced north-east, and *at their rear was a vast extent of woods*. In the south-east of the district the nests face south-east, *with woods again at their backs* and open country in front." The italics are mine. I need not labour the conclusion that birds seek sun and warmth when building their nests. In this connection it is interesting to quote an observation made by Mr. Roosevelt ("African Game Trails," p. 290). He notes that, in Guaso Nyero, just north of the equator, the weaver birds place the mouth of the nest invariably towards the north, away from the strong, prevailing winds.

J. H. TULL WALSH.

Heath House, St. Faiths, Norwich, December 11.

Tribo Luminescence of Uranium.

I HAVE not seen in recent literature any reference to the "tribo" luminescence shown by uranium salts, and by metallic uranium in particular. Having accidentally knocked over a bottle containing 2 grams of the latter substance, I was surprised to see the bottle glow with a brilliant yellowish-white light, and on shaking the bottle the luminosity could be maintained to such an extent that the label on the bottle was read with ease, and the general illumination seen easily throughout a large lecture-room. The best way to see the glow is to bring the bottle sharply down on the palm of the hand.

On repeating the experiment with compounds of uranium, the nitrate and yellow oxide show the same effect, but to a very much smaller degree, whilst the black oxide and sodium uranate do not give it.

I expect the above must be known to workers with uranium salts, but it may be useful to some of your readers to know a method by which tribo luminescence may be so easily demonstrated.

W. A. DOUGLAS RUDGE.

Grey University College, Bloemfontein, November 18.

MARKED BIRDS IN TWO SENSES.[1]

(1) THE interesting brochure referred to below gives an account of the bird observatory belonging to the German Ornithological Society at Rossitten, which, already well known, is likely to become in the future of prime importance in securing data, by local observations and by the labelling of living birds, towards the determination of many obscure questions in bird migration.

Rossitten is situated on the narrow belt of sand-dunes, lying between Cranz and Memel, which bank out the Baltic Sea from the Kurische Haff, the more northern of the two lagoons chiefly forming the seaward face of East Prussia. The station—mainly designed by Dr. Thienemann, the distinguished ornithologist—was established in January, 1901, and fitted up at the expense and under the auspices of the Ministers of Education and Agriculture. Being, therefore, a State institution, it will possess greater stability than it could have had under the private enterprise of the society alone. Dr. Thienemann is director of the station, and holds with this post that of Custos of the zoological collections of the neighbouring university in Konigsberg. Ulmenhorst, the actual designation of the observatory, derives its name from the generous lord of the manor, Herr E. Ulmer, who presented, in 1907, the present buildings in a new and more favourable site, some seven kilometres from Rossitten, than the original installation. Here Dr. Thienemann and his assistants, cut off from the world, spend the dreary and stormy season of the year from October 1 to May 1. The station stands on the narrowest part of the sand-spit, whence the observers have a free and unrestricted view of the area between the seaward and the inner sandhills, and can study the birds which specially collect there under genuinely natural conditions. Previous observations made along this stretch of sand-dunes, on the movements of the hooded crow (*Corvus corax*), proved that a migration route of great importance passed along it, and that every year it was a rendezvous for flocks composed of the same individuals. The site, therefore, though peculiar and isolated, has been deliberately chosen because of its special advantages.

The chief objects of the observatory are to record the exact dates and composition of the migration flights, with the numbers and age of their component species; the direction in which the birds travel; the velocity and altitude of their passage (to be determined by the use of field telephones and box-kites), and the atmospheric conditions prevailing during its continuance, with the effect of any changes on the migratory stream. Many other cognate questions are to be inquired into, such as bird-life in relation to food supply, moulting, and colour changes in the plumage at different ages, the economical value of birds, and the most suitable means of protecting useful species. It is intended also to form extensive collections of the skins and internal parts of the birds of the Nehrung and neighbourhood for reference and systematic study. The scope of these observations as proposed to be carried out at Rossitten, if covering a somewhat wider field than, does not greatly differ from that undertaken by, the committee of the British Ornithologists' Union and by other observers elsewhere. Valuable as the observations all are, however, they do not, as was pointed out in NATURE of May 26, 1910, seem likely to carry us further forward than we at present are towards the solution of the phenomena of migration, until such observatories are more numerous and widely distributed; for what is now required is to trace individual birds or flocks along every part of their route from their birthplace to their winter quarters, and back again several times. These feathered armies may change their altitude, speed, and direction, or may break up into several battalions beyond the nearest horizon of an isolated observatory, and be affected in front and in rear by weather conditions unobservable from it. Even such bird observatories are as yet few in number. There is one at Riga, one in Algiers, another in Heligoland, and the one so well known, at Buda-Pesth, which cooperates with an observer in almost

[1] (1) "Die Vogelwarte Rossitten der Deutschen Ornithologischen Gesellschaft und das Kennzeichnen der Vögel." By Dr. J. Thienemann. Pp. 36. (Berlin: Paul Parey. 1910.)

(2) "Aigrettes and Bird Skins: the Truth about their Collection and Export." By Harold Hamel Smith. With a Foreword by Sir J. D. Rees, K.C.I.E., C.V.O., M.P. Pp. iv+138. (London: John Bale, Sons, and Danielsson, Ltd., 1910.) Price 5s.

every Hungarian province. By the more crucial method of bird-marking the Rossitten observers are busily engaged in carrying out investigations which will give us eventually, we trust, the essential data referred to above: the identification of the members of a flock all along its migration route.

Besides those of Rossitten, only a few other ornithologists have attempted the "kennzeichnen" of birds. These are Prof. Martensen in Viborg, Prof. Thomson in Aberdeen, Mr. Witherby in London, and the watchers at the Heligoland station. The "marking" is done by affixing a light aluminium garter, capable of easy and quick attachment to the leg of adult birds captured for the purpose, and of fledglings before they leave the nest. The weight of these rings is so disproportionate to that of the bird that they form (as has been proved) no possible impediment to its flight or feeding. The weight of a stork's ring, for instance, is only 2·4 grammes, while that for small species is only 0·05 grammes. Each ring bears a number and the name of the station embossed on it, and when attached serves as an addressed missive for its return to the station of origin. The latter is obviously an essential factor to the success of the system. At all events, if the ring itself be not returned, its number with an accurate note of the time and place of its wearer's recapture must be communicated to the observatory, or published in some journal likely to meet the eye of the Rossitten or other European ornithologists. Each bird, as soon as ringed, is liberated to assemble with or rejoin its associates in autumn and fare forth on its adventurous voyage. The larger the number of birds ringed out of a migratory flock, the greater are the chances of prizes being drawn in this novel lottery by the man with a gun or a snare, and of data, indisputable and free from conjecture, being accumulated towards the elucidation of the routes followed by the flock, and of the terminus of its journey.

At Rossitten numbers of hooded crows, black-headed and herring gulls, storks, rough-footed buzzards, and various species of Totanidæ, Fringidæ, and Charadriidæ have been ringed since the observatory was established. The success of these experiments has been most remarkable. Large numbers of hooded crows were obtained for marking through the observatory's investigators associating themselves with the crow-catchers who frequent the dunes for the purpose of netting these birds for food. Twelve per cent. of the marked crows were recaptured, and the place of their misfortune plotted on a map, which shows that this species disperses over a wide region to the north and south. The most northern point of recapture was 30 km. from Savonlunna in Finland, and Solesmes in France, the most westerly and southerly; while Prettin on the Elbe was the most southern spot in Germany itself. From Rossitten to Savonlunna the distance is 900 km., to Solesmes 1280 km., and from Savonlunna to Solesmes 2180 km. Recaptures were also often effected in the crow-catchers' nets in the neighbourhood of the East Prussian lagoons, sometimes after the lapse of three or four years, showing that the hooded crows come backwards and forwards to this region. Strange to say not a single marked individual from Rossitten has been reported from the Netherlands.

Space does not permit our referring to any of Dr. Thienemann's other records save that of the stork, which indicates very clearly the great value of the results to be expected by and by from these investigations. The first gartering experiments on storks were made in the Zoological Gardens in Berlin on old and on half-fledged birds. They were so successful that assistance was requested, from those who had access to nests of these birds, in ringing as many individuals as possible. The observatory distributed rings free and post paid to all who requested them, on the sole condition that a list of the birds marked, with a note of the place and date of their liberation, and of the numbers on the rings, be sent to Rossitten. In the first year 1044 rings were distributed to outside helpers. The results were astonishingly successful. First of all it was proved that the storks migrate in autumn, not to the south-west, but to the south-east. On plotting the "find places" of the recaptured birds on a map, the course of their long journey from East or North Prussia, where they were ringed, could be traced out with beautiful regularity to east and south. One was returned from Poland, one each from Damascus, Acco (in Palestine), and Alexandria; one, snared by a native, from Fittrisee, in Central North Africa; one from Rosseres, on the Blue Nile; one out of a flock from Fort Jameson, in Rhodesia; one from the Kalahari desert, 8600 km. from its home, killed for food by a Bushman, who, seeing the ring, threw his prize away in terror as something uncanny! and two from Basutoland, in southernmost Africa, which were nine months old, and had travelled 9600 km. from their birthplace. The dated rings proved also that storks return from between one to three years after leaving the nest to within a distance of their natal district of from 6 to 94 km.

The recapture of certain ringed swallows in the nest in which they were born a year after leaving it raises, by the way, the interesting question: If a young bird of the previous year returns to its actual nursery, where do its parents nest? This system of marking the old and young of migrating species will unquestionably go far to provide data for solving the great mystery of bird-life; but it is essential that it be extended to the northern regions of America and Asia; and be instituted not only there, but in the middle and at the southern extremity of the journey—in Central Africa, in South America, in South China, and in Australasia—a work in which ornithologists, travellers, civil servants, and military officers in these regions could render very important assistance. Nor must the marking be confined to large birds. Passerines, because less conspicuous, and because they are captured in large numbers for food, for cage-birds and as agricultural pests, should be ringed in all holarctic regions in vast numbers while in the nest. The establishment of new observatories in these distant regions of the globe is also a matter of urgency which should be seriously dealt with by the next Ornithological Congress. Chance and happy circumstance will doubtless in time reward such efforts, and return to the expectant ornithologist answers from out of the empyrean to his numerous queries, and will yet, we trust, reveal to him the *causa causans* of the periodical restlessness that impels the novice-bird to start and guides it on its long, dangerous, often fatal, but hitherto untraversed route to winter quarters of which it has no previous knowledge.

(2) The second book on our list is, we fear, rather an apple of Sodom, fair on the outside, but, within, ashes—of gunpowder. It deals with birds marked for a very different purpose from those of Rossitten. It is chiefly made up of contributions by Mr. Harold Smith, reprinted from a paper called *Tropical Life*, of which he is editor, and from the *Times*, by various correspondents, to defend those engaged in the plume trade in the tropics from, as is suggested, attacks behind their backs and in their absence by those "bigoted members of society," "well meaning but badly informed agitators," and "egotistical humanitarians," who are urging the Government to legislate to prevent the indiscriminate slaughter of "plumage birds now

rife in certain parts of the British Empire," and, by prohibiting their import into England, to discourage the wearing of birds' skins, feathers, and plumes.

Of course, the badly informed humanitarians are the ornithologists and the lovers of birds in all parts of the civilised world. These people form, however, a large body of highly educated men and women, who among them have closely studied bird-life in every corner of the globe; and who, entirely disinterested, are possessed of—let us say—*quite* as much common sense, are as little led by "sentiment," and know "the true facts of the case through long years of experience," as well as Mr. Harold Hamel Smith and the feather traders.

The book is full of red-herring trails across the question, and of mean suggestions (*cf.* pp. 31, 41 (footnote), and 56) which are not worth our while to notice, and from which even Sir J. D. Rees, who writes a foreword to the book, dissociates himself. It would be reslaying the slain to discuss the question whether or not the slaughter of many kinds of birds for trade purposes is cruelly carried on or not. "Their [the plumers'] ravages are simply sickening," says Prof. Newton, one of the most accurate and unsentimental ornithological historians that ever lived. The evidence is overwhelming. Nor is it worth while discussing whether or not many species of birds are, through the same agencies, becoming exterminated. That question is also beyond contention. The paper on extinct and vanishing birds, by the Hon. Walter Rothschild, in the Proceedings of the fourth International Ornithological Congress (1905), should be read by those interested in this question, and also the remarks of Prof. Newton on Extermination in his "Dictionary of Birds." "The collection of skins for ornithological museums or fishing tackle," we are told, "is far more likely to exterminate a few rare birds than the millinery trade"—who, we are also told, are "the real protectors of birds"—"ever will be." The great bird collection in the British Museum, the largest in the world, contains probably about 500,000 skins, the result of more than a century's assiduous amassing. The present writer has been witness of that number of humming-birds (chiefly) and other bright-plumaged denizens of the Brazilian woods, all killed in the breeding season, being shipped in one consignment (and that not the solitary one of the season) from Rio de Janeiro to London; and has seen in the Moluccas a single canoe-load brought by native hunters consisting of scores of thousands of the most gorgeous members of the New Guinea avi-fauna spread out like wheat in a godown awaiting shipment to Europe.

Such extensive massacres, in which not only the parents but the nestlings perish, may go on for years and not become very obvious without investigation on the spot; but history shows that the results appear only when it is too late for protective measures to be taken. When a species has been reduced in numbers below a certain point, natural enemies, "red in tooth and claw," and causes difficult to determine, begin to operate, and these complete the ruthless work of man without his further interference. Another good reason for legal regulation of this trade is that, by the extinction of dominant species in a region, the equilibrium of nature is disturbed, and results disastrous to agriculture and in other directions arise. These questions formed the theme of many serious discourses by ornithologists from all parts of the world at the congress held this summer in Berlin. There the concensus of opinion was that measures must be taken internationally to prevent the present wanton slaughter of birds.

The burden of this book is that the plume-traders will suffer great loss by the exclusion of skins and feathers from this country. The same cry was raised by the slave-traders against the emancipators who struck at a "legitimate and honest trade" and "an important industry in this country." One correspondent of the *Times* writes (p. 98) it is "generous of you to offer your columns to both sides of this controversy." Mr. Smith, less generous, excludes all correspondence sent to the same journal on the protectionists' side. From one of the letters he publishes we learn that the feather trade is rapidly going to other countries, for reasons independent of threatened legislation or of interference by "badly informed agitators."

If it be true that the really large part of the trade is done in "the millions of poultry and game-birds' plumage, quills, and tails" (p. 105), why, then, this great outcry against the protection—which the traders say they desire—of the most beautiful and useful of living creatures, since tropical skins form in England so small a portion of the trade. Among the demands of the traders one is protection for the birds at their natal centre only. This the Government to some extent has done, and can do only, in its own possessions; still, its legislation instead of "not securing the preservation of a single bird" (p. 84), is providing, and will increasingly provide, very large areas of sanctuary for them. It would stultify itself if it allowed the importation of feathers from everywhere else, but prohibited it from its own dominions. Another demand is a close season (in India, for instance), after which skins and plumes would be allowed to be exported. As it is in the breeding season chiefly during which the birds don the ornamental plumage for which high prices are paid, it is obvious—human avarice being what it is—that bird slaughter would be carried on surreptitiously during that season, and the results quietly stored away until the closure was over. The expense of enforcing a close season being prohibitive, the next best means of staying the evil is prohibition of export. The "agitation" has been taken up by the Ornithological Congress, and we may shortly look forward to international regulation of the trade.

This book may contain "the truth" about the collection of "aigrettes and bird skins" as it appears to Mr. Harold Hamel Smith; but we conscientiously believe that every unprejudiced, disinterested humanitarian in this country will repudiate his assertion.

A MONOGRAPH OF THE OKAPI.[1]

THOUGH this monograph is replete with exact, and in many cases novel, information regarding the outward aspect and bones of the okapi, it will certainly strike the general reader, as well as the zoologist, as being an incomplete treatment of the subject. This may not be the fault of its principal author, Sir E. Ray Lankester, and is certainly not that of the keeper of the Natural History Museum, Dr. Sidney F. Harmer, but is apparently due to the financial control disliking the expense of publishing the volume of text, which should have accompanied the mere illustrations included in the volume under review. The reason given is that as Jules Fraipont has already published a monograph of the Okapi for the State Museum of Tervueren, Brussels—an admirable piece of work, it is generally admitted to be—the publication of the text of Sir E. Ray Lankester's studies and deductions would be superfluous. It is

1 "A Monograph of the Okapi." By Sir E. Ray Lankester, K.C.B., F.R.S., assisted by Dr. W. G. Ridewood. Pp. viii+48 plates. (London: British Museum (Natural History) printed by Order of the Trustees, Longmans and Co., B. Quaritch, Dulau and Co., Ltd., 1910.) Price 25s.

difficult to agree with the propriety of such a decision, and it is to be hoped that before long the text which should accompany these illustrations will also be printed and published, especially as in the interval of time which must elapse, further accurate information regarding this interesting beast may have come to hand. (The present writer has just been advised by Dr. Bumpus, of the Natural History Museum at New York, that a collector sent out by that museum has succeeded in capturing alive a male, female, and calf of the okapi, and these living forms of the animal are now being conveyed across the Congo basin for shipment to New York.) M. Fraipont's work, moreover, complete as it was for the date of its publication in 1908, is not nearly so accessible to ordinary students of zoology as the British Museum publications.

