THURSDAY, NOVEMBER 29, 1900.

THREE BOOKS ON BIRDS.

The Birds of Ireland; an Account of the Distribution, Migration and Habits of Birds as Observed in Ireland, with all Additions to the Irish List. By R. J. Ussher and R. Warren. Pp. xxxii + 419. Illustrated. (London: Gurney and Jackson, 1900.)

The Story of the Birds. By C. Dixon. Pp. xiv + 304. (London: George Allen, 1900.)

Among the Birds. By Florence Anna Fulcher. Pp. iii + 253. (London: S.P.C.K, 1900.)

IN a few months half a century will have elapsed since the publication of the third and concluding volume of Thompson's "Birds of Ireland," and, with the exception of a smaller volume written on more popular lines, and the valuable "List of Irish Birds" (two editions of which have appeared), by the late Mr. A. G. More, of Dublin, no other complete treatise on the same subject has hitherto been issued. With the great advances in our information on this special subject, and the improvements in our method of treating natural history in general, to say nothing of the changes which have occurred in the Irish avifauna itself during that long interval, it will be evident that there is abundant room for an authentic and standard work of the nature of the one before us. And no one could have been found better fitted to undertake this important and laborious task than Mr. R. J. Ussher, who has written the bulk of the present volume, and who has devoted the greater part of his life to the study of the history and habits of his well-beloved Irish birds. As regards the contributions of Mr. R. Warren, whose name appears on the title-page as joint-author, we are told in the preface that the portions of the work actually from his own pen are restricted to the accounts of half-a-dozen species. Mr. Ussher is, however, careful to acknowledge his indebtedness to his friend and coadjutor for a number of observations on the habits and distribution of birds. And he likewise declares his obligations to the late Mr. More, and also to Mr. R. M. Barrington, who has contributed much information with regard to bird-migration, drawn from the observations taken at the lighthouse stations.

Mr. Ussher appears, indeed, to have carried out his task in a thoroughly satisfactory and conscientious manner; and has succeeded not only in producing an accurate and trustworthy treatise on Irish birds, but likewise a readable and interesting book. With the many illustrated works extant at the present day on British birds, it would have been merely a useless expense to have repeated figures of the species found in Ireland; and a wise discretion has, we venture to think, been exercised in limiting the illustrations (which can scarcely be surpassed for excellence) to photographs of the nests of birds and of the breeding haunts of some of the maritime species. An exquisite coloured plate of six distinct colour-phases of Irish peregrine falcon eggs forms an appropriate frontispiece.

A feature of the work is the special attention bestowed on the local distribution of birds within the area treated of; this being elaborated in a series of tables which alone serve to indicate the enormous amount of labour bestowed by Mr. Ussher on his subject. In formulating these tables, he owns himself greatly indebted to correspondents from all parts of the country, who have filled up schedules sent to them for the purpose of recording their observations. So far as our recollection serves us, similar tables have not been issued with any work on the birds of Britain generally; and, in view of the present trend of natural history studies, the importance of those drawn by Mr. Ussher can scarcely be over-estimated.

In regard to classification and nomenclature, Mr. Ussher follows Mr. Saunders, in his "Manual of British Birds," and since, in our opinion, uniformity is of more importance than anything else in classification, we think he has been well advised in so doing. With the exception of the red grouse, he apparently regards no species of bird as peculiar to the British Islands; neither are any local Irish races admitted. In regard to the British marsh-tit, which Dr. Sharpe considers entitled to rank as a species apart from the continental form, under the name of *Parus dresseri*, Mr. Ussher admits no such distinction. Curiously enough, however, the subspecific title *Parus palustris dresseri* occurs in the index, but on turning to the page (31) quoted, only the name *P. palustris* is to be found. It may also be noted that on p. 230 the author refers to the generally lighter colour of Irish red grouse as compared with their relatives in Great Britain; and if this be a constant point of distinction, it would justify, in the opinion of many naturalists, the separation of the former as a local race.

It may be noticed that in the preceding paragraph we have employed the word "apparently" in regard to the absence of peculiar British species and races. We have done so because we have not been at the pains to look at the heading under which each particular bird is described, and there is no table of contents to the book in which it could be seen at a glance whether or no the above statement is absolutely correct. The omission of such a table is, we think, a decided disadvantage to the book. Its presence would likewise have told us the number of species of birds regarded by Mr. Ussher as entitled to be called Irish; but, as he does not number his species, this also can only be ascertained by going through the book page by page.

Not that this question of the number of species is one of much importance one way or the other, for, as the author tells us, it is always difficult to draw lines in cases of this nature. On the whole, however, we think that a wise discretion has been exercised in this particular instance, the species whose claims to admission rest on the slenderest foundations being treated by themselves. Apart from its fossilised bones, the only historic evidence in modern times for regarding the great auk as an Irish bird is furnished by the example captured near Waterford Harbour in 1834; and consequently the account of this species might with advantage have been considerably curtailed, as almost more than enough has been written about it in other works.

Occupying the most western position of the islands of the British group, and enjoying a singularly equable and mild climate, Ireland naturally cannot lay claim to the possession of nearly so many species of birds as are found within the limits of Great Britain. This deficiency in species is, however, in some degree compensated by the great numerical abundance of certain of these in individuals, many of the coast cliffs, with their adjacent islands, being frequented during the breeding season by vast flocks of gannets, gulls, auks, puffins, guillemots, petrels, &c.

In regard to the eggs of guillemots, it may be mentioned that Mr. Ussher makes two interesting observations. In the first place, he says that the beautiful varieties of colouring, which are so characteristic of the eggs of this species, "must help each bird to distinguish her egg from others lying near, until they all become stained and soiled." In another passage he observes that the eggs "get completely covered in filth as incubation proceeds, and I have seen many cemented thereby to the rock. This may account for the exaggerated statement that the bird has the power of gluing them to the rock to prevent them from falling off."

In connection with the uniform climate of Ireland, to which reference has already been made, it may be observed that climatic conditions can scarcely explain all the features in the distribution of birds; this being remarkably exemplified by the circumstances that while the red-breasted merganser has an extensive breeding range in Ireland, yet that elsewhere in the British Islands its breeding is restricted to Scotland.

In regard to "station," Ireland, as most of our readers are doubtless well aware, possesses a variety which renders it peculiarly adapted to an abundant development of bird life. These variations are excellently well displayed in a map, in which the uncultivated areas are tinted brown. *Primâ facie*, it might have been thought that all the moors and bogs of Ireland were equally well suited to maintain a large bird population. But this, according to Mr. Ussher, is by no means the case, most of the western moors being comparatively destitute of life. The reason for this we should like to see explained.

Many birds now rare in England are comparatively common in Ireland, among them being the raven and the chough. Of the former Mr. Ussher writes that "in the west it still breeds undisturbed on the Arran Islands, High Island, and the Twelve Pins of Connemara, while the cliffs of Mayo and of Achil Island are among its chief strongholds." We presume there is no danger to the bird in the mention of these localities, as otherwise the author would not have done so, since he states, on page 374, that the disclosure of the nesting haunts of the red-throated diver led to its extermination as a breeding Irish species.

While Ireland has lost certain members of its original fauna, such as the great auk, the crane and the capercaillie, it has gained others by apparently natural causes. Among these latter are the missel-thrush and the magpie, both of which have now thoroughly well established themselves. Sportsmen will be pleased to learn that woodcock are yearly becoming more numerous during the summer in Irish coverts. And although it was feared some years ago that the quail was about to forsake the country for ever, its reappearance in some numbers during 1892–93 affords hope that it may some day be reestablished. All efforts to introduce the blackcock and the ptarmigan have, however, resulted in signal failure, and Mr. Ussher refuses to admit certain evidence derived from cavern bones as to their former existence in the island.

In conclusion, we cannot but repeat our sense of the high value and importance of Mr. Ussher's work, which must long remain the standard authority on the subject of which it treats. Errors and misprints are few and far between, and most of them have been detected and corrected by the author. The book is thoroughly well turned out, and should have a place on the bookshelves, not only of every British ornithologist, but of every sportsman who visits Ireland.

Of a very different character from the above is the book standing second on our list, which appeals only to the amateur ornithologist. Mr. Dixon and his publishers seem, indeed, to be under the impression that the British public has an unlimited appetite for popular bird-books, and to supply this an endless stream of works is poured from this author's pen. In the present volume Mr. Dixon takes a new departure, and tries to interest his readers in the anatomy and general structure of birds, as well as in their geographical distribution, both past and present.