The history of the discovery of this Giraffid form at the very opening of the twentieth century has already been related so frequently that it does not need to be repeated. But the specimens received during the first few years from the present writer and others, left and above the eyes, swellings to which attention was immediately directed by the whorls of hair in the skin of my large specimen, which suggested that the okapi could develop giraffe-like "horns" on those places. The complete skin and skull obtained for me by Lieuts. Meura and Eriksson, and now in the British Museum, were shown conclusively to belong to an example that was sub-adult, namely, not grown to its fullest size of development. The sex was very doubtful. The natives who brought in the skin seem to have spoken of it as the skin of a male, but it was generally adjudged to be a female.

As soon as attempts were made to transmit okapi specimens to Europe, the zoological authorities in Brussels, London, and Paris were not long in having in their hands skulls of undoubted male okapis possessing ossicones three inches long or more, some of which bore at the tip a small piece of naked bone equivalent to the beginning of an antler. Other skulls, again, supposed to be female, were quite hornless. In some cases, minute ossicones were dis-

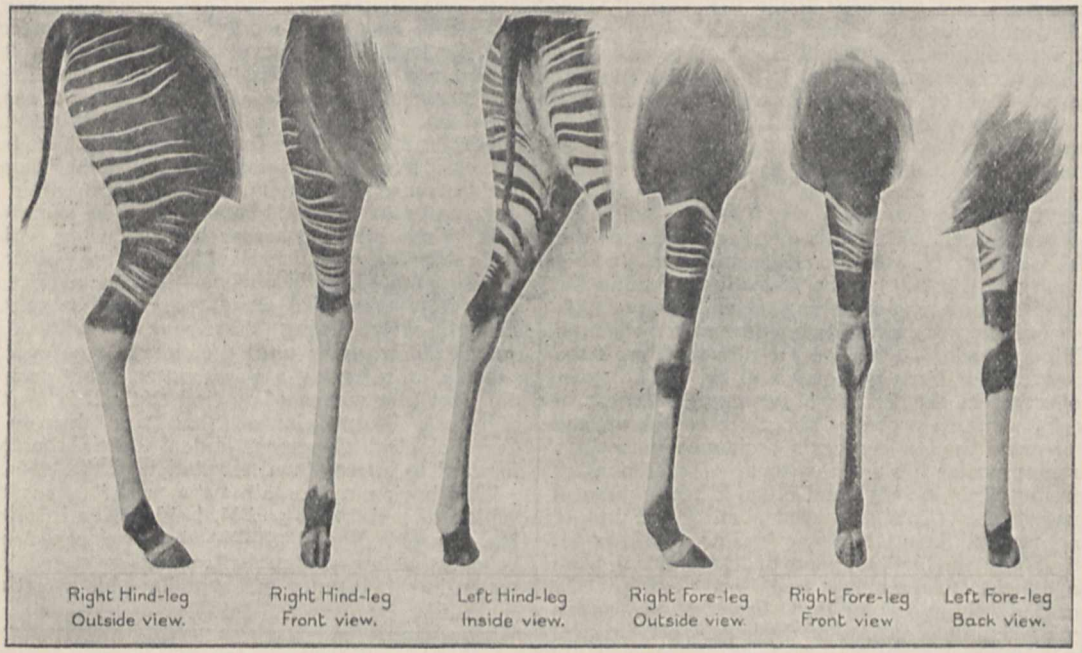

FIG. 1.—Specimen of Okapi in the British Museum (Natural History) presented by Sir Harry Johnston. From "A Monograph of the Okapi."

those zoologists who studied them in some perplexity, for they seemed to indicate, when closely compared and examined, the existence of two types, or even species, of okapi. There was considerable difference, for example, in the arrangement of the stripes on the hindquarters between the first strips of skin sent home by myself in 1900 and the complete skin obtained by me with the help of Lieuts. Meura and Eriksson in 1901, and still more in the specimens secured later by the Belgian officers in the Congo basin and a number of British explorers or natural history collectors.

As already stated by M. Fraipont, this variability of the alternations of black and white on the hindquarters and fore limbs must apparently be accepted as a characteristic feature of the okapi, and can scarcely be regarded as of specific value. But then arises the problem of the existence and non-existence of ossicones. Both the skulls sent home by me in 1901 were found to be hornless, though one presented slight swellings of the bones at the base of the nose covered under the skin. The general conclusions to which zoologists were brought by the imperfect material at their command were: that there were either two species of okapi, one horned and one without horns; or that the comparatively speaking hornless female okapi was larger than the male: for the horned skulls of all the known male okapis are found to be smaller than those of the specimens of hornless females.

Then, again, the skulls seemed to be divisible into two series, broad and narrow. The question of two distinct races, subspecies, or species, of okapi (the first known of which was styled *Okapia johnstoni*) can only be decided finally by extended research. M. Jules Fraipont came to the general conclusion in 1908 that there was but one species known to us which he re-named as above, but opined that there might be distinct local races, varieties or even subspecies, within a geographical range, which, although described in the monograph under review as of limited

area, is really not so very restricted after all. The notes and observations of explorers and Belgian officials show that the okapi is met with from the vicinity of Nyangwe, in the eastern part of the Congo basin, at no great distance from the west coast of Tanganyika and from between 4° and 5° south latitude, to the River Welle at the same distance north of the equator, and almost to the banks of the Semliki River and the forests west of Lake Albert Nyanza; while its western range has already been extended (north of the main Congo) to the lower course of the Mubangi River, which lies not far away from the zoographical limits of the Cameroons district. Indeed, it would not surprise me at all if some such explorer as Mr. George Bates discovered the okapi in the Cameroons hinterland, just as he has discovered there the Black Forest pig, and other equatorial African animals first recorded in the East or Central African forests.

Whether the okapi is found anywhere to the *west* or *south* of the course *of the main Congo* is as yet unrecorded, just as we have no record of the existence of any anthropoid ape in the Trans-Congo regions. So far as our imperfect information goes, the main stream of the great Lualaba Congo acts as the limit of distribution of some other forms of mammals, and it may well be that at the time these creatures entered tropical Africa the greater part of the Congo basin was still a vast, shallow, fresh-water sea. A good many of the creatures of the equatorial belt of Africa extend from Mount Kenia and the East African and West Tanganyika forests, right across Uganda and the northern Congo basin to the Lower Niger, the Gold Coast, Liberia, and Sierra Leone, but of this series so far no trace of the *gorilla*, the *okapi*, or the *Black Forest pig* have been met with westwards of the Lower Niger, or even of the Cameroons, though there are Dutch records of the seventeenth century, as well as existing native traditions, which point to the existence of some form of Black Forest pig in the Liberian forests.

H. H. JOHNSTON.

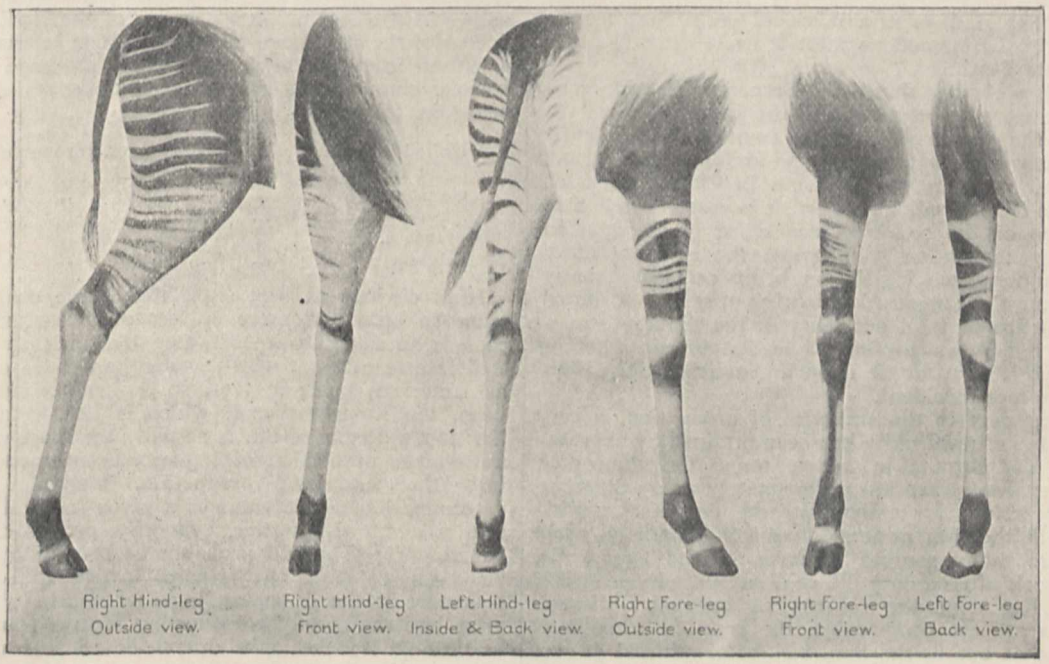

FIG. 2.—Specimen of Okapi in the British Museum (Natural History) presented by Major Powell-Cotton. From "A Monograph of the Okapi."

INTERNATIONAL MINERAL STATISTICS.[1]

TO the student of mining economics, part iv. of the Mines Report is always a volume of special interest. The publication of Colonial and foreign statistics in the present form was due to the initiative of the late Sir Herbert Le Neve Foster, to whom all interested in mineral statistics owe a deep debt of gratitude. No one, however, was more sensible than Le Neve Foster himself of the many shortcomings of this publication, as the writer of the present review can personally testify, and it is a matter of great regret that so little has yet been done to remedy some of the more glaring of the defects of this publication. It is not to be inferred that the removal of these defects is a simple or an easy matter, or even that it lies within the power of any one individual to accomplish it, for it is highly probable that nothing short of an international agreement amongst the great mineral-producing countries of the world can effect this end, even partially. Such a work as the present has for its main object the comparison of the mineral outputs of various nations, and of the conditions under which this output is obtained, mainly with reference to the labour engaged in its production and the relative danger of the miner's occupation. It is a truism that no real comparison is possible unless similar data are compared, and it is here that the main difficulty lies, the same terms being used in different countries with widely different meanings.

To take a striking example, we find in the introduction a statement to the effect that the death-rate from accidents in coal mines is as follows for the year 1908:—

Per 1000 Persons employed.

United Kingdom	1·32	France	0·95
British Empire	1·45	Germany	2·46
Austria	1·10	United States	3·42
Belgium	1·07	Foreign countries generally	2·34

[1] Home Office. Mines and Quarries: General Report and Statistics for 1908. By the Chief Inspector of Mines. Part iv., Colonial and Foreign Statistics. Cd. 5284. (1910.) Price 1s. 8d.

This statement is given without comment or explanation, and leaves us to draw the obvious inference that coal-mining in the United Kingdom is attended with considerably greater risk to the miner than is the case with our French and Belgian neighbours. To those who know the true facts, it is, however, by no means certain that this greater risk in this country is a real rather than an apparent one. It is a curious fact that in no country does legislation define what is meant by a fatal mining accident. In the United Kingdom our inspectors have adopted a working definition which answers all purposes, although devoid of legislative sanction, and class as a fatal accident any accident that directly or indirectly causes the death of the victim within twelve months after the occurrence of the accident. In Belgium, however, only those accidents are considered fatal that directly cause death within thirty days of the accident, whilst in France, where no definition at all is attempted, an accident is only classed as a fatal accident if it causes directly the death of the victim, either on the spot or at any rate within a very short interval of time, whilst in Germany and Austria it would seem that for an accident to be classed as fatal it must directly cause immediate death.

It is thus obvious that if the French or Belgian accident list were calculated upon the same basis as the British, the death-rate in those countries might quite conceivably appear to be higher and not lower than our own. When the supreme importance of this matter is considered, and when it is remembered that every one of the countries concerned is engaged in discussing legislation to promote the greater safety of the miner, such legislation being not infrequently based upon the comparative degrees of safety as shown by the ratios of fatal accidents in the different countries, it is surely a pertinent question to ask whether it is impossible to agree upon an international definition of a fatal accident.

Coming next to the statistics of production, a certain degree of uniformity has been attained by expressing all the outputs in metric tons. On the other hand, however, there are unfortunately many different methods in use for estimating the outputs. Beginning with the first mineral on the list, namely, coal, there are many sources of error in the apparently simple task of recording the coal output. Even in the United Kingdom the returns as between different collieries are not comparable, the practice being here to return as output the total weight of mineral drawn up the shaft, regardless of the fact that this may contain more or less stone. So that if of two mines, which produce an equal quantity of coal properly speaking, the whole of the stone is in one case picked out below ground, whilst in the other a good deal of picking is left to be done on a picking belt at bank, the latter will be returned as producing more coal than the former. Again, the question of colliery consumption has to be considered; a certain proportion of the coals raised is used for the purposes of the colliery itself, in order to generate steam for the various engines at work, whilst in other cases, again, some of the miners are supplied free with coal for domestic purposes, this coal constituting in effect a portion of their wages. It is obvious that it will make a considerable difference in the output returns if the colliery consumption under one or both of these heads is included or excluded.

The best plan would probably be to return only the vendible coal as the output of a colliery, in which case the coal supplied to the colliers, and in effect sold to them as part of their wages, should be included, but not that used for raising steam. More important, however, is it to have a definite rule, which rule ought to be clearly and precisely set forth in the returns; some legislative enactment on the subject is obviously required. In Belgium the returns until quite recently were always those of the coal raised including stone; of late years some collieries have, however, returned only vendible coal, whilst others adhere to their ancient practice. In France the return represents the vendible coal *plus* the colliery consumption. In Germany the output returns comprise vendible coal *plus* colliery consumption *plus* a certain allowance for wastage. Further, it must be remembered that on the Continent the coal itself is very often not weighed, but its weight is estimated from the volume *e.g.* from the number of tubs of a known capacity, produced by the mine. Here, again, it is obvious that we are comparing figures which we have no means of reducing to any uniform denomination, and here, again, it is most important that there should be an international agreement as to what is meant by coal output.

Most countries assign a value to their coal production, and in the introduction to the present report the values of the coal outputs of some of the leading producers of the world are tabulated. It is interesting to calculate from this table the values assigned by the various countries to their coal, the figures obtained being as follows:—

United States	5·79	*s.* per metric ton
Great Britain	8·78	,, ,,
Germany	7·91	,, ,,
Austria and Hungary... ...	6·10	,, ,,
France	12·68	,, ,,
Belgium	12·92	,, ,,

It is obvious at first sight that these coal values must be based on more or less arbitrary data, and possess no scientific importance. Intrinsically French coal is certainly not worth more than twice as much as American coal; in fact, so far as absolute value goes, the American coal, which is here returned as the least valuable of all, is actually the most valuable, as a large proportion of high-class anthracite enters into the American production. Undoubtedly the determination of the value of a given mineral production is a difficult matter, even if a precise definition be adopted; it would probably be best to take as a basis the value of the mineral loaded up ready for transport at the mine, or, in other words, its selling price less the cost of transporting it to a market and marketing it; the only drawback to this mode of valuation lies in the fact that the values thus assigned may be liable to wide fluctuations in accordance with the laws of supply and demand. Fortunately, it may be said that of all the data contained in this report, the monetary values of the mineral production are probably the least important.

In some cases, improvements have been introduced in the methods of stating the returns; thus gold and silver are now returned in kilograms of fine metal. In many cases the output of metalliferous minerals is stated, not in terms of the weight of ore, but in terms of the weight of metal contained in the ores. The heading in the report before us says, "contained in or obtained from ore," but we assume that the latter half of this phrase is an error. The figure that is required is either the amount of metal contained in the ore or else that obtainable from it, the two being by no means equivalent statements. If the former is adopted, it means the weight of ore multiplied by the percentage of metal contained in it as determined by accurate chemical analysis, not by so-called commercial assay. If the latter method is adopted, the return would give the amount of metal that can be obtained from the ore by the smelting operations to which it is

subjected in each case; and it is therefore less than the former figure by the smelting losses of various kinds. The latter form of return would be decidedly the more useful, but is the more difficult to obtain correctly. It is, however, essential that one or other of these two methods be adopted, and not sometimes the one and sometimes the other.