Although a compilation, in which the author confesses himself much indebted to Prof. Newton's "Dictionary of Birds," the account of the palæontology and osteology is, on the whole, satisfactory. Perhaps, however, the statement on page 3, that reptiles are more nearly related to birds than to any other animals, might advantageously be modified in view of recent investigations into the structure of the anomodonts; and it is not true that all dinosaurs are gigantic. Exception may also be taken to the statement on page 13, that the tropical types of birds whose remains occur in the European tertiaries are necessarily of southern origin, the available evidence, for what it is worth, pointing to a precisely opposite conclusion. Neither do we think the idea mooted on page 105, "that some scheme of latitudinal division will yet be proved to be the correct one" for the division of the globe into zoo-geographical distribution is at all likely to find acceptation among those best qualified to deal with this subject.

In the osteological section, no indication is given that the so-called tibia of the bird (p. 35) includes a portion of the tarsus, or that the remaining part of that element is fused with the compound bone incorrectly called metatarsus.

After treating of their palæontology, structure, and distribution, Mr. Dixon takes into consideration their general habits and physiology, including flight, social instincts, food, mimicry and protective coloration, nuptial display, song, and nidification. All these subjects are treated in a manner calculated to attract the interest of the general reader. But there are some ugly sentences; as, for instance, the following on p. 29:—

"The first cervical vertebra is termed the atlas, because it bears the head, and which is articulated with it by a single occipital condyle."

And the work is not free from misprints, as witness (p. 115) *Merganettine* instead of *Merganettinae*. Nevertheless, the book, as a whole, is a creditable production; and it has the great merit of drawing attention to the fact that the scope of ornithology is not confined to the c lours and other external characters of birds.

Essentially popular and "gossipy" in its style, Miss Fulcher's "Among the Birds" is written by an enthusiastic bird-lover for other bird-lovers—whether young or old—who desire information on a fascinating subject without entering into zoological technicalities. As we learn from the preface, a number of the chapters have already appeared in various journals and magazines; and, in spite of the multitude of bird-books relating to the British Islands, they seem decidedly worthy of reproduction in permanent form. For the author has much of the fascination of style characteristic of "A Son of the Marshes," and writes mainly, if not entirely, from personal experiences of her feathered friends, her observations extending from the peaceful meadows and fields of Middlesex and Hertfordshire to the rugged moors and sea-cliffs of Scotland and the Farne Islands. Indeed, if the author has a fault, it is in a somewhat overweening confidence in her own opinions and theories, this being especially noticeable in the chapter on migration. And in this connection it may be mentioned that there are other English ornithologists besides Mr. C. Dixon who have written on the last-mentioned subject.

Personally we are of opinion that the author is at her best when describing birds in their actual haunts, the chapters on migration, nests, song and the "ministry of birds" being far less satisfactory than those dealing with the avifauna of particular stations. The chapters which strike us as being the most interesting are those entitled "The Tern Nursery on the Noxes," "Birds on the Wide Opens," "Guillemots on the Pinnacles," "Puffins" and "Birds of a Sea Marsh." In the second of these we have been particularly attracted by the description of the oyster-catcher. "Its form," writes the author, "is attractively odd and quaint as it rests heavily on its long and delicate pink legs. But the feature which distinguishes it from all British birds is the beak—the great staff of coral on which the bird seems to rest, when it stands with head bent, as a kangaroo rests on its tail—the great load of coral which seems to weight the bird's head so that it bows at every step it walks, and which it holds out like a herald's trumpet as it flies: two great mandibles of coral, thick and long, twice as long as the bird's head, and almost twice as thick as its long and slender legs. Why it requires such an implement is not quite clear." This, which is by no means a solitary instance, is distinctly original, and originality is a consummation much to be desired in natural history writings.

With the ways of the poacher the author displays considerable familiarity; and her statement of the manner in which illicitly killed grouse are preserved in Ireland till the 12th of August will probably be a revelation to many of our readers. She is perhaps unnecessarily severe on those who enjoy a dish of roast larks or a plover's egg; and, we believe, she decidedly over-estimates the fear of any serious diminution in the number of either lapwings or larks in this country. But all will be with the author in her endeavour to promote increased protection for birds in such cases as it may be demonstrated to be necessary.

In spite of the competition to which allusion has already been made, it may be hoped that lovers of birds will find a place in their bookcase for the present attractive little volume. R. L.

CHRONICA MATHEMATICA.

A Brief History of Mathematics. An authorised translation of Dr. Karl Fink's "Geschichte der Elementar-Mathematik." By W. W. Beman and D. E. Smith Pp. xii + 334. (London: Kegan Paul, Trench Trübner and Co., Ltd., 1900.)

THANKS, in great measure, to the unwearied industry and acumen of Dr. Moritz Cantor, it is now comparatively easy to construct a synopsis of mathematical history down to the beginning of the nineteenth century. It is true that success depends upon much more than a mere knack of précis-writing: the task requires judgment, discrimination and a certain kind of sympathy; still, the labour of such a work is greatly simplified now that the essential facts have been made accessible in Dr. Cantor's incomparable lectures. But when the historian loses the aid of this accomplished guide, and endeavours to carry on the tale down to our own time, he is at once met by serious difficulties, even if he confines himself to a strictly limited field. Most of the writers of popular histories of mathematics break down hopelessly when they reach the nineteenth century; they are hampered by the limitations of their own knowledge, and a consciousness of the difficulty of writing so as to be understood by the audience to whom they address themselves.

Prof. Fink, with rare and admirable courage, has disdained to shirk the problem, and has made a conscientious effort to trace the development of his subject down to the present day. The range of his work is limited to "elementary mathematics," that is to say, arithmetic, elementary geometry and algebra, and trigonometry; this has, of course, lightened his task considerably. But he has kept in view the connection of these subjects with those far-reaching theories which have grown out of them during the century now drawing to its close; and this has led him to give an outline of the course of modern research in such things as the theory of equations, function-theory, projective geometry, and non-Euclidian geometry. Moreover, he has not neglected to draw attention to the various tendencies of contemporary schools, and the directions of current investigation.

To do all this in such brief compass has involved severe limitations. Prof. Fink writes for the mathematical student, not for the dilettante, and assumes that his reader is acquainted with the ordinary technical terms of the science. Legendary biographies and items of irrelevant gossip are rigorously excluded; the author has faith enough in the intrinsic interest of his subject to refrain from larding it with scraps of tittle-tattle. The style, too, is concise almost to a fault; the translation, at any rate (and, we should imagine, the original work as well), is not distinguished either by grace or lucidity. But the substantial merits of the book, its well-considered plan its general trustworthiness, and its stimulating character, deserve cordial recognition.

In a work of this kind mistakes in detail are practically unavoidable. No one man possesses such a thorough knowledge of mathematics as to protect him from occasional error when he tries to make a survey of the whole field, or of any considerable part of it. For the correction of such inevitable errors the author must depend upon the help of those who have paid special attention to particular lines of research; and it is with the intention of doing a service of this kind that the remarks which now follow have been made.

On p. 137 "the form $x \equiv a$ (mod. b), identical with $\frac{x}{b}=y+a$" should be corrected, at the end, by printing $x=by+a$. On p. 142 Reuschle's tables of 1856 are mentioned, but not his "Tafeln complexer Primzahlen" (Berlin, 1875). By an extraordinary oversight, it is said, on p. 207, that "we can construct a regular polygon of n sides only when $n-1=2^2$ (p an arbitrary integer)," although a correct statement (so far as it goes[1]) is given, pp. 161–2. On page 162, again, it is apparently said that Baltzer was the first to notice that 2^n+1 is not always prime when n is a power of 2; as a matter of fact, Euler proved that $2^{32}+1$ is divisible by 641 (*cf.* Smith's "Report on the Theory of Numbers," Art. 61).

On page 259, after explaining von Staudt's interpretation of "imaginary points" as double elements of involution-relations (which is not strictly correct: the involution itself, *plus* a distinguishing "sense," is the imaginary point), the author says, "This suggestion of von Staudt's, however, did not become generally fruitful, and it was reserved for later works to make it more widely known by the extension of the originally narrow conception." Besides being rather disparaging in tone, this is likely to convey a wrong impression. It is true that Kötter and others, in trying to extend von Staudt's theory to curves of higher orders, have been led to introduce involutions of a more general kind than his; but this does not affect his definition of an imaginary point, which is perfectly general and complete. The imaginary points in which a curve of any order is met by any line must admit (theoretically) of representation by involutions in von Staudt's sense: just as an equation with ordinary complex coefficients has a set of ordinary complex roots. The equation may be, from some points of view, insoluble or irreducible, and we may find it convenient to keep all its roots together; it is this which corresponds to the case of these "higher" involutions.