The report also deals with the number of persons employed in producing the mineral output of the various countries, and there is perhaps no portion of the statistical records before us in which more divergent methods of enumeration are made use of. Some countries return indiscriminately men, boys, women, and girls, and some Europeans and natives all under the same heading, whilst others separate these categories. In Germany the usual practice is to return the full number of all names on the register, ill or well, at work or idle, working whole shifts or only parts, working throughout the year or only for a portion, as the number actually employed. The present writer does not know with certainty what the practice is in Great Britain, and doubts whether there is any generally accepted practice; certainly there is none that has legislative sanction. Most managers in this country simply return the number of men on their books on the day when the return is made out; a few seem to consider that the number of shifts worked in the year divided by the the number of shifts worked in the year divided by the number of actual working days. A better method probably would be to take as the average number of men employed daily the total number of shifts worked in the year divided by the number of possible working days. A still more exact method has been proposed by some authorities, and is carried out in some places on the Continent, in connection with schemes of insurance, namely, to take the total number of hours worked in a year by the whole of the workpeople employed, and to divide this figure by some standard figure which shall represent the average number of working hours in a year; this average number might for the United Kingdom be taken as 2400, namely, 300 days of eight hours. Obviously here, again, an international agreement is indispensable. Furthermore, it is necessary to decide whether any, and if so, which of the mine officials shall be included in the list of mine workers; the general practice appears to be to include subordinate officials but none of the staff and none of the office employés, but here again much diversity of practice exists.

Further difficulties arise with reference to the classification of mine workings, our distinction between mines and quarries being quite different from that which obtains in other countries. There is no uniformity of practice in respect of the substances which ought properly to be included in a return of mineral output, and it is an open question whether, *e.g.* brick-clay should be included as well as fire-clay, salt derived from sea water as well as rock-salt, and so forth.

Enough has been said to show that the figures in the report before us must be used cautiously, and that it is unwise to attempt to draw deductions from them unless their meaning is quite fully understood in each case. No doubt this fact detracts considerably from the utility of such a report but it need hardly be said that not the slightest blame can be imputed to those responsible for the report for the existing state of affairs. The work of the statician should, however, always be more than the mere unintelligent accumulation of figures, and here there is ample scope for someone who could persuade the principal mining countries of the world to agree upon a common basis for drawing up the essential elements of mineral records.

At the recent International Congress of Mining and Metallurgy, the question of the unification of mineral statistics occupied a prominent position, and, in fact, the only resolution that was thought worthy of being brought before the general meeting, and was unanimously adopted, was to the effect that the congress should urge upon the various Governments there represented the importance of the adoption of an international system. The report just published by the Home Office is only another proof, if such were indeed needed, of the urgency of such a step, and it is greatly to be desired that our Home Office would take upon itself to lead the way in this matter. It has for many years past made a special feature of the collection of international mineral statistics, and it would be eminently appropriate that Great Britain should inaugurate an attempt to arrive at an international understanding; there can be no doubt that the other Great Powers interested in the question would heartily welcome such a step, and that an international commission could easily enough arrive at a satisfactory arrangement. Until this has been done, all the expense, care, and trouble involved in producing part iv. of the "Mines Report—Colonial and Foreign Statistics," must necessarily be to a large extent wasted, since it cannot but fail in giving a proper comparative view of the world's mineral industry.

HENRY LOUIS.

NOTES.

THE *Times* correspondent at Stockholm reports that the Nobel prizes, amounting to more than 8000*l.* each, were distributed by the King of Sweden on December 10 with the usual ceremonial. All the prize-winners were present to receive their prizes and give the statutory lecture, except the winner of the prize for literature, Herr Paul Heyse, who was prevented by his advanced age from attending. The other recipients were Profs. Van der Waals (physics), Wallach (chemistry), and Kossel (medicine).

THE Physical Society's annual exhibition, which is to be held on Tuesday, December 20, will be open both in the afternoon (from 3 to 6 p.m.) and evening (from 7 to 10 p.m.). Prof. J. A. Fleming, F.R.S., will give a discourse at 4.15 p.m., and again at 8 p.m., on some improvements in transmitters and receivers for wireless telegraphy, and Mr. R. W. Paul will give a number of kinematograph demonstrations of some physical phenomena. Most of the leading makers of scientific instruments are sending apparatus to the exhibition.

THE opening address by Dr. Muir, C.M.G., F.R.S., to the South African Association for the Advancement of Science was delivered before a large audience in Cape Town on the evening of October 31, the day of the arrival of the Duke and Duchess of Connaught to open the Union Parliament. The main subject dealt with was "The State's Duty to Science," and the South African newspapers all agree that nothing more important or more suitable for the occasion could have been chosen. The State was viewed in succession as an educationist, a landowner, a health guardian, and as a patron of pure science, and under each head illustrations were given from the past actions and present needs of Cape Colony. The chief part of the address is reproduced elsewhere in this issue. The Minister of the Interior, General Smuts, in proposing the usual vote of thanks, threw out some hope that the day of university reform in South Africa was not

far distant. At the close of the meeting Dr. Muir presented the South Africa medal to Prof. J. C. Beattie, for his magnetic and other work.

THE jubilee of the German Agricultural Society is being commemorated in Berlin this week by a series of meetings. The Berlin correspondent of the *Times* states that at the meeting on December 12 a vast audience in the building of the Prussian Diet listened to the congratulations of the German Emperor, the Imperial Chancellor, the Prussian Minister of Agriculture, and other distinguished personages. In the course of his remarks, the Emperor is reported by the *Times* correspondent to have said:—"Many a seed has been scattered since the society was founded twenty-five years ago, and has sprung up and flourished under the blessings of peace. Admirably have you succeeded in adopting all the advances in science, in botany, in chemistry, in the breeding of animals, and in industry, and so increased the efficiency of German agriculture and raised the value of Germany's soil. Accept my most cordial good wishes for the future. May the agricultural population continue to hold its own as the core of the people, trustworthy in all circumstances, to the advantage and welfare of the Fatherland."

A GENERAL meeting of opticians and others was held in the rooms of the Chemical Society, Burlington House, on Tuesday, November 29, to consider the desirability of making arrangements for the holding of an Optical Convention in 1912. The chair was taken by Dr. R. T. Glazebrook, C.R., F.R.S., as chairman of the permanent committee. A resolution was carried *nem. con.* that, provided sufficient financial support is obtained, an optical convention be held in the spring or early summer of 1912. The main objects of such a convention were specified as being:—(1) the holding of an exhibition of optical and allied instruments; (2) the preparation of a catalogue of optical and allied instruments of British manufacture to serve as a convenient work of reference for all users of optical and scientific instruments, not necessarily to be limited to instruments actually exhibited; (3) the holding of meetings for the reading of papers and for discussions and demonstrations on optical subjects; (4) the publication of a volume of Proceedings, in which these papers would be collected together. The questions of the inclusion of a foreign section and of the scope of the convention and exhibition were discussed, and an organising committee was nominated to undertake the work of making the necessary arrangements for the convention.

THE Agenda Club, which was formally inaugurated by a banquet last week, proposes to organise effort, knowledge, and influence for the purpose of getting things done which need doing for the benefit of the community. The movement first acquired publicity through "An Open Letter to English Gentlemen" in the *Hibbert Journal*. This letter, and the club itself, appeal frankly to the idealism and the goodwill of the best men; but an equally essential characteristic of the club is to organise the altruism of its members with at least as much efficiency as that of the most successful modern business. The club expressly enunciates its need of guidance by scientific men in determining the agenda to be undertaken and in many details of its work. It is a coordinating society, and not one that overlaps the work of other bodies devoted to special purposes. Among other methods to be employed is that of the most extensive publicity. It should be able to win recognition of the importance of scientific education, to spread scientific ideas, and to extend the application of scientific method and results to the affairs of everyday life. It contemplates the encouragement of research, especially perhaps in social science, and its scheme includes groups of associates, among which are mentioned engineering, literature, medicine, and science. In thus applying tested principles and modern methods to the desire to help, which, if sometimes latent, is almost universal, the club is effecting, at a singularly opportune and critical moment, a new "grouping," which may prove a significant step forward in social evolution. There is no entrance fee and no fixed subscription. Money without other support is neither invited nor desired, but cooperation, with or without subscriptions, is both sought and welcomed. The address of the club is 4 Essex Court, Temple, E.C.

THE report of the council of the Scottish Meteorological Society was presented to the general meeting of the society held on December 6. From it we learn that the prize of 20*l.* offered for competition amongst students and graduates of the Scottish universities for the best essay on a meteorological subject has been awarded by the council to Mr. David MacOwan, of Edinburgh University, for an essay on "Observations in Atmospheric Electricity in and near Edinburgh." The council reports with satisfaction that the publication by the Royal Society of Edinburgh of the observations made on Ben Nevis and at Fort William from 1883–1904 has just been completed by the issue of vol. xliv. of the Transactions of that society. This marks the completion of a great enterprise; and it is noted that not only have the observations themselves been printed in detail, but that the four volumes in which they appear contain also numerous papers in which various theoretical and practical aspects of the observations are discussed. It is a matter of further satisfaction that almost simultaneously with the completion of the publication of the Ben Nevis observations the society has, through the generosity of its friends, been entirely relieved from the burden of debt which it had to assume when the observatories were closed in 1904. The following officers were elected at the meeting:—*President*, Prof. A. Crum Brown, F.R.S.; *vice-presidents*, J. Mackay Bernard and Ralph Richardson; *council*, J. Macdonald, Dr. C. G. Knott, Sir David Paulin, G. Thomson, H. M. Cadell, Captain H. G. Lyons, F.R.S., Sir A. Buchan-Hepburn, Bart., G. G. Chisholm, and M. M'Callum Fairgrieve; *hon. secretaries*, R. T. Omond and E. M. Wedderburn; *hon. treasurer*, W. B. Wilson.

CANCER once again formed the subject of the Bradshaw lecture, delivered by Sir Arthur Pearce Gould at the Royal College of Surgeons on December 7 before a large and appreciative audience, which included Prince Alexander of Teck. For three years in succession, 1903, 1904, and 1905, cancer—although the conditions of the endowment mention merely a "lecture on surgery"—was discussed in speculative fashion and in its surgical aspects by one Bradshaw lecturer after another. This was when the modern revival in the investigation of this disease was in its beginnings, and had contributed little that was new or could be properly appraised. Perhaps from the mere fact that all had been said, and said ably, that could be said, perhaps from a feeling that it was unseemly to harp always upon the same subject, cancer has been left alone for four years. It was well to revert to it again, for by doing so Sir Alfred Pearce Gould put himself in the position of being able to assure his hearers that great advances in knowledge have been made, and that the pessimistic views held by those brought most in contact with the disease are giving way before new hopes. The lecturer showed that the four years' respite had sufficed for the results of the comparative and experimental investigation of cancer

to make a deep impression upon the leaders of the surgical profession. He had much to say which no previous Bradshaw lecturer ever had an opportunity of knowing, and much that even his immediate predecessors had not had time to assimilate. The lecture, which appeared in full in both the *Lancet* and the *British Medical Journal* of December 10, will repay the perusal of all interested in this complex problem and the efforts that are being made to solve it.

COMMITTEES have nowadays become quite a usual form for the organisation and supervision of scientific research to take, and investigations conducted under their ægis may at times not redound in full measure to the credit of the actual workers. Therefore, in Sir Alfred Gould's Bradshaw lecture on cancer it is gratifying to note this generous tribute paid to the workers who have raised the English school of cancer research to its present pre-eminent position among kindred organisations abroad. The lecturer said:—"This college, in conjunction with our sister in Pall Mall, by the initiation, control, and housing of the Imperial Cancer Fund, has taken a very prominent part in this movement, and it is a matter of great satisfaction that the researches carried out in our laboratory are universally recognised as having been of fundamental importance. We gladly recognise that all the success which has attended, and may hereafter attend, the labours of Dr. Bashford and his distinguished associates is not due to the association with these Royal colleges, nor to the sources from which the fund has been collected, but to the ability, the wide knowledge, the patience, and the honesty that are associated with the laborious industry of the workers." However excellently committees may be constituted for advisory purposes and for control, they can never replace the initiative and enthusiasm of individual workers. It is gratifying to know that this principle is acknowledged in the investigation of a subject of such great public moment as is cancer.

THE death is announced of Captain G. E. Shelley, the youngest son of the late John Shelley, of Avington, in Hampshire, and nephew of the poet. After a short service in the Grenadier Guards, Captain Shelley retired from the Army and devoted himself entirely to ornithology, especially to that of Africa. Captain Shelley's earliest publication was a "Handbook on the Birds of Egypt," a most useful companion to the voyager on the Nile, illustrated by many excellent coloured plates drawn by Keulemans. He next turned his attention to the sun-birds (Nectariniidæ), and in 1880 completed a beautiful quarto work containing coloured figures of every species of this brilliant family, which may be said to represent the humming-birds of the New World in Africa and Asia, although the two groups are by no means nearly related to each other. In 1890 Captain Shelley was requested by Dr. Günther to join Mr. Sclater in preparing the nineteenth volume of the great "Catalogue of Birds in the British Museum." To this he gladly consented, as among the families included in this volume were the cuckoos and other groups of which he had made a special study. Captain Shelley now planned a general work on the birds of Africa, in which he proposed to comprise an account of all the birds known to occur in the Ethiopian region. The first volume of this important work was published in 1890, and succeeding volumes were issued up to 1906, when the failing health of the author brought the continuance of the work to a stop. Besides these three works, Captain Shelley was for many years a constant contributor to the *Ibis*, the journal of ornithology published by the British Ornithologists' Union, of which he was a well-known member. He was also an excellent field naturalist, and made many excursions to different parts of Africa in order to observe the bird life with his own eyes and to add to his valuable collections, which, we believe, have attained a final resting place in the British Museum.

THE Berlin correspondent of the *Times* reports the death, at seventy-eight years of age, of Prof. Franz König, who held in succession the chair of surgery at the Universities of Rostock (1869), Göttingen (1875), and Berlin (1895). He retired from the latter chair in 1904. His reputation was based largely on his skill in the treatment of articular tuberculosis, on which he published a monograph in 1883 (later edition, 1895). He was also author of teaching manuals of surgery, which were frequently republished.

THE *Aëronautical Journal* for October contained the announcement that the council of the Aëronautical Society had conferred the gold medal of the society on Mr. Octave Chanute, consulting engineer, of Chicago. It was regretted that there was no immediate prospect of his being able to receive the medal in person, owing to the serious illness which overtook him at Carlsbad, from which, however, it was confidently expected that he had recovered after removal to Paris. It is with greater regret that we now learn of the death of Mr. Chanute at seventy-eight years of age. Born in Paris in 1832, Chanute trained as an engineer in America, where his professional duties involved the construction of numerous railways and bridges, including consultative duties connected with the New York elevated railway; wood preservation was also his speciality. From 1874 onwards Chanute became interested in the problem of aviation, and not only did he make numerous experiments with models, but shortly after, or perhaps simultaneously with, Lilienthal and Pilcher's experiments in Europe Chanute took up the practical realisation of gliding flight in America in collaboration with Mr. Herring and Mr. Avery. A large number of glides were made with different types of glider, commencing with a model based on the descriptions of Le Bris's historic "albatross," and including gliders with a large number of superposed planes, but the type finally adopted was a biplane glider furnished with a smallish balancing tail. Although balance was, as a rule, maintained by moving the body, Chanute embodied in his apparatus the principle of a flexible framework, which thus paved the way for the Wright Brothers' "warping" devices and similar arrangements for the recovery of balance and counteraction of instability, which form such a noteworthy feature of modern aëroplanes. The glides made with his machines were remarkably successful, and, the practising grounds being among sand dunes, no fatalities ensued. Chanute was the author of a number of papers and reviews dealing with the flight problem, and the Wright Brothers, the late Captain Ferber, and numerous other aviators were indebted to him for much valuable assistance.