There are some obscurities which may be due to the author or translators or both. Thus, p. 250, "Möbius started with the assumption that every point in the plane of a triangle ABC may be regarded as the centre of gravity of the triangle:" (this is partially cleared up by the context). On p. 205, line 4, the sentence beginning "The semiparameter" is unintelligible, and is probably a mistranslation. Page 147, "the theory of binary forms has been transferred by Clebsch to that of ternary forms (in particular for equations in line co-ordinates)" is a very inadequate account of Clebsch's "Uebertragungsprincip," and will hardly convey any definite idea to the average reader.

Two obvious slips in translation may perhaps be mentioned. On p. 270, through not noticing an idiomatic inversion, the subject of a sentence has been treated as the predicate, and *vice versâ*: read "this point is offered by the eleventh axiom." On p. 203, for "and also with the normals" read "that is to say, with the normals:" *also* has been confused with *auch*, or rather with our "also." Finally, by the omission of an "s," Plücker has been made to say that "he (Monge) introduced the equation of the straight line into analytical geometry."

At the end of the book there are short biographical notices of a number of mathematicians: the list has been recast by the translators. Whether it is worth the space it occupies (26 pp.) is rather doubtful. Many entries are either trivial, or anticipated in the previous part of the book. Some of the notes are misleading, to say the least. Cauchy is said to have "contributed" to the theory of residues, the fact being that he invented it. All that is said of Eisenstein is that "he was one of the earliest workers in the eld of invariants and covariants"; this is true in a sense, but his fame rests principally on his arithmetical memoirs, and his researches on doubly infinite products and elliptic unctions. Sophie Germain "wrote on elastic surfaces." Legendre "discovered the law of quadratic reciprocity," an erroneous statement which may be corrected by p. 138 of the book itself. And what is the use of such entries as "Donatello, 1386—1468. Italian sculptor"? It would be an improvement to cut down this list to the really important names, and to give indications of such trustworthy biographies, or other sources of information, as may be available. G. B. M.

[1] The necessary and sufficient condition that a regular polygon of n sides may admit of Euclidean construction with rule and compass is that the "totient" of n is a power of 2; in other words, $n=2^m pqr\ldots$, where m is zero or any natural number, and $p, q, r \ldots$ are *different* odd primes, *each* of the form 2^k+1. The values of n below 100 are excluding 2) 3, 4, 5, 6, 8, 10, 12, 15, 16, 17, 20, 24, 30, 32, 34, 40, 48, 51, 60, 64, 68, 80, 85, 96.

THE SCIENCE OF COLONISATION.

New Lands: their Resources and Prospective Advantages. By H. R. Mill, D.Sc., LL.D. Pp. xi + 280. (London: Charles Griffin and Co., Ltd., 1900.)

THE present is a very appropriate time for the publi cation of this book. Public attention is occupied with Imperialism and colonial development, so that a trustworthy statement of the resources and conditions of life in the countries of the temperate zone, where there is still an opening for the energies of English-speaking people, should be of real service. The colonies and countries described from this point of view are Canada, Newfoundland, United States, Mexico, Temperate Brazil, and Chile, Argentina, the Falkland Islands, Australia and Tasmania, New Zealand and South Africa. To intending settlers and capitalists desiring to know the prospects of success in these countries the book will be invaluable; for it brings together in a convenient and concise form all the essential particulars available in official reports and other authoritative works.

This is what the practical man wants, and he will probably not concern himself seriously with the chapter in which the development of new lands is considered in its scientific aspects, yet to our minds this chapter is the most valuable in the book, and every statesman and colonial official anxious that the progress of his country shall be steady and permanent should be familiar with the principles it contains. It is an instructive statement of the factors which ought to be considered in connection with the development of every land, but are often neglected.

Take, for instance, the subject of geographical boundaries. It is the British habit not to give any serious attention to this subject until forced to do so by a dispute with a neighbouring nation. As Dr. Mill remarks:

"Such a muddle as that respecting the boundary of Alaska, and futile suggestions like those which were made for the boundaries of British Guiana, before the final settlement, could never have been made if the statesmen who were responsible had consulted geographers, and had acted on their advice."

Related to this is the subject of topographical surveys. It ought to be a political axiom that a Government should know its country; but we are all aware how frequently this duty is neglected, and the war in South Africa has brought the deficiency into unpleasant prominence. Even the "man in the street" is now in a state of mind to agree that

"If the survey of British South Africa had been begun years ago, or even as late as 1880, and pushed forward with an ample supply of trained surveyors, the war of 1899-1900 within its borders would have been simpler, safer and immensely cheaper."

In addition to topographical surveys, there should be geological surveys, hydrographic surveys, climatological surveys, biological surveys, and other official determinations of the features, fauna and flora of the country, with a view to possessing trustworthy information for future as well as present service. The fundamental value of a knowledge of rainfall in determining the value of colonisable countries is not often recognised, though so much depends upon it. How important an extensive system of rain measurement is in some new countries is shown by the fact that Australians in their calculations often convert inches of rain into numbers of sheep or even pounds of wool per acre. This and other similar cases justify Dr. Mill's remark that

"in almost every case it will be found that the crux of a new land is the water supply. Water, as rain or rivers, is indeed the very life-blood of the habitable world, and the phenomena of its circulation are often complicated, and require much study to elucidate."

It is unnecessary in these columns to give further instances of the dependence of the success of the colonist upon the scientific information available concerning his adopted country. The difficulty is to relieve practical politicians of the thought that knowledge for which there is no immediate use is useless; they have no sympathy with purely scientific work, therefore they are unwilling to encourage it. Let us hope that in the course of time our statesmen will receive an early training in scientific method and foresight, sufficient to enable them to consider colonisation as a study in anthropogeography instead of a haphazard system of settlement.

OUR BOOK SHELF.

The Child: a Study in the Evolution of Man. By A. F. Chamberlain, M.A., Ph.D. Pp. i—xii + 495. With Illustrations. The Contemporary Science Series. (London: Walter Scott, Ltd., 1900.)

THIS book is intended as a study of the child in the light of the literature of evolution; an attempt to record and, if possible, interpret some of the most interesting and important phenomena of human beginnings in the individual and in the race. Anthropology, as a science embracing many aspects of the human race, is concerned with inquiry as to the evolution of man, and applies fresh knowledge, gained by scientific methods, to the correlation of ascertained facts. The book refers more to the psychological aspect of human development than to the physiological causes of evolution; dealing in a philosophical spirit—not always by strictly scientific processes—with the several subjects dealt with, evidence is afforded by the collection of data and the opinions expressed by many writers rather than based upon the author's own observations and arguments.

In the opening chapter on "the helplessness of infancy" the results that follow from early weakness and the prolonged period of dependency are shown by numerous quotations, while explanation is afforded by reference to Mr. Fiske's view that this has led to the lengthened association of children with their parents and thus developed social habits. The comparative adolescence and longevity of man and animals is shown, and the dictum of Schleiermacher, "Being a child must not hinder becoming a man; becoming a man must not hinder being a child," suggests application to education.

The periods of childhood suggested as distinctive of stages in development are numerous, and definitions from Pythagorus downwards are given. Dr. Chamberlain says, "not only does the child seem to recapitulate physically and mentally the chief points of the race's history, but his own development is fairly teeming with epochs and periods, isolated spots sometimes, the interpretation of which is not yet at hand." The examples given are very interesting, but do not convince us that there is sufficient evidence of any standard by which normal psychological development can be judged. The successive manifestations of mental growth in children form a promising field in child-study; the account given of the linguistic periods in the advance towards speech forms one of the most interesting chapters in this book. Other chapters are explanatory of the relations of the child with the savage and criminal showing certain analogies, but do not afford much guidance in studying child-evolution or explain why the children are such as we find them to be.

The desire to explain the evolution of infancy has sometimes led the author wide of the teaching of scientific views, as when he says, p. 442, "The moment Nature decided that, with man, the struggle for existence was ultimately to be altruistic, rather than selfish, she was forced to make man weak in order to ensure his later strength in the right direction." Such teaching leads the student to neglect the facts of physiology and the effects of physical environment.

The book presents much of interest to the philosophical reader, and maintains the contention that the teaching of evolution and child-study should go hand in hand as mutually instructive.

The value of this volume would be increased by a table of contents; this want is accentuated by the brevity of the index. Eighteen illustrations afford useful explanations of types of manhood and the artistic productions of children.