THE annual general meeting of the Royal Agricultural Society of England was held on December 7. It was announced that the total membership is now 10,129, having reached five figures for the first time since 1901. The report, which was adopted at the meeting, contains abundant evidence that the society is assisting scientific research in agriculture in a substantial manner. At the Woburn Experimental Station, in addition to general experiments, trials have been made of the new varieties of cross-bred wheats introduced by Prof. Biffen, of Cambridge, and also of French wheats. The residual values of calcium cyanamide and nitrate of lime have been ascer-

tained in comparison with sodium nitrate and sulphate of ammonia. The pot-culture work has included further experiments on the influence of magnesia on plants. The Hills' experiments concerned chiefly the use of zinc in different forms and of lithium. The question of green-manuring with leguminous and non-leguminous crops respectively has been advanced a further stage. In the botanical department some forty specimens of infected plants were sent for examination. For the most part these were attacked by common diseases, but the following are not so generally met with:—silver-leaf on black currant, Pseudomonas on swede, and Hypomyeces on mushrooms. Two diseases, one on mangolds the other on asparagus, are apparently new to science, and are now under investigation. The society has decided to carry out experiments with calves at the Woburn Farm, for the purpose of demonstrating that by means of isolation it is possible to rear healthy stock from tuberculous parents. Lord Rothschild has undertaken to provide, free of all expense to the society, thirty calves for the purposes of the proposed demonstration. The arrangements are in the hands of a special committee, and Sir John McFadyean has undertaken to supervise the demonstration. With the view of enabling the Royal Veterinary College to make further investigations as to Johne's disease, an obscure disease of sheep met with in certain parts of England, and vaccination as a preventive against tuberculosis in cattle, the council has agreed to make a special grant to the college of 200*l.* per annum for three years, commencing on January 1, 1911.

THE trustees of the Beit memorial fellowships for medical research have elected the following persons to fellowships. We give in each case the general character of the proposed research and the place where it is intended to carry out the research:—*T. R. Elliott*, pathological changes in the suprarenal glands, at the Medical School of University College Hospital. *E. E. Aitkin*, investigation of a group of toxins with respect to the manner of destruction, mode of neutralisation by antibody, and effect of the various modifications upon the animal organism, at the Bacteriological Laboratory of the London Hospital. *Frances Mary Tozer*, the presence of sensory fibres in the third, fourth, and sixth cranial nerves; their influence upon ocular paralysis in locomotor ataxia and other diseases, and the site of the ganglion cells, at the Physiological Laboratory, Liverpool University. *R. W. H. Row*, the structure, development, and functions of the pituitary body in Vertebrata, at (1) King's College, London (Zoological Laboratory); (2) Marine Biological Association's Laboratory; and (3) Naples Zoological Station (collection of specimens and embryological and experimental work). *H. Priestley*, study of the diphtheroid organisms with regard to their distribution, morphology, cultural characteristics, pathology, and relationship to diseased conditions of man and animals, at the Lister Institute of Preventive Medicine. *F. P. Wilson*, the changes in the lipoids of the tissues produced by syphilis and their relation to hæmolysis and immunity, at the Biochemical Department, University of Liverpool. *A. G. Yates*, the bacteriology of acute rheumatism, at the Pathological Department of the University of Sheffield. *Annie Homer*, the chemistry and physiology of tryptophane; the metabolism and chemistry of hæmoglobin in so far as they bear on its production in the animal body; the comparison of normal and pathological tissues as regards their contents of intracellular ferments, at the Physiological and Chemical Laboratories, Cambridge. *F. J. F. Barrington*, investigation of the functions of the male accessory genital glands, at University College Medical School. *J. F. Gaskell*, the origin of the suprarenal body in the invertebrates and lower vertebrates, and on the function of the chlorogogen cells in invertebrates, at St. Bartholomew's Hospital Medical School. The next election of fellows will be held in December, 1911. Correspondence should be addressed to the honorary secretary, Beit Memorial Fellowships for Medical Research, 35 Clarges Street, W.

IN the *Philippine Journal of Science* (vol. v., No. 3) Mr. R. B. Bean gives a further account of his investigations into the different types of ears occurring among the Philipinos, giving on this occasion illustrations of the Iberian and the primitive types. In the former the characteristic features are the inversion of the conch and the rolling out of the helix, this producing a shallow bowl in the conch and a flat helix below. The whole ear is thin, flattened, and usually placed parallel to the head. The primitive ear, on the contrary, is distinguished by the inversion of the conch and the rolling in of the helix, the upper and lower portions of the latter projecting in the form of a shelf, while the conch is deep and bowl-like. The whole ear is thick. In the opinion of the author, ears afford much better race-characters than skulls.

IN the report for the year ending September 20, the committee of the Bristol Museum and Art-gallery expresses its obligation to Lady Smyth for her gift of 1500*l.* to fit up a companion room to the one for which she had previously provided funds. This will enable the adjacent rooms to be arranged in uniformity. Among the additions to the collection is the skin of a giraffe from East Africa, which is now in the hands of the taxidermist, and will in due course be installed in the building.

THE new museum and art-gallery opened at Plymouth on October 25 form the subject of an illustrated article in the November number of the *Museums Journal*. The foundation-stone of a building was laid so long ago as the Diamond Jubilee year of Queen Victoria, but soon after this was done the financial affairs of the city became involved in difficulty, and further progress was stopped. Later on Mr. Andrew Carnegie offered a large sum for the building of a public library, and it was eventually decided to combine with the library a museum and art-gallery, for which funds were provided from other sources. The result is the present fine building, constructed partly of Portland stone and partly of Devonian limestone, with a total frontage of about 320 feet. Of this, the northern 180 feet are allotted to the museum and art-gallery. The whole building is one of which Plymouth may justly be proud.

AMONGST publications recently issued by the International Council for the Study of the Sea are vol. xii. of the *Rapports et Procés-Verbaux*, vol. iv. of the *Bulletin statistique*, and No. 48 of the *Publications de Circonstance*. The first of these contains useful summaries of the fishery work carried out under the direction of the council. Dr. Hoek gives an account of the recent work on eggs and larvæ of the Gadidæ, Prof. D'Arcy Thompson of that on the distribution of the cod and haddock, Dr. Ehrenbaum on the eggs and larvæ of flat-fishes and Dr. Masterman on their later stages, and Dr. Hjort reports on the herring investigations. The statistical bulletin contains a summary of all fish landed in the different European countries in 1907. The last of the three publications deals with the plankton researches, and gives a list of all organisms which have been recorded between 1905 and 1908 on the periodic cruises, with an account of the stations at which they were found. This forms a useful summary of the detailed tables published in the bulletins.

IN an abstract from the *American Breeders' Magazine* (vol. i., No. 2) Dr. G. H. Shull adduces further evidence in favour of a so-called pure-line method in corn breeding that consists in raising self-fertilised generations with the object of developing pure homozygous strains or biotypes, and then cross-breeding from such pure strains year by year.

A NOTE on works of improvement in the forests of the Federated Malay States, contributed by Mr. A. M. Burn-Murdoch, appears in the *Indian Forester* (October). The author distinguishes gutta-percha forests, where *Palaquium gutta* and *P. oblongifolium* are the important species, and mixed timber forests. Under natural conditions the Palaquium forests contain a great number of tall, slender trees in the pole stage arising from an undergrowth of palms, chiefly *Eugeissona tristis*, and shrubs; there are also a few giant trees. When the young trees are cleared of the undergrowth some are unable to support their own superstructure and require lopping, from which, however, they quickly recover.

A PALM disease receiving the name of "koleroga" is described at length by Dr. L. C. Coleman in Bulletin No. 2, issued by the Department of Agriculture in the Mysore State. The disease, confined to the Areca palm, has been prevalent in two separate areas on the west coast of India. For the most part the fruits are attacked, but occasionally the fungus finds its way to the growing apex. Spraying with Bordeaux mixture has proved efficacious. From a study of the sporangiophores, zoospores, and both kinds of sexual organs, and from infections made with the spores, the author concludes that the fungus is very closely allied to the well-known *Phytophthora omnivora*, from which he separates it as a special variety.

THE prominent item in the September number (vol. v., No. 4) of the botanical section of the *Philippine Journal of Science* is the first part of a description, by Mr. E. D. Merrill and Mr. M. L. Merritt, of the flora of Mt. Pulog, the highest, but until recently little known, peak in the island of Luzon. Four zones of vegetation are distinguishable, of which the most important is an open forest belt in which *Pinus insignis* is the characteristic tree; this gives place at an altitude of 7000 feet to a denser forest of irregular trees covered with mosses and lichens, where epiphytic ferns and orchids are abundant, while the summit is open meadow. In the flora the families Polypodiaceæ, Compositæ, and Gramineæ are best represented. There is a predominance of continental Asiatic as opposed to Malayan types, together with a definite, although small, admixture of Australian elements.

MR. BERNARD SMITH has written on the Upper Keuper sandstones of east Nottinghamshire in the *Geological Magazine* for 1910 (p. 302). His study of the characters of these rocks bears out the view, shared by Mr. Cresswell in the paper above referred to, that they were accumulated in distinctly shallow water. "Large tracts with isolated pools were laid bare from time to time." The sandstones among the marls are the deposits of wet seasons, and show characteristic signs of flood and current action. Mr. Smith suggests that the grey or green beds in the Keuper are due to the check on oxidation caused by organic remains and humic and organic acids swept down from the land-surface.

FROM the report of the chief of the U.S. Weather Bureau for the fiscal year 1908–9 we note that observations of the lower strata of air by kites and captive balloons are made daily except on Sundays; efforts are being made to secure materials for kites that will not absorb moisture. Measurements of the intensity of solar radiation and the polarisation of sky light were made whenever conditions were favourable; both appear to have had a higher value than during the previous year. Isobaric charts based on telegraphic reports from selected stations throughout the northern hemisphere have been prepared daily, and successful forecasts for about a week in advance have been issued at intervals; Prof. Moore remarks that the application of world-wide observations and upper-air researches to the art of weather forecasting, both for short and long periods, is yearly becoming more apparent. Reports of marine observations by wireless telegraphy have been discontinued on the Atlantic, but the work has been taken up, to some extent, on the Pacific coast. In the climatological summaries we note that the total precipitation is determined from amounts recorded daily, from midnight to midnight.

DR. L. BIRKENMAJER, of the Cracow University, the author of an elaborate biography of Copernicus, has been fortunate to find (in the "Riks-Arkivet," Stockholm, and in the library of Upsala University) several entirely unknown autographs of Nicolaus Copernicus. The most interesting is a letter written by the great astronomer, on behalf of the Bishop and the Cathedral Chapter of Ermland, on July 22, 1516, to Sigismond I., King of Poland. This message conveys to the King embittered complaints against the Teutonic Order "the Knights of the Cross," described as "praedones, latrones et homines scelerati" in the text of the document, which is entirely in Copernicus's own handwriting. For other interesting details we must refer to the memoir published by Dr. Birkenmajer, in collaboration with the distinguished Upsala scholar Dr. Isak Collijn, in the *Bulletin International* of the Academy of Sciences of Cracow, June, 1909.

THE paper read by Sir Robert Hadfield and Prof. B. Hopkinson before the Institution of Electrical Engineers on Thursday last marks an important advance in our knowledge of the magnetic properties of iron and its alloys. By working in the intense fields obtained between the poles of a large electromagnet they have succeeded in showing that iron and its alloys with carbon, silicon, aluminium, nickel, or manganese have definite saturation intensities of magnetisation which are reached, in general, in fields of less than 5000 units. For pure iron the saturation intensity is 1675 units, and for iron carbide about two-thirds of this. Each alloy behaves as a mixture of one or more magnetic substances with materials having permeabilities not differing much from unity. In annealed carbon steels the saturation intensities are 6 per cent. less than for pure iron for each per cent. of carbon present. The tests of alloys of iron with nickel and manganese have not led to any simple relation between their magnetic properties and their composition.

SINCE Coulomb stated the laws of friction of solids on each other more than a century ago, little work has been done on the subject except from the technical point of view, which does not attach much importance to the absolute cleanliness of the surfaces in contact. The *Verhandlungen der Deutschen Physikalischen Gesellschaft* for October 30 contains a short account, communicated by Prof. W. Kaufmann to the Versammlung Deutscher Naturforscher, of some careful experiments on the subject made by his pupil Miss C. Jakob. The glass or brass surfaces used were chemically clean, and were used in a glass

chamber, which could be evacuated and dried. The observations were made by tilting a large plate of the material with a perfectly smooth surface until a small piece of the same substance, provided with three spherical feet, would slide down the surface. Sliding begins at a very small angle, 1·5° for glass, and the speed has a fixed terminal value for each angle of tilt up to a little more than 5°, when the motion becomes an accelerated one. Up to this point there is a definite relation between the speed and the friction, and this relation must be substituted for the discontinuous law of Coulomb, according to which friction prevents motion until an angle of tilt of the order of 10° or 20° is attained.

An interesting article on critical speeds for torsional and longitudinal vibrations, by Prof. Arthur Morley, of University College, Nottingham, appears in *Engineering* for December 9. The driving effort of a reciprocating engine, or the resistances to be overcome, may be periodically fluctuating in magnitude, and if the period of such a variation should approach to the period of a free torsional vibration, or to an integral multiple of it, torsional oscillations of some considerable magnitude may be set up, with accompanying high stresses in the material of the shaft. Cases of approach to dangerous resonance with longitudinal vibrations are perhaps much less common in machinery. The author gives a complete mathematical analysis in the article, and concludes with an interesting application to the case of a pit cage and contents weighing ten tons, and being raised by an engine running at 100 revolutions per minute. Taking the net section of the rope at 2·5 square inches and E as 13,000 tons per square inch, the depth at which the natural frequency of vibration of the loaded rope is equal to the speed of the engine is 955 feet, neglecting the weight of the rope. Taking a rope weighing 8·4 lb. per foot, and making allowance for its weight, the depth at which resonance will occur works out to about 862 feet.

OUR ASTRONOMICAL COLUMN.

Nova Aræ, 98.1910.—A telegram from Dr. Ristenpart to the *Astronomische Nachrichten* (No. 4457) states that the magnitude of Nova Aræ, recently discovered by Mrs. Fleming, was 9·6 on November 19.

The nova is invisible on forty-four plates of the region taken at Arequipa during the period August, 1889, to March 19, 1910, but appears on twenty-one photographs secured between April 4 and August 3 of this year; on these plates its magnitude apparently ranges from 6·0 to 10·0, and thus it would appear that between March 19 and April 4 the magnitude increased from 12·0, the limiting magnitude of the Arequipa plates, to 6·0. Like most of its class, this nova lies well in the Milky Way, its position (1875·0) being $\alpha = 16h.\ 31m.\ 4s.$, $\delta = -52°\ 10{\cdot}4'$.

Saturn's Rings.—Herr K. Schiller, writing to the *Astronomische Nachrichten* (No. 4458), states that he observed Saturn's ring system on November 26 at Bothkamp, and could detect no extraordinary feature such as was described by M. Jonckheere in an earlier communication; the atmospheric conditions were excellent, and Herr Schiller employed powers of 200, 600, and 800.

Publications of the Allegheny Observatory.—We have received the first four numbers of vol. ii. of the Publications of the Allegheny Observatory of the University of Pittsburgh, and give brief abstracts of them below. In No. 1 Prof. Schlesinger describes the Mellon spectrograph with which he and the other observers prosecute their radial-velocity researches. This instrument was provided, by the generosity of Mr. Andrew Mellon, for line-of-sight work when the Keeler memorial telescope was completed in 1906. The grave disadvantages arising from the location of an astronomical observatory near a large town, where the sky is never clear and ever illuminated by artificial illuminants, had to be considered when the form of instrument was under contemplation. Consequently, the work which is possible had to be materially restricted, because of the necessity of keeping the possible exposures within reasonable limits, and a one-prism spectrograph was designed. The sacrifice was considerable, but peculiar circumstances rendered it necessary. However, it appeared that useful work might be done if the investigations were confined to such stars as have broad, hazy lines, and this decision has been justified by the results already published. Dr. Schlesinger describes and illustrates the details of the instrument, showing how rigidity has been attained with moderate weight. A region of the spectrum from λ 3930 to λ 4750 can be brought into sharp focus, and under exceptionally good conditions a strong spectrum of a fifth-magnitude star can be obtained in about twenty minutes. Owing to the impurity of the town atmosphere, the large mirror of the Cassegrain reflector has to be resilvered once a month, and the small one every other week; even then, at times, they only reflect about half as much light as when newly silvered, and some 40 per cent. of the deterioration takes place within three or four days of resilvering. The arrangements for maintaining the temperature range of the prism box within 0·1° C., for eliminating flexure, and for adjusting the focus are minutely described and very ingenious.

In No. 2 Dr. Schlesinger and Mr. D. Alter discuss the relative motions of 61 Cygni and similar stars. This discussion indicates that the motion of the companion star is orbital rather than in a straight line—that the two stars are physically connected; thus the designation "of the 61 Cygni type," as indicating pairs not physically connected, should be abandoned.