Sieroterapia e Vaccinazioni preventive contro La Peste Bubonica. Dott Alessandro Lustig. Pp. vi + 150. (Torino: Rosenberg and Sellier, 1899.)

THIS book gives an account of the preparation of anti-plague serum by the author's method.

According to Prof. Lustig, a considerable degree of immunity against plague is obtained by inoculating animals with a nucleo-proteid contained in the bodies of the bacilli. A culture of plague bacilli grown on solid media is scraped off and dissolved in a 1 per cent. solution of caustic potash. After washing and passing through a Chamberland filter, the substance is used for inoculating horses.

After repeated inoculations the horses are bled, and the serum is used for treatment of plague patients.

Or a solution of the nucleo-proteid may be used as a prophylactic, as advocated by Prof. Lustig and Galeotti (*British Medical Journal*, February 10, 1900). The curative treatment was tried for a period at the Arthur Road Hospital, Bombay, but the results were not very satisfactory. We have now however a paper before us, by Dr. A. Mayr, read at the Bombay Medical Union, April 21, 1900, dealing with more recent trials, in which there were 38·2 per cent. of recoveries in 403 patients treated, the recoveries of patients under ordinary treatment being 19·5 per cent.

Whether the nucleo-proteid be used as a prophylactic to inoculate persons or to immunise horses to prepare a curative serum, it is evident that the antitoxin given rise to in the person or the horse is an antitoxin against the poisonous nucleo-proteid; the stakes in the race for recovery are all placed on the nucleo-proteid.

But it is not improbable that the metabolic products formed by the plague microbe in the medium it grows on—be it the body or an artificial medium—require to be immunised against, and herein lies the distinction between Haffkine's prophylactic and Lustig's nucleo-proteid used as a prophylactic. Haffkine uses the bodies of the bacilli together with the broth they have grown in, for he considers the broth acted upon by their growth to be useful if not essential. This has been shown to be the case in experiments on animals by Dr. Balfour Stewart (*British Medical Journal*, March 3, 1900).

Lustig's nucleo-proteid prophylactic has some technical advantages in its preparation over Haffkine's, but for the reasons pointed out above it is not likely to be as efficacious. C. B. S.

A Monograph of the Erysiphaceae. By Ernest S. Salmon, F.L.S. "Memoirs" of the Torrey Botanical Club. Vol ix., Pp. 292. (New York: 1900).

THE Torrey Botanical Club has performed a valuable service to mycologists in the publication of this excellent monograph of the Erysiphaceæ, a group of parasitic fungi causing the diseases known as white mildew, powdery mildew, blight, *Mehlthau*, *blanc*, &c. In their conidial or "oidium" stage they are common throughout the summer on various host-plants, such as roses, hops, vines, peas, maples, and many wild plants, giving a mealy appearance to the part infected; while in the later summer or autumn the perfect ascigerous form is produced in the form of dark brown or black spots, consisting of peritheces containing ascospores, and usually provided with characteristic appendages.

The number of known species of this well differentiated group of fungi is not large; the author describes forty-nine, including a very few new ones, in addition to a number of well-marked varieties. These are arranged in six genera, Podosphæra, Sphærotheca, Uncinula, Microsphæra, Erysiphe, and Phyllactinia. Great confusion exists in the nomenclature of the European species, and the author corrects several prevalent errors. He regards the ascus as the result of a true sexual process, and does not support Dangeard's view that the fusion of the nuclei in the young ascus is of sexual signification.

The monograph is illustrated by nine plates, and is supplemented by a very copious bibliography, in which no less than 400 distinct works or papers are referred to, and a host-index of the plants attacked by these fungi. A. W. B.

An Old Man's Holidays. By The Amateur Angler. Pp. xii+140. (London: Sampson Low, Marston and Co., 1900.)

"AN AMATEUR ANGLER" is an observer of nature as well as an enthusiastic Waltonian, the result being that these holiday sketches contain here and there an observation of interest to naturalists. Referring to the growing scarcity of kingfishers he says, "This is partly owing to the fact that they have the credit of being destructive enemies of young trout; the fact is, they do feed on little fishes, but not so much on trout as on minnows, dace, sticklebacks, miller's thumbs, and even leeches" The book contains several illustrations of rural scenes.

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.*]

Buchner's Zymase.

THE