No. 3 contains a discussion of the orbits of the spectroscopic components of ε Herculis, by Dr. R. H. Baker, determined from seventy-two plates taken with the Mellon spectrograph during 1907–8. The period is found to be 4·0235 days, and the orbit nearly circular; there is no substantial evidence for the presence of a third body. In No. 4 Dr. Baker discusses the orbit of 1 H. Cassiopeiæ, from fifty-seven plates secured during 1908–9, and finds the period to be 6·067 days.

The Orbit of the Perseids.—Meteoric astronomy is being, and is likely to be, considerably advanced by the energetic and organised observations of the Antwerp Société d'Astronomie. Since 1896 the Perseid and other showers have been independently observed at many stations, and the results collated and discussed. During 1909 and 1910, 485 and 303 Perseid trails were recorded, and indicate the existence of seven radiants. For five of the best marked of these M. Henri Dierckx has calculated elliptic elements, which he compares with Hayn's elements for Tuttle's comet, 1862 III., in an article appearing in Nos. 11–12 of the *Gazette astronomique*. The agreement is well marked, although, as the author remarks, the probably large area covered by the swarm of meteoritic particles precludes the expectation that the Perseid elements would rigidly agree *inter se*.

Definitive Elements for the Orbit of Comet 1904 II. (1904*d*).—This comet was discovered by M. Giacobini at Nice on November 17, 1904, and was observed until May 2, 1905. Herr J. Sedláček has now discussed 118 observations, referred to eighty-four comparison stars, and publishes the resulting orbital elements in No. 4453 of the *Astronomische Nachrichten*. The orbit appears to be hyperbolic, but the departure from a parabola is so slight as to be practically negligible.

Designations of Newly Discovered Variable Stars.—In No. 4457 of the *Astronomische Nachrichten* the commission of the AG Catalogue of Variable Stars gives the permanent designations to 126 recently discovered variable stars. Many of the objects have been discovered to be variable during the present year, whilst the variability of others was detected during preceding years. In addition to the designations, the commission gives the provisional numbers, the positions for 1900, the range of magnitude, and remarks concerning the discovery, the period, the type, and the spectrum of each object.

THE TRANSANDINE RAILWAY.

IT was on March 29, 1835, that Charles Darwin, who had reached Mendoza from Valparaiso by Peuquenes and Portillo, set out on his return journey across the Andes by the more northern line of the Uspallata and

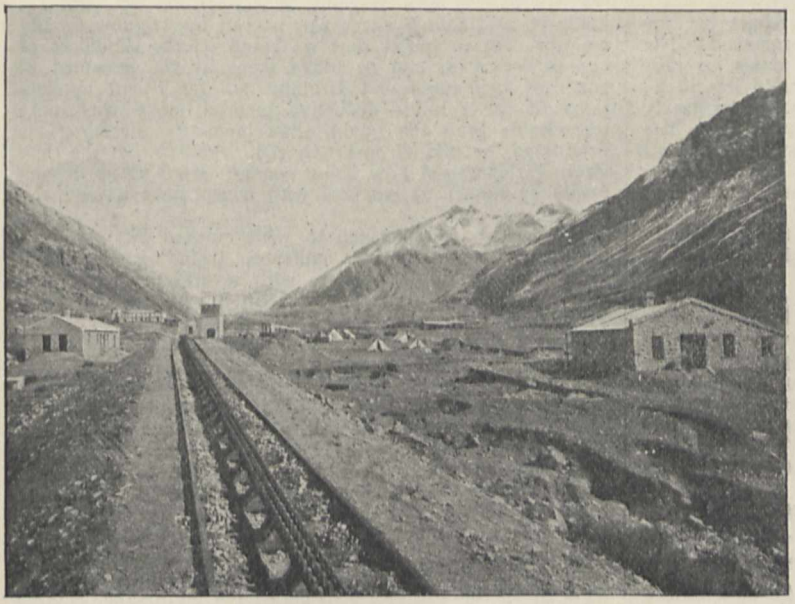

FIG. 1.—Valley of the Rio Mendoza below Puente del Inca, looking up stream; the rack rail is seen in the foreground.[1]

Cumbre passes, which has always been the principal means of communication between the pampas and the Pacific Coast. It was not until twelve days later that he reached Santiago, though no doubt a less ardent geologist might have completed the journey in somewhat shorter time. It could now be easily accomplished by rail in less than the same number of hours.

The Transandine railway is constructed on the metre gauge, like many of the Indian lines, although it links up two broad-gauge systems. Leaving Mendoza, where it connects with the Argentine Great Western at a height of 2700 feet above the sea, it turns southward across the plain, making for the point where the Rio Mendoza leaves the eastern or Uspallata range of the Andes, and then follows the windings of the deep river valley through the mountains. It thus takes a route somewhat to the south of that by which Darwin and other travellers crossed this range. According to their descriptions, the eastern slopes are composed of Rhætic sandstones and bituminous shales resting on Devonian and Ordovician slates, such as are found in many parts of the Andes. These are covered unconformably still further to the westward by thousands of feet of acid and basic lavas and tuffs interstratified with sandstones and carbonaceous shales, and believed to be of Tertiary age. Intrusions of granite and porphyry also occur.

After emerging from these mountains and traversing the Uspallata Pampa, a plateau of coarse detritus at an altitude of 6000 feet, the railway enters the central cordillera of the Andes by the deep gorge of what may still be called the Rio Mendoza, though, like most South American rivers, it is known by different names in different parts of its course. Here the slates are covered apparently conformably by a thick succession of Mesozoic rocks described in detail by Darwin, Stelzner, and Schiller. They include acid lavas and tuffs, breccias and conglomerates of the same material passing into arenaceous rocks, amygdaloidal basalt, limestones, gypsum interstratified with red and purple sandstones and conglomerates, and finally lava flows, tuffs, and conglomerates, consisting mainly of andesite, which are probably of late Cretaceous or even early Tertiary age. Although marine fossils of Jurassic and Cretaceous types are met with, some of the beds were probably laid down under continental conditions. On the east the rocks are much disturbed, and are penetrated and metamorphosed by granite and diorite, as well as by minor inclusions, which traverse, not only the stratified, but the plutonic rocks.

The sides of the gorge present magnificent sections of the geological structure, one of the finest of which is at the mouth of the Horcones valley, by which Aconcagua was successfully ascended. At Las Cuevas, a little further on, the train enters the tunnel beneath the Cumbre ("summit") pass and emerges in the valley of a tributary of the Rio Aconcagua, which makes its way westward to the Pacific. The tunnel is less than two miles long, and little more than 10,000 feet above the sea, while the pass is some 2000 feet higher. It is stated to have been excavated in limestone and gypsum, and conglomerates of rocks of igneous origin. The western slopes of the ridge are exposed to the wet north-west winds, and the rocks are in places saturated with water and decomposed, so that it was necessary to face the interior of the tunnel with concrete.

The railway then follows the valley of the Aconcagua,

FIG. 2.—Scenery on the Chilian side of the tunnel.

where the later volcanic rocks dip at moderate angles to the westward, and are penetrated here and there by intrusions of "porphyry," down to the fertile plain of the same name, where at Santa Rosa de los Andes it connects with the State railways of Chile. On account of the steepness of the valley slopes and the decomposition of

[1] The illustrations are reproduced, with permission, from a paper by Mr. W. S. Barclay in the November number of the *Geographical Journal*.

the rocks the construction of the line on the western slope presented serious problems to be solved, and the central rack rail is almost continuously employed for a distance of fifteen miles, while on the Argentine side it is only occasionally resorted to.

Nearer the equator, where south-easterly winds prevail, there are railways which, starting from the Pacific Coast, reach an altitude of more than 14,000 feet without the use of any special appliance of this character, for the rainless western slopes present comparatively few engineering difficulties; but when the time comes for railways to be built down to the Amazonian plain it will be no easy task to construct a firm track through the deeply dissected country, where the almost continuous rain has decomposed the rock to a considerable depth, and from time to time great landslips leave a strip of the valley-side denuded from crest to base of its thick covering of trees.

The opening of this through route from the Atlantic to the Pacific is an important step in the development of communications in South America. Soon the Argentine railways will be united to those of Bolivia and Peru, and the lowlands of Bolivia rendered accessible by the railway round the cataracts of the Madeira. Everywhere the plateau, the pampa, and the forest are losing their remoteness and their solitude, and bid fair to be occupied, ere long, with a population drawn from European sources, a consummation that, however natural and inevitable it may be, cannot but inspire some vain regrets in those who have known them when they were still in the state in which the early Spanish adventurers found them.

JOHN W. EVANS.

EVOLUTION: DARWINIAN AND SPENCERIAN.

ON Thursday, December 8, the Herbert Spencer lecture at Oxford was delivered by Prof. Meldola, F.R.S., the title of the lecture being "Evolution: Darwinian and Spencerian." Prof. Meldola began by pointing out that while Oxford had influenced Darwin through Lyell (whose reputation, however, was made by throwing over the doctrine of his old master at Oxford, Buckland), it had also influenced Spencer through both Lyell and Mansel. Evolution, the lecturer proceeded, did not stand or fall with natural selection, but the prominence given by Darwin to the latter principle availed to convert Spencer from exclusive Lamarckism. Darwin and Spencer approached the problem of evolution with different types of mind, and addressed themselves to different audiences; the special task of Spencer was to show that organic evolution was a particular case of general evolution. In this he entirely succeeded, points of objection that might be taken to his views being of minor importance. Selection, so far, had only been shown to prevail in relation to the phenomena of life. Darwin's influence in departments where selection is not found was only indirect.

There was a fundamental difference in the method of attack of scientific problems adopted by Darwin and Spencer respectively. The procedure of the former was analytic, that of the latter synthetic. For Spencer, philosophy was unified science. His treatment of scientific questions was characterised by extreme breadth, inasmuch as his principles transcended the data of particular sciences, this being one reason why he failed to impress scientific men so much as might have been expected. No such attempt to wield the weapon of unified science had ever before been made. In estimating the comparative validity of the methods employed by the two men, it should be remembered that Darwin was working at a lower level; thus his foundations were more securely laid; and however sound the method, information can, after all, only be acquired by beings of finite intelligence and imperfect sense organs. Hence mistakes could be, and actually were, made; these, however, the same method would be competent to correct in the presence of better information. Spencer's plan, on the other hand, was to prove the existence of underlying principle controlling all the processes of nature. Hence his method was philosophical in the more enlightened sense of that term—the sense seen in the old expression "natural philosophy."

From this point of view the division between sciences, though convenient, is arbitrary. The *rôle* of the philosopher is to develop generalisations and present them for verification by science. Hence the sphere of science is different from that of philosophy; and in the region of physical phenomena the deductive method has never been called in question. In conversation with Darwin, the lecturer was once speaking of the difficulties attendant on the interrogation of Nature, to which Darwin replied, "She will tell you a direct lie if she can"! It could not justly be said that Spencer was not an investigator at all; we were apt to forget that we stand on the shoulders of our predecessors, and to judge them by the standard of our own appliances and attainments. Of recent applications of the genuine deductive method, none was more remarkable than the quantitative biometric investigations originated by Sir Francis Galton, pursued by the late Prof. Weldon, and now being carried into various departments by numerous workers with conspicuous energy and success.

The lecture was listened to with marked interest by a large and representative audience, including the Vice-Chancellor of the University, with several professors and heads of colleges. It is published in full by the Clarendon Press.

THE WORK OF POLYTECHNIC INSTITUTES.

THE Lord Chief Justice, Lord Alverstone, G.C.M.G., P.C., distributed the prizes at the annual prize distribution at the Northampton Polytechnic Institute, London, E.C., on Thursday, December 8. In the course of his address, after the distribution of the prizes, he remarked that one reason why perhaps years ago we had fallen back was that this country and this metropolis had not then been aroused to the necessity of thoroughly good technical education, but that now immense good had been done to all the outlying districts of the metropolis, as well as to the City itself, by the establishment of the great polytechnics and by their capability for doing good work and of leading their students to higher and better grades. With reference to the proposed establishment of a great institution of technical optics in connection with the Northampton Polytechnic, he recalled a visit he paid years ago to the workshops of Messrs. Beck, and was satisfied that with the development of science that was now going forward practical optics would take a very prominent place in the future; he hoped that the polytechnic, with the support of those interested in it and the support of public bodies, would be able to say next year that the building of the new optical school had been commenced. It was always, he considered, a matter of regret when the educational facilities of any branch of technical industry were cribbed, cabin'd, and confined, and he further expressed the opinion that it was of very great importance that any school of practical technology or practical instruction in any expert business should be able to command the best apparatus and the best accommodation, because if it did not it would soon take second place. In these days specialisation is absolutely necessary in every trade, and after the preliminary training in fundamental subjects the time soon comes when specialisation must begin with the students, for in the present day it is no good scratching at a subject, but it must be gone through right to the bottom, so that the higher branches may be developed. Rapid modern developments, for instance, in electricity are constantly calling upon the institution for better apparatus, upon the teachers for greater acquirements, and upon the students for greater application.

After reference to the expenditure of some 6000*l.* on the new electric generating station, the Lord Chief Justice reminded the governors that they must be prepared for change if they desired to keep up the standard of the institution to the highest possible point. They must be on the look-out in each subject for the particular branches which can be specialised. In speaking to the students of the necessity for concentration on the object in view, he remarked that the extraordinary thing about Faraday was that he seemed to be able to think and think only of the particular subject that he was studying, and if he saw a light by the way which perhaps might lead him to some other aim or object he did not follow it up at once, but made a note, so to speak, in his mind, never forgetting the main object at which he was aiming, but putting a little mark so as to

come back some day and explore it. The address concluded with appreciative remarks regarding the social and recreative work of the institute, and especially with respect to the high place taken in gymnastics. The necessity for laying up for themselves a store of health and strength was strongly impressed upon the students, and the inestimable advantages of the social intercourse made possible by the existence of the various clubs and societies was insisted upon.

CERTAIN PHYSICAL CHARACTERS OF THE NEGROES OF THE CONGO FREE STATE AND NIGERIA.

IN a lecture at the Royal Anthropological Institute on November 29, Dr. Arthur Keith dealt with the physical characters and relationships of certain negro tribes in Equatorial Africa. His account was founded on data collected by (1) Mr. E. Torday amongst tribes in the Congo Free State, including the Bushonga, Basoka, Sango, and several others; (2) by Mr. P. A. Talbot in southern Nigeria, including the tribes of the Ekoi, Kabila, and Korawfs. Dr. Keith had also at his disposal three collections of crania, an extensive one of the Batatela (a tribe towards the eastern part of the Congo Free State), which was brought home by Mr. Torday; another from southern Nigeria, which he owed to Mr. P. A. Talbot; and a third (from the delta of the Niger) which had been placed at his disposal by Dr. Frank Corner.

In British Nigeria there are several types, but the one which he regarded as characteristic was represented by individuals of low stature, relatively long-headed, with the skull decidedly flattened from side to side. Many of the physical characters of this Nigerian type can be recognised in the Sango and other Congo tribes bordering on the Sudan. In head form, although not in stature, the Dinkas and Furs of the Nilotic tribes resemble the Nigerian type. In a contracted type which is prevalent in the Congo Free State, and which may be called the Congoese type, the head bulges laterally in the parietal region, and is relatively short and low.

The Batatela and the Basoka are representative of this type. It occurs also in some Nigerian tribes, and also in the Nyam-Nyam and Baran tribes of the Sudan. The Korawfs, a Nigerian tribe near the borders of the German Cameroons, are of a low stature with relatively long arms, as in Sir Harry Johnston's "forest negro type," but in head-form they resemble the Nigerian type of negro. The Bushongo from the south central part of the Congo Free State are tall compared with the Korawfs, but possess the massive head, great span, and large nose of the "forest type." In many features the Bushongo are related to certain of the Sudan tribes, such as the Nyam-Nyam. To account for the present distribution of physical characters among the negro tribes of Equatorial Africa one must assume that there has been a free intermigration of tribes, and that in their evolution the tendency in one tribe has been towards the accentuation of one set of features, in another tribe of another set of characters. Thus in the Nilotic Dinkas high stature and narrow-headedness have become marked characters; in typical Nigerians low stature and narrow heads; in the Bsoka a wide, short head and low stature; in the Buruna a wide head and high stature. Interbreeding may have played a part in the determination of tribal characters; if it had played a great part we should have found a greater degree of physical uniformity. The extent to which an admixture of Arab blood has modified the physical characters of negro tribes has probably been exaggerated.

SCIENCE AND THE STATE.[1]

IN all ages the welfare of a State must have been in a greater or less degree dependent on the development of its material resources and on the vigour and intelligence of its people; it is only in comparatively recent years, however, that recognition has been given to the fact that the State must leave nothing of this to chance, but must set itself deliberately by the use of scientific method to make the very best of its resources, and to increase the available vigour and intelligence of everyone within its borders. Not only so, but it must take suitable precautions that intelligence be universally trained, and be also duly organised so as to give the most effective and productive result. It is no longer enough that the State shall merely welcome and applaud a discoverer when he arises, or merely safeguard a private inventor from being fleeced; on the contrary, it must give of its substance to foster both discovery and invention, and must give legislative help to secure that inventions when made shall not be unfruitful through want of skilled labour or other hampering cause.

If we ask the reason for this change, the answer is that the keenness of international competition has vastly increased, that this has led to serious searching of intellect, that the laws of evolution have in consequence been seen to be applicable to nations as well as to individuals, and that under these inexorable laws the very existence of a State may be imperilled by ignorance or neglect. It is thus more important than ever that statesmen and leaders of the people shall not only be men of probity and high general character, but men of wide knowledge and penetrating forethought. They must have studied and must know all the possibilities of both land and people. On the material side they must have reckoned up the mineral resources, the agricultural resources, the water power and other forms of potential energy, the harbour accommodation, the waterways, and the advantages of the geographical position for over-sea commerce. On the human side they must have noted the natural gifts and weaknesses of the people, the best means of developing the former and of correcting the latter; and if it should be that there are varieties of race and colour in the population they must have thought out plans, not only for preventing loss of power through internal friction, but for obtaining the close cooperation of all the races in the general national interest. In the future it is only in a relative sense that there will continue to be "hewers of wood and drawers of water"; the State that aims at being in the forefront will have to see that even its wood-hewing and its water-drawing are done intelligently and to the best advantage. Further, the exploitation of any race in the interest of a higher race will be fatal folly when the need exists for exploiting all races in the interests of the State.

These considerations make it readily appear that the first great duty of the State towards science is to provide an effective and comprehensive system of national education. In the lower stages of the system direct and formal instruction in science need not bulk very largely; what is essential is that the pupil shall throughout his course be trained to observe, to think, and to reason. In the middle stages—the stages covered by secondary schools of all classes—the actual study of science, and especially of scientific method, must form a larger and ever-increasing part of the curriculum. Under neither of these heads, however, need we enter into detail to-night; it is sufficient for our present purpose to insist in connection with both on the desirability (1) of fostering rather than repressing the natural curiosity of the young; (2) of constantly recurring to the study of things in supplement to that of words; (3) of training the hands in the use of appropriate tools other than the pen; (4) of gradually introducing research methods into class-room work. It is the neglect of this advice that has been a main cause in the retardation of science; it has also helped to make school life a byword for dulness, and in many cases made the after-life unintellectual and even trivial.

When we come to the higher stages—the stage of the university, and more practical institutions coordinate therewith—the interest in our subject naturally increases, for there we look, not only for instruction in science and training in scientific method, but for a steady flow of fresh contributions to the stock of human knowledge. That this last is a legitimate expectation is now the received opinion throughout the whole civilised world. In accepting it, too, we have but returned to the original conception of a university—a conception that in the course of a long period of years had gradually come to be forgotten in English-speaking countries. The evil results of

[1] From the presidential address delivered before the South African Association for the Advancement of Science on October 31 by Dr. T. Muir, C.M.G., F.R.S.

this period of somnolescence at length became so striking, not to say alarming, that in May of 1870 a Royal Commission was appointed in England to make inquiry into the whole matter. It may safely be said that no stronger commission ever sat on a cognate subject, and that its long series of reports are models of clear statement and wise counsel which even to-day it would be difficult to improve upon.

"We have no doubt," one weighty report says, "that for a professor the duty of teaching is indispensable, but we agree that original research is a no less important part of his functions. The object of a university is to promote and to maintain learning and science, and scientific teaching of the highest kind can only be successfully carried on by persons who are themselves engaged in original research. If once a teacher ceases to be a learner it is difficult for him to maintain any freshness in the subject which he has to teach; and nothing is so likely to awaken the love of scientific inquiry in the mind of the student as the example of a teacher who shows his value for knowledge by making the advancement of it the principal business of his life." How far the great English universities then fell short of the ideal here indicated may be gathered from the writings of the time. On the monstrously developed examination system much of the blame had, of course, to be thrown. When it was asked what the universities did with their endowments and equipment, a voice from Cambridge said "they perform the functions, for too many of their students, of first-grade schools merely, and that in a manner about which opinions are divided; and superadded to these is an enormous examining engine, on the most approved Chinese model, always at work." Another writer advised that in order to be honest the university ought to put up a large brass plate with the inscription "Examinations held here"; and there were endless other well-deserved sarcasms from those who knew the facts best.

Of the agitation, the inquiry, and the plain speaking much good came, and the English universities of to-day show in consequence a very different character and spirit. The difference may not be all that earnest reformers still desire, but who in South Africa can with any conscience throw a stone at the offenders? Even so late as 1901, when numerous reforms had been effected in England, a great educationist and chemist, in directing attention to the function performed by universities on the continent of Europe, wound up with the passionate cry:—"Their universities have always been schools of research, of inquiry; unless, and until, ours become such, and our youth can be trained to advance, there can be no hope for us. God help us to make the change before it is too late!" If this be the prayer considered suitable for England when the present century began, what petition will suffice to-day for South Africa, which, as regards university research, stands well in the rear of the England of forty years ago? Are we to be encouraged to hope that one result of this year of union will be a serious effort to uproot our low ideals of university work, and to sow in their place the seeds of true learning and research? Fortunately, in one or two of the "colleges" a few individual teachers have set an excellent example, striving so far as their scant leisure permitted to advance the boundaries of their subject. All honour to them, and may more and more of their students imbibe their spirit and unite to press on the question of university reform and the removal of a deeply engrained stigma.

Coordinate in a sense with universities are public museums and libraries, the link of connection being that, besides intended for the promotion of research, they have other purposes to serve. All of them profess to aim at the instruction of the people; but in the case of museums and libraries this instruction is avowed to be mainly of a popular character, and in the case of museums it often differs very little from that more or less elevated amusement called sight-seeing.

As regards "museums," especially local museums, we have to note that, in the first place, very seldom have their founders had the purposes of real research in their minds. Usually, indeed, the original object has been the formation of a collection of animals, plants, and mere curiosities, with the result that if anything profited thereby it was natural history and archæology alone. Further, a fresh museum has almost uniformly been started without any intention of supplementing or cooperating with those already in existence; much loss in effectiveness has thus been sustained. How best to remedy these initial defects has been a long-standing problem with scientific men, and it is now fairly well agreed (1) that the museums of a country should for purposes of coordination and cooperation be under some common control; (2) that while in local museums appropriate specialisation should be encouraged, no science should be wholly neglected; (3) that both of the main purposes, instruction and research, should receive adequate attention in all museums; (4) that in the case of the central museum the purpose of research should be paramount, all the chief officers being chosen because of their ability to advance the knowledge of their own subjects. We in Cape Town have in the South African Museum, with its annals, a scientific agency of great national value and of immense promise for the future. Sad it is to think that, while its collections have been rapidly growing in magnitude and importance, the accommodation for exhibiting them remains as it was fifteen years ago.

As regards libraries, the state of matters is not greatly dissimilar. There are more of them it is true; but if the list be arranged in order of merit we have not got far down it when we find that we have parted company with scientific research. Indeed, the libraries that cater for anyone else than the so-called "general reader" are exceedingly few in number; cooperation is thus at least as necessary as in the case of museums. This is especially true in regard to scientific journals and the publications of scientific societies. The number of these is nowadays so great that a long purse is necessary for the maintenance of a complete collection; but by neglecting cooperation we make matters worse than they need be. Here in Cape Town, for example, we have four or five libraries that purchase scientific serials, and, though the libraries are within short distance of one another, duplicate and triplicate copies of some journals are to be found on their tables, while other journals equally important are neglected by them all. The time surely cannot be far distant when this will be rectified, when the importance of such reference libraries will be better appreciated by the State, and when the South African Public Library, having its special annual grant for reference books restored to it, will take the lead in a scheme of cooperation calculated to meet the wants of all engaged in scientific or literary research.

When thus dealing with the functions of universities, museums, and libraries, I have been in a manner viewing the State as an educationist. I now wish, in the same way, to invite your attention to the State as a landlord. With an extensive and varied property calling for development, one of the first and most urgent duties is to have it surveyed and inventoried under every needful heading. In the first place it must be accurately mapped; in the second place its surface constituents and rock formations must be ascertained and registered; in the third place the animal life of every district must be put on record; in the fourth place the same must be done with its plant life; and, lastly, its water supply, rainfall, and other climatic factors must be observed and tabulated. There thus arise as necessary scientific departments of the State's work—the topographical, geological, zoological, botanical, and meteorological. The fact that some of these subjects are incidentally dealt with by college lecturers and private students is no satisfactory reason for negligence on the part of the State. All such outside aid, it must be remembered, is subject to the uncertainties of personal liking, fashion, and caprice, and, consequently, is in its nature fitful and untrustworthy in an emergency. Besides, much of the work wanted to be done requires continuous attention over long periods, so that efficiency can only be secured by the existence of a permanent staff.

Attention has next to be directed to the State's duty in a third capacity, namely, as general health guardian. Fortunately this, though involving consideration of a number of sciences (entomology, bacteriology, mycology, &c.), need not be enlarged upon, it being self-evident that the bodily and mental fitness of the people is all-important in the life struggle of nations, and that it is almost equally momentous that animals and plants useful to man should be protected from the ravages of disease. Further, there

is the satisfactory reason that in dealing with such matters South African Governments have been, on the whole, sympathetic and, in some directions, markedly liberal. Here again, however, and perhaps in a special degree, it is necessary to give warning that the State should not burden itself with work proper to individuals and private corporations, but should confine itself to needful scientific work which other agencies cannot accomplish. It should never be forgotten that the State which discourages self-help is undermining its own strength.

Thus far we have been considering sciences with direct practical applications; indeed, the reasons for considering them at all has been in the main because of the existence of these applications—because the sciences bear more or less immediately on the welfare and prosperity of the State. What, then, are we to say of sciences from which the State or its people cannot hope to obtain any immediate benefit? Our answer is—and it ought to be given with entire frankness—such sciences must be content to take a second place. The State, we feel, has a perfect right to expect something tangible in return for its outlay; and, its supply of funds being limited, it is bound to pass in review before it any proposed series of scientific schemes, separating them out into practical and impractical, and thereafter sifting the practical into those that are urgent and those that are not. A manifest danger, however, besets the discriminators between rival schemes, it being far from easy to foresee what particular research will prove fruitful of practical applications and what will not. How often has one seen the pure mathematics of to-day change into the applied mathematics of to-morrow, and the previously despised insect collector being hailed shortly afterwards as a benefactor of mankind! All that one can hope for is that those with whom such decisions rest will always take the best advice available. Of recent years European Governments have tended more and more in such cases to consult their great leading scientific corporations; the Government of the Union may in like manner find our own Royal Society a willing and useful guide. I would merely add as a fact worth ruminating on that the States which have differentiated least between pure and applied science are the States which lead the world to-day.

While thus whole-heartedly urging the great importance of science on those who may be called to administer the affairs of State, it would be unfair to ignore the difficulties and troubles which well-disposed administrators are said to have experienced in their dealings with scientific men, or "experts," as they prefer to call them. The complaint of the most moderate of these critics is that the man of science is normally unpractical, and that his value to the State is marred by eccentricities due to over-study or excessive specialisation; and those critics who are not moderate, and who love a biting phrase better than strict accuracy, say that when he is not an astute self-seeker he is either a mooning pedant or a pernicious crank. Now in regard to this I should first wish to ask whether it be not the case that the failure of the scientific expert is often due to causes wholly outside himself. Time and again one has seen a man chosen for his high qualifications in a special branch of knowledge, and then set, not to the work of extending this knowledge by investigation, but to the absolutely diverse work of "running" a Government office or carrying on a purely business undertaking. Failure, nine times out of ten, is thus inevitable, so rare is it to find the successful student and the capable administrator combined in one. Surely it is the merest common sense to urge that if both sets of qualifications be wanted, reasonable care should be taken either that they are possessed by the same individual or that a practicable arrangement involving their separation has been previously devised. One thing certain is that in particular the appellation "self-seeking" as applied to men of science is singularly unfortunate, for, though the man of science with such a bent is not unknown, one's whole experience is that he is a comparative rarity, and that the more zeal a man has for science the less regardful he is of self. Indeed, it has been maintained that in the virtues of unselfishness and truthfulness the man who has chosen the pursuit of science for his life-work noteworthily excels. No less an authority than Helmholtz, himself a man of the world as well as a great investigator, has spontaneously testified to this, speaking with enthusiasm of the scientific man's "Sittenstrenge" and his "Uneigennützige Begeisterung." Unfortunately, it is possible that this "Sittenstrenge" is exactly what our public men would consider an eccentricity, their short-sightedness leading them to mistake a surface freckle for a deep-seated defect.

Be all this as it may, however, it is important to urge on both sides the fact that the man of science and the man of affairs, whatever their respective frailties may be, have need of each other, and must therefore in the future strive to know each other better, and learn to cooperate more effectively in the interest of the State. To this end he who aims at State administration must seek to possess other qualities and other aptitudes than those of the mere party politician, so that, besides doing his own proper work well, he may be the better able to gauge the value of pure scientific work, and be the better fitted to sympathise with the ideals and aspirations of even the extremest of specialists. On the other hand, the specialist must aim a little more at width of outlook and knowledge of men and affairs, must seek to moderate his exaggerated estimate of the importance of his own little domain, and must try to see good in the labours of other specialists in fields far distant from his own, never forgetting that all fields are but perfectly fitted portions of a cosmic whole, and that, as the botanist and the astronomer in particular must come to know,

> Thou canst not stir a flower
> Without troubling a star.

It would be a neglected opportunity if we did not note in passing that the need for a good understanding between the devotee of statecraft and the student of science is only part of a much wider need. Men who aspire to be leaders in municipal affairs, in commerce, in trade, in the manufacturing industries, in agriculture, must all come to know how substantially dependent they are upon science, and how, indeed, in a very real way, they must become more and more scientific themselves in the conduct of their affairs. With them also the day is gone when rule-of-thumb is a sufficient guide. Even sound common sense, so great a standby in the past, is no longer enough: what is wanted is that glorified form of common sense known as scientific method. Practical men in every line of life are beginning to see this, though they may not use the term. In plain language, what it means is the employment, at every stage of a process or undertaking, of the means best suited to attain the desired end. And as a method it is always essentially the same, no matter how the desired end may vary—whether the latter be, as we in Cape Colony have seen it to be, the sanitation of a town, the tracking of a crime, the repression of a native rebellion, the fighting of an invading disease, or the capturing of a market for fruit or wool. In all of these there was the same need for collecting accurate data, using all previously acquired relevant knowledge, planning skilfully a course of procedure, selecting wisely the human agents necessary, and then prosecuting with steady persistency the plan resolved on.

I need hardly say, in conclusion, that all that the most enlightened State can do will never be fully effective without a continuance of that zeal and devotion on the part of the "private worker" which has been so conspicuous in the past history of science; and, fortunately, in the course of evolution man has become so constituted that a stoppage of the supply need not be feared. Many will still be found willing and eager to work for the work's sake, whether the State does its duty or the reverse, merely resting on the assurance that "Nature never did betray the heart that truly 'loved her.'"

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The special board for biology and geology has adjudged the Walsingham medal for 1910 to A. V. Hill, of Trinity College, for his essay entitled "The Heat Produced by Living Tissues, with Special Reference to Muscular Activity"; and a second Walsingham medal to J. C. F. Fryer, of Gonville and Caius College, for his essay entitled "The Structure and Formation of Aldabra and Neighbouring Islands—with Notes on their Flora and Fauna."

The Vice-Chancellor gives notice that the Walsingham medal for 1911 will be awarded for a monograph or essay giving evidences of original research on any botanical, geological, or zoological subject, zoology being understood to include animal morphology and physiology. The regulations for the medal are published in the *Ordinances*, p. 629. The competition is open to graduates of the University who at the time fixed for sending in the essays are not of standing to be created Master of Arts. The essays for the ensuing year are to be sent to the chairman of the special board for biology and geology (Prof. Langley, The Museums) not later than October 10, 1911.

It is proposed to confer the degree of science, *honoris causa*, upon Prof. George E. Hale, director of the Solar Observatory of the Carnegie Institution of Washington, Mount Wilson, California.

THE Earl of Lytton will distribute the prizes and certificates at the Borough Polytechnic Institute on Monday next, December 19, at 8 p.m.

A REUTER message from Kimberley states that the De Beers Company has made a donation of 25,000*l.* towards the founding of a South African university.

WE learn from *Science* that Yale University has received an anonymous gift of 3000*l.*, the interest of which is to be used as an emergency loan fund in the interest of instructors and assistant professors of the University; 6000*l.* of a fund of 10,000*l.* left to the University by the late Mr. J. Burnett Collins, of Fort Worth, Texas; 4000*l.* from Mr. Newton Barney, of Farmington, Conn., toward the fund for the professorship of education, and a like amount from the family of the late Mr. John H. Whittemore, of Naugatuck, as a memorial gift. From the same source we learn that the University of Vermont has just received 5000*l.* by the will of Mr. Lewis L. Coburn, a graduate of the class of 1859.

THE annual meeting of the Mathematical Association is to be held on January 11, 1911, at the London Day Training College, Southampton Row, London, W.C. At 11 a.m. the president, Prof. H. H. Turner, F.R.S., will deliver his address, and this will be followed by a paper on the teaching of mechanics by Mr. G. Goodwill. The business meeting will begin at 2 p.m., and will be followed by the reading of papers. The Rev. Canon J. M. Wilson will deal with two fragments of geometrical treatises found in Worcester Cathedral library, and Mr. C. V. Durell will take as his subject the arithmetic syllabus in secondary schools. A discussion on the report of the committee on the teaching of algebra and trigonometry will take place, and an exhibition of scientific apparatus and books will be held.

IN connection with the Winter School of Agriculture of the Essex Education Committee, a course of instruction on farm crops and livestock is to be conducted at the County Laboratories, Chelmsford, from January 9 to March 17 of next year. The aim of the winter school is to impart instruction in the cultivation of the soil, the growth of crops, and the rearing of stock, based upon a knowledge of the sciences on which the practice of agriculture depends. The instruction in chemistry and physics, botany and zoology, is accompanied by practical laboratory work. The lectures on agriculture and surveying are supplemented by field and other demonstrations, but no instruction is given in the actual processes of farm work, it being held that these must be learnt upon the farm itself. The school, in fact, is intended to supplement farm training, not to replace it. The instruction is free to students resident in the County of Essex. Applications to attend must be made to the principal on or before December 16, from whom further particulars and forms of application may be had.

IT is proposed to organise in London next July a holiday course of lectures for the advancement of commercial studies. The object of the lectures is to familiarise the students—mainly commercial men and teachers of economics from Continental countries—with the history and practical working of English commerce and industry. The lectures are being arranged by the International Society for Promoting Commercial Education, which has already held similar annual courses in Milan, Mannheim, Havre, and Vienna. The society receives the patronage and financial support of many European Governments. The London course is to be held at the School of Economics, Clare Market, London, W.C., from July 24 to August 12 next. Arrangements are being made for securing the assistance as lecturers of the most eminent British authorities on economic and commercial subjects, and promises of help have been received already. An influential committee is in course of formation, and the names will shortly be announced. Persons interested in the subject are invited to communicate with the organising secretary for Great Britain, Mr. E. Cleveland-Stevens, School of Economics, Clare Market, London, W.C.

THE Education Committee of the General Medical Council has been considering for a year the place in a medical student's career that the preliminary sciences should occupy, and it has been engaged also in discussing the framing a pattern scheme showing how the subjects required could be studied adequately and the necessary examination passed within the prescribed period. The report of the committee was submitted to the General Medical Council at its winter session held at the end of November. The Education Committee has come to the conclusion that the schools of the country generally are not at the present time in a position to take up the work of preparing students in the preliminary sciences, chemistry, physics, and biology, and that the student must study these subjects at a medical school or science institute. The committee further came to the conclusion that any attempt to fix a standard minimum curriculum would fail, and eventually recommended only the elimination of some of the more junior examinations—which are recognised as preliminary examinations in general education—and their replacement by tests of an intermediate character. After some discussion, in which it was clear that there was a large body of opinion against the committee's recommendations, the further consideration of the subject was postponed until the May session of the council next year.

AT a meeting of the governing body of the Imperial College of Science and Technology, held on December 9, it was decided to invite Prof. Friedrich Czapek, of the University of Prague, to occupy the newly founded chair of plant physiology and pathology in the college, and to take immediate steps to afford the accommodation necessary for the important work of such a department. It is understood that, in furtherance of the aim of the Imperial College to apply science to industry, this chair has been founded to meet the needs for training young men to act as advisers in matters connected with agriculture at home and in the Empire abroad. Under existing conditions of agriculture it is everywhere recognised—notably by the large planting communities—that the advice of scientific experts has become absolutely necessary. There is, in fact, a demand considerably exceeding the supply for the services of trained scientific men to act in these capacities. Prof. Czapek enjoys a world-wide reputation as one of the leaders in plant physiology and pathology, and he has devoted special attention to the biochemical aspect of these subjects. It is precisely from this biochemical treatment that results of the highest importance for industry may be expected. We are informed that the college has every reason to expect that Prof. Czapek will accept the invitation. It is anticipated that the recognition of the importance of the business interests wrapped up in this work will justify the authorities of the college in looking beyond their immediate resources for the heavy initial expense required for building and suitably equipping such a department and for its subsequent maintenance.

AT the annual Convocation of the Allahabad University, held on November 12 at the Muir Central College, the Vice-Chancellor, Mr. Richards, conferred the degrees and delivered an address. Great strides, he said, have been made with the project for providing the University with a habitation of its own. The plans prepared by Sir Swinton Jacob will be on view in the exhibition shortly to open in Allahabad. The plans include a senate hall with offices and committee rooms, a law college, and a university library. When the buildings are completed they will amply provide for all the needs of Allahabad University. All the money needed for carrying out the whole scheme has not yet been collected, but with Government

assistance and the donations promised and received some Rs. 7,00,000 can be counted on. Further donations are urgently needed. Later the Vice-Chancellor said the University may congratulate itself upon a windfall that has come to it during the year. A sum of more than Rs. 75,000 has been received from the Queen Victoria Memorial Fund as an endowment for founding readerships for research work. The institution of university chairs was recommended by the Universities' Commission of 1904 for this very purpose, and it has been a cherished hope for many years that Allahabad University might be able to do something for the promotion of research among its graduate members. Hitherto, for lack of funds, nothing could be done. Now, however, a beginning can be made, and though it must be in a modest way at first, it inaugurates a new and important era in development; and as time goes on it will attract other benefactions, until the University has at length sufficient funds for research in all the directions of university study.

THE report on the work of the Department of Technology of the City and Guilds of London Institute for the session 1909-10 is now available. At the recent examinations 24,508 candidates were presented in technology from 418 centres in the United Kingdom, and of these 14,105 passed. By including the candidates from India and the colonies, and those for the teachers' certificates in manual training and domestic economy, the total number of examinees was 26,878. These figures show an increase on those of any previous year. In order to secure the expert advice of trade societies and professional bodies in the conduct of the department's educational work, the institute has arranged for the formation of advisory committees, consisting of persons interested in, and with a knowledge of, the technical details of different industries. The functions of each committee are to suggest improvements in the syllabuses of instruction, to recommend for appointment new examiners, and generally to advise on any matter connected with the course of instruction which may be referred to them by the institute. Reference has been made in former reports to the two main causes which impede progress in the technical instruction of artisans, and prevent the results of the teaching, now so liberally provided by local authorities, from being as satisfactory as might be desired. These causes are emphasised in the special reports of several of the institute's examiners. They are, first, the difficulty of finding competent teachers, and, secondly, the unduly large proportion of artisan students who enter technical classes without the preliminary knowledge necessary to take full advantage of the instruction they receive. While local authorities accept readily the advice and assistance of the department in their selection of teachers, and a higher standard of qualification is now more generally required, further improvement in this direction must be looked for if the money expended on technical instruction is to produce its best results. There can be no doubt that the teaching of technology has greatly improved during the past few years, but it must be noted that the examiners have still to direct attention repeatedly to the insufficient preliminary knowledge that some candidates possess.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, November 23.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. W. F. **Hume**: The effects of secular oscillation in Egypt during the Eocene and Cretaceous periods. There is evidence of the gradual advance of the Cretaceous sea from north or north-east over Egypt during Upper Cretaceous times. Four stages in this advance are indicated by the distribution of the Cretaceous deposits. The four phases are:—(*a*) A north Egyptian type, in which the Nubian Sandstone entirely underlies fossiliferous beds of Cenomanian age. This extends across Egypt from Sinai to Baharia Oasis. (*b*) A Wadi-Qena type, developed near the head of the valley of that name, characterised by the alternation of Nubian Sandstone with fossiliferous Cretaceous beds. (*c*) A central Egyptian or Hammama type, in which the Nubian Sandstone forms the greater portion of the Cretaceous series, only the Danian and Campanian beds being fossiliferous limestones or shales. The Campanian beds are characterised by the presence of phosphatic fish-beds. (*d*) A south Egyptian type has resemblances to the central Egyptian, but in the Campanian the phosphatic beds are inconspicuous. As regards the transition from the Cretaceous to the Eocene, the existence of two types of strata at the base of the Eocene is noted: the first, the Luxor type, being fossiliferous, and developed in the Western Desert; the second, or Qena type, being unfossiliferous, and composed of white limestone similar to the Danian white limestone below them, but structurally different. These variations may be due to fold-effects produced while the land was gaining on the sea at the beginning of Eocene times, the Qena limestones being remade Cretaceous material. Whereas in southern Egypt Lower Eocene strata directly overlie the Danian strata, in northern Egypt unconformities exist between the Middle Eocene and the Cretaceous beds. The palæontological differences between the Cretaceous and the Eocene are recorded, the principal feature being the sudden incoming of the foraminifera Nummulites and Operculina. The distribution, zonation, and variation of the Eocene series are considered. The apparent uniformity of the fossiliferous Lower Eocene strata wherever developed is noted. The lack of uniformity in the Middle Eocene strata. The nature of the Eocene beds between Baharia Oasis and the depressions of Moela and the Fayum are described, zoned, and compared with the Middle Eocene in other parts of Egypt. The influence of the gain of land over sea is traced through the Upper Moqattam beds. The Cretaceous period in Egypt is marked by the gradual gain of sea over land; during the Eocene land appears to have been steadily gaining on the sea, probably accompanied by gentle fold-movements, which account for the minor differences in the nature of the Eocene deposits.—A. R. **Horwood**: The origin of the British Trias. During the Triassic period in Britain, deposition, it is maintained, was brought about solely by the action of water, and the British Trias is a delta-system, for during Carboniferous, Permian, and Triassic times deposition was mainly in the same area. There is a gradation from the Bunter to the Rhætic. The Bunter is known to be of fluviatile origin, and there is a continuity from Lower to Upper Trias, with an unconformity due to the new mode of formation and change in sedimentation. Oscillation and overlapping are admittedly due to aqueous agency. The Triassic outcrop and the delta-area of the river Mississippi are closely similar. Coloration is original, from below upwards, and not coincident with bedding. The thickness of the Bunter is an argument for a subsiding area. The ferruginous types in the Carboniferous, Permian, and Trias are alike due to delta conditions. The Trias is horizontal now, as originally, away from any ancient hills which it covers. It is only the skerries that are rippled. Screes occur mainly to the south-west of submerged hills. Sandstones thin out eastward, marls westward, and the skerries are on the hills. Rock-salt and gypsum are also horizontal and continuous in a linear direction. The Keuper gradually merges into the Rhætic phase, and the latter into the Lias. Since the Bunter sediments came from the north-west into the Midlands, so probably did the Upper Trias. Local metamorphic and volcanic rocks may have provided some of the heavier minerals, but, as a whole, their source was more distant. The flora and fauna can be grouped in provinces around the delta-head of the Trias. These considerations point to an aqueous mode of sedimentation in a moist and equable climate.

Physical Society, November 25.—Prof. H. L. Callendar F.R.S., president, in the chair.—Dr. A. **Russell**: The electric stress at which ionisation begins in air. Prof. J. B. Whitehead has published the values of the electric stress at which ionisation begins in air. His electrodes consisted of a metal tube and a cylindrical wire coaxial with it. Alternating pressures were employed, and the inner wires had diameters from 0·089 to 0·475 cm. If a be the radius of the inner wire, the expression $32+13{\cdot}4/\sqrt{a}$ gives all Whitehead's experimental results for the maximum electric stress in kilovolts per centimetre with a maximum inaccuracy of less than 1 per cent. Experiments show that the electric stress at which ionisation occurs is independent of the metals used for the electrodes

and of the inner radius of the outer tube. It depends on the radius of the inner wire. Steinmetz's experimental results on the sparking distances between parallel rods are in substantial agreement with Whitehead's figures. An empirical formula based on experimental results published by Kowalski and Rappel is given for the sparking voltages between equal spherical electrodes. The electric stress at the moment of discharge has a minimum value when the distance between the electrodes is a certain function of their radius. Great stress is laid on the currents of electrified air which stream round the electrodes before the discharge takes place. These currents often modify the values obtained for the disruptive stress at the moment of discharge. The similarity between the formulæ for the temperature gradient at the surface of a hot wire cooling in air and the empirical formula for the potential gradient at the surface of an electrified wire when ionisation is taking place at its surface is pointed out.—Prof. R. J. **Strutt**: The afterglow of electric discharge. When the electric discharge has passed at low pressure through certain gaseous mixtures, a luminosity survives for some seconds after the discharge has been turned off. An improved method of experimenting on the phenomena was introduced by Dewar. A powerful air-pump is used to draw a regulated current of gas through the vacuum tube. A continuous removal of the gas from the region of discharge is effected, and the afterglow which it emits, in passing through another vessel on its way to the pump, can be examined continuously and at leisure. There has been difference of opinion as to whether pure oxygen shows a glow or not. The glow, if any, is certainly exceedingly faint. With air a bright yellow glow is obtained, which is improved by enriching the air with oxygen. Pure nitrogen gives no glow whatever. Previous experimenters have connected the glow with ozone, though without expressing definite views as to what part ozone played. The evidence for this has been that the glow is only obtained where oxygen is present, and that it is destroyed by heat. Additional evidence has been obtained. (1) The glow cannot survive passage through a tube cooled in liquid air. This is regarded as due to condensation of ozone. (2) It is destroyed by passage over oxides of copper, manganese, and silver. Ozone is known to be destroyed by these substances. (3) While the glowing gas oxidises bright silver, the gas current beyond the point at which the glow has died out does not do so. Disappearance of the glow is simultaneous with disappearance of ozone from the gas. The glow involves consumption of ozone. It is natural to regard it as a flame of low temperature, arising from the oxidation of some other body by ozone. Experiments were made to determine the nature of this other body. A current of ozone from a vacuum tube fed with oxygen was allowed to mix with any other gas which it was desired to test on its way to the pump. Nitrogen or ordinary air added to the ozone gave no effect, but air which had been through an independent discharge, and had been deprived of its original glow by silver oxide, was found to glow again on mixing with ozone. Some body is produced in air by the discharge the oxidation of which is responsible for the glow. This body is nitric oxide. On leading a current of this gas into the ozone stream a brilliant glow was obtained of the characteristic yellow colour. This glow can be produced in the form of a pointed flame, with dark inner cone. The glow is not associated with a sensible rise of temperature. Condensing the ozone with liquid air, allowing it to re-evaporate, and admitting nitric oxide to it, a yellow flash can be obtained long after the electric discharge is over. The glow is purely chemical in its origin. Ozone from the Siemens tube used at atmospheric pressure seems incapable of yielding the glow when mixed with nitric oxide. This may be due to the low percentage of ozone present. The main conclusion is that the ordinary yellow afterglow is due to oxidation of nitric oxide by ozone.—L. F. **Richardson**: The approximate solution of various boundary problems by surface integration combined with freehand graphs.

Zoological Society, November 29.—Dr. H. Woodward F.R.S., vice-president, in the chair.—Dr. H. B. **Fantham** and Dr. H. Hammond **Smith**: A possible cause of pneumo-enteritis in the red grouse (*Lagopus scoticus*). The authors recorded that in grouse-chicks dying of coccidiosis, many of which showed symptoms of pneumonia, they found coccidian oöcysts in the bronchioles, bronchi, and trachea. The coccidian cysts in the bronchioles were probably capable of setting up sufficient irritation to account for the pneumonic symptoms. These observations were interesting as showing that the much criticised views of Klein, Tegetmeier, and others on "pneumo-enteritic" as a cause of mortality in grouse may have some foundation in fact.—Dr. J. F. **Gemmill**: The development of *Solaster endeca*, Forbes. The author described the ovaries and ova and the processes of spawning, fertilisation, segmentation, and gastrulation, and then dealt with the characters of the free-swimming larvæ and the changes related to the metamorphosis. He discussed the development of the internal cavities and of the skeleton, and described the methods he had employed in obtaining and rearing the larvæ. The memoir, in addition to details of adult anatomy, contained a description of various points in development.—F. E. **Beddard**: The alimentary tract of certain birds, and on the mesenteric relations of the intestinal loops. Notes the author had accumulated relative to the viscera of birds which had died in the society's gardens. The paper dealt more particularly with species that had not been carefully studied from the point of view of the convolutions of the intestine, and attention was directed to a considerable series of birds.—Prof. A. **Cabrera**: The specimens of spotted hyænas in the British Museum (Natural History). Three apparently new forms were described.

Linnean Society, December 1.—Dr. D. H. Scott, F.R.S., president, in the chair.—Captain C. F. **Meek**: The spermatogenesis of *Stenobothrus viridulus*, with special reference to the heterotropic chromosome as a sex determinant in grasshoppers.

Mathematical Society, December 8.—Dr. H. F. Baker, president, in the chair.—G. H. **Hardy**: Properties of logarithmico-exponential functions.—G. H. **Hardy**: Some results concerning the increase of functions defined by an algebraic differential equation of the first order.—A. A. **Robb**: Optical geometry of motion.—T. C. **Lewis**: Note on the Pellian equation.—G. B. **Mathews**: The arithmetical theory of binary cubic forms.—Dr. W. H. **Young**: The integration of Fourier's series.—Dr. W. H. **Young**: The theory of the application of expansions to definite integrals.

Royal Astronomical Society, December 9.—Sir David Gill, K.C.B., president, in the chair.—A. C. D. **Crommelin**: Note on Mr. Innes's paper on the mean or perihelion distances of comets.—A. Stanley **Williams**: The equatorial current of Jupiter in 1880. The author concluded from observations of eight spots that the rotation period of the equatorial current in 1880–1 was nearly 20 sec. shorter than during the years 1888–1908, amounting to a difference in velocity of about 15 miles an hour.—A. A. **Rambaut**: Observations of Halley's comet, Daniel's comet (1909*e*), and comet 1910*e*, made at the Radcliffe Observatory, Oxford.—A. A. **Rambaut**: Observations of stars occulted by the moon during the eclipse of 1910 November 16. A photograph of the eclipsed moon and trails of stars was shown, the telescope having been adjusted to the moon's motion during the eclipse.—C. V. L. **Charlier**: Multiple solutions in the determination of orbits from three observations. The author showed that in certain regions more than one solution could be obtained from the observations, while in others only one was possible; in consequence of this, much difficulty was somtimes found in obtaining the true orbit, as was the case with comet 1910*a*.—H. H. **Turner**: The accuracy of the positions of the star images in the "Harvard Sky." By the latter term was intended the Harvard series of fifty-five plates, forming a photographic map of the heavens on a scale about one-eleventh that of the Astrographic Catalogue. Formulæ were given for computing the optical distortion, varying as the cube of the distance from the centre of the plates, and also for the differential refraction.—S. A. **Saunder**: The determination of selenographic positions, and the measurement of lunar photo-

graphs. Fifth paper: Results of the measurement of two Yerkes negatives. The negatives, taken by Prof. Ritchey, were extremely fine, but their dates—given as 1901 August 3 and November 21—were uncertain. The result of the author's reduction of the measures of the plates enabled him to show that they were actually taken on September 3 and November 20. The measures appeared to show that points on the moon greatly above or below the mean surface should be rejected, owing to their being shifted in opposite directions by libration. A diagram was drawn to exhibit the close agreement between points independently measured on photographs by Prof. Franz and Mr. Saunder compared with the considerable divergence in the positions of the same points as determined by Lohrmann and Mädler. The actual measures had been made on the negatives by Mr. Hardcastle.

PARIS.

Academy of Sciences, December 3.—M. Émile Picard in the chair.—G. **Lippmann**: Two pieces of metal lightly touching do not, in general, form an electrical contact when the difference of potential is small. Two forms of contact are described in which no pressure is necessary. In one of these a strip of paper moistened with a solution of an electrolyte (calcium chloride) is employed; the second consists of two amalgamated silver wires.—A. **Gautier**: Concerning the invention of porous filtering candles. The author points out that he described the manufacture and use of porous porcelain filters two years before Ch. Chamberland.—A. **Laveran** and A. **Pettit**: A new hæmogregarian of *Damonia subtrijuga*.—M. **Gouy**: The potential of the discharge in a magnetic field.—W. **Kilian** and M. **Gignoux**: The levels of the pebble beds and terraces in the neighbourhood of Saint-Rambert-d'Albon (Drôme) and of Beaurepaire (Isère).—M. Lecornu was elected a member in the section of mechanics in the place of the late M. Maurice Levy.—G. D. **Boerlage**: An attempt at "*vol à vortex*." Attention is directed to the effect of the thickness of the front edge of the wing in birds, and the author suggests that an attempt might be made to realise these conditions in aëroplanes.—M. **Lambert**: A form of the equations of motion of a small planet.—M. **Borrelly**: Observations of the new Cerulli comet made at the Observatory of Marseilles with the comet finder. Data are given for November 10, 12, 14, and 16.—M. **Coggia**: Observations of the Faye comet (1910*e*, Cerulli, November 9) made at the Observatory of Marseilles with the Eichens equatorial of 26-cm. aperture. Positions are given for November 12 and 16.—P. E. **Gau**: The integration, by the method of M. Darboux, of any partial differential equation of the second order.—T. **Lalesco**: The poles of resolving nuclei.—Henri **Villat**: The movements of a fluid round an obstacle of given form.—Marcel **Chopin**: The absolute measurement of currents of great intensity. A description of a modified tangent galvanometer capable of measuring currents up to 1000 amperes.—M. **Tian**: The nature of the decomposition of hydrogen peroxide solutions produced by light. It has been shown that the decomposition of hydrogen peroxide by heat is a bimolecular reaction, whilst the decomposition by catalysis in presence of colloidal platinum, diastase, &c., is a unimolecular reaction. An experimental study of the decomposition produced by ultra-violet light shows that the reaction is unimolecular, and hence is not analogous to the action of heat, but rather resembles catalytic decomposition.—Paul **Jégou**: The reception of the Hertzian time signal from the Eiffel Tower. The apparatus described and illustrated works with Leclanche cells instead of secondary batteries, and is simplified in other directions.—L. **Décombe**: The mechanical interpretation of the principle of Carnot and Clausius. The case of a compensated transformation.—F. **Charron**: The modifications produced by the air layer in friction and sliding between solid bodies.—Br. **Glatzel**: New experiments in stimulation by shocks in wireless telegraphy. It is well known that by interposing very short sparks into the primary circuit of a Hertzian wave excitor the vibrations in this circuit are effectually deadened. The author passes the sparks through a tube containing hydrogen between nickel electrodes. Reproductions of photographs are given showing the complete damping effect obtained.—R. **Marcelin**: The mechanics of irreversible phenomena.—A. **Besson** and L. **Fournier**: By passing a rapid current of hydrogen bromide over amorphous silicon at a red heat a liquid is obtained which, on submitting to fractional distillation, gives as the main product of the reaction silicon tetrabromide; small quantities of SiH_2Br_2 are also obtained, and also a liquid which appears to be a mixture of this with SiH_3Br. Details are also given of a rapid method of preparing a crude silicon suitable for the reaction. By the action of the silent discharge upon the vapours of the silicobromoform four substances were identified, $SiBr_4$, Si_2Br_6, Si_3Br_8, and Si_4Br_{10}, the silicon analogues of tetrabromomethane, octobrompropane, and decabrombutane.—E. A. **Salmon**: A method for producing a reaction between two bodies in the electric arc.—L. **Tchougaeff** and W. **Fomin**: The addition of hydrogen to the isomeric thujenes and sabinene. The application of the Sabatier and Senderens reactions having been shown to be too energetic in the case of these two hydrocarbons, the addition of two atoms of hydrogen to each molecule was effected by the catalytic action of platinum black, the hydrogen being used under a pressure of 25 to 50 atmospheres. The physical and chemical properties of the resulting hydrocarbons are given.—Georges **Denigès**: A new reaction of morphine. The reagent proposed is a mixture of ammonia, hydrogen peroxide, and copper sulphate in aqueous solution. A red colour is produced if the concentration of the morphine is above 0·03 gram per litre. This reaction gives negative results with codeine, thebaine, papaverine, narceine, and narcotine.—A. **Verneuil**: The nature of the oxides causing the coloration of the Oriental sapphire. Careful analyses of sapphires from different sources (Montana, Burmah, and Australia) showed the invariable constituents to be oxide of iron and oxide of titanium. The latter oxide was not detected in the earlier analyses by other workers. No chromium was found in the two sapphires examined for this element, and the author concludes that chromium is not essential to the production of the characteristic colour. The conclusion that the colour is due to the oxides of titanium and iron alone is confirmed by the synthesis of the gem by fusion previously described.—Henri **Coupin**: The influence of various volatile substances on the higher plants.—L. **Moreau** and E. **Vinet**: Insecticide treatments in viticulture.—Ed. **Griffon**: The influence of the tarring of roads on the adjacent vegetation. The author comes to the conclusion that no injurious effect to vegetation can be proved to have been caused by the tarring of roads. Laboratory results cannot be regarded as conclusive on this point, which can only be settled by actual practice in the open air.—MM. **Melchissédec** and **Frossard**: Muscular fatigue in singing.—M. **Doyon**: The formation of antirhombine in the liver previously frozen at a very low temperature.—G. **Linossier**: The influence of iron on the formation of the spores of *Aspergillus niger*. It has been shown by previous workers that if iron be omitted from the culture solutions of *Aspergillus niger* spores are not formed. The author has extracted the black pigment from the spores of this mould, and shows that it possesses properties resembling the hæmatin of the blood, and contains iron as an essential constituent. This furnishes a full explanation of the impossibility of producing spores in the absence of iron.—Gabriel **Bertrand** and Arthur **Compton**: The influence of temperature on the activity of cellase. Cellase from sweet almonds has a maximum activity at a temperature of 46° C. This is independent of the duration of heating, and is a specific value of great interest.—M. **Lemoine**: The presence of deposits of cholesterol in the coats of sclero-ætheromatous arteries.—Ch. **Vélain** and Albert **Michel-Lévy**: The primary strata of the south of the Vosges.—MM. **Bernard** and **Mougin**: The stratification of the *névé* and of the ice in the upper regions of the collecting areas of glaciers.—Ph. **Glangeaud**: The glacial phenomena in the mountains of Forez.—Paul **Bertrand**: General characters of the stipes of *Asterochlaena laxa*.—M. **Martel**: The removal of obstruction in water-bearing fissures.—P. **Mercanton**: The magnetic condition of the diabases of Isfjord at Spitsbergen.—Louis **Gentil**: The lower Mlouya (eastern Morocco).

NEW SOUTH WALES.

Linnean Society, September 28.—Mr. C. Hedley, president, in the chair.—C. T. **Musson** and W. M. **Carne**: The adventitious roots of *Melaleuca linariifolia*, Sm.—R. J. **Tillyard**: Some experiments with dragon-fly larvæ. This paper embodies the results of experiments carried out with the object of showing:—(1) That dragon-fly larvæ of certain kinds live longer than one year. An unknown Libellulid larva taken at Heathcote on October 10, 1908, and more than half-grown then, has lived in an aquarium to the present date. It now appears full-fed, and may be expected to emerge this season. Its age, from the egg, must be more than two and a half years. (2) That certain dragon-fly larvæ can resist severe and prolonged drought. Eight larvæ of *Synthemis eustalacta*, Burm., were placed in a shallow-water aquarium over sand; no food given from December 25, 1909, and water allowed to evaporate. The aquarium was dry on February 2, and the larvæ were kept alive, hidden in the sand, until May 29, a period of nearly four months. The larvæ were then returned to water and fed up. Seven are still alive, and may be expected to emerge this season.—T. Harvey **Johnston** and Dr. J. Burton **Cleland**: The Hæmatozoa of Australian Reptilia. No. 1. A list of Australian reptiles from which Hæmatozoa have been recorded is given, and three species of Haemogregarina (Karyolysus) are described as new.

October 26.—Mr. C. Hedley, president, in the chair.—T. **Iredale**: An additional note on the birds of Lord Howe and Norfolk Islands. The opportunity of inspecting the Watling drawings in the British Museum prompted the author to investigate the authenticity of the early chronicles relating to some of the birds of Norfolk and Lord Howe Islands, now extinct, or the identity of which has never been settled satisfactorily. From the consideration of the historical evidence available, the author concludes that the extinct white gallinule (*Notornis alba*) was restricted to Lord Howe Island; that the "Norfolk Island petrel" of Latham is probably *Puffinus griseus*, Gm., which still breeds about the typical locality, and not *P. chlororhynchus*, Less., as supposed by the late Dr. Sharpe; and that drawing No. 282, regarded by Dr. Sharpe as representing *P. tenuirostris*, Temm., is undoubtedly a figure of the Œstrelata still breeding, or which apparently used to breed, on Norfolk Island, which must bear the name *Œstrelata phillipi*, Gray, and which is different from *Œ. neglecta*, Schl. Some omissions are rectified, and observations supplementary to those of Mr. Hull (Proceedings, 1909, p. 636) are given.—A. F. Basset **Hull**: Further notes on the birds of Lord Howe and Norfolk Islands, with the description of a new species of petrel. The author endeavours to dispel the uncertainty enshrouding the identification of the petrels of Norfolk Island. Captain Hunter's "bird of providence" remains a mystery, as visits to Mount Pitt in November, and in the succeeding year in August, offered no signs of birds or burrows, a condition of things possibly due to the extermination of the old-time colony, or its removal to more secure breeding grounds. The "Big Hill mutton-bird" of Lord Howe Island, which breeds upon Mount Gower, is shown to be markedly different from *Œstrelata neglecta*, Schlg., and is described as new.—J. H. **Maiden** and E. **Betche**: Notes from the Botanic Gardens, Sydney. No. 16.—A. M. **Lea**: Australian and Tasmanian Pselaphidæ (Coleoptera).

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 15.

LINNEAN SOCIETY, at 8.—Reports on the International Botanical Congress at Brussels, 1910: Dr. Otto Stapf, F.R.S., and others.—Non-calcareous Sponges from the Red Sea, collected by Mr. Cyril Crossland: R. W. H. Row.—Comparative Anatomy of Leaves of Veronica: R. S. Adamson.

ROYAL SOCIETY OF ARTS, at 4.30.—The Taj Mahal and its Relation to Indian Architecture: R. F. Chisholm.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Submarine Cables for Long Distance Telephone Circuits: Major W. A. J. O'Meara, C.M.G.

FRIDAY, DECEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Production of Castings to withstand High Pressures: Prof. H. C. H. Carpenter and C. A. Edwards.—The Constitution of Troostite and the Tempering of Steel: Andrew McCance.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Mathematical Deduction of the most Economical Ratio of Reinforcement for Reinforced-concrete Structures: R. N. Mirza.

SATURDAY, DECEMBER 17.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.—Notes on a "Neolithic Floor" near Rayleigh, Essex: F. W. Reader and S. Hazzledine Warren.—Sarsens, Basalt, and other Boulders in Essex: Dr. E. A. Salter.

MONDAY, DECEMBER 19.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The French Antarctic Expedition, 1903–1910: Dr. J. B. Charcot.

INSTITUTE OF ACTUARIES, at 5.—On the Valuation of the Liabilities of an Insurance Company under its Employers' Liability Contracts: W. Penman, Jr.

TUESDAY, DECEMBER 20.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Winning of Coastal Lands in Holland: A. E. Carey.

WEDNESDAY, DECEMBER 21.

GEOLOGICAL SOCIETY, at 8.—The Keuper Marls around Charnwood Forest: T. O. Bosworth.—The Relationship of the Permian to the Trias in Nottinghamshire: R. L. Sherlock.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Modern Methods of Research on a Scientific Cruiser: Arthur Earland.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—(1) Report on Balloon Experiments at Blackpool, 1910; (2) The Meteorological Significance of Small Wind and Pressure Variations: Capt. C. H. Ley.—Atmospheric Waves of Short Period: Dr. Wilhelm Schmidt.

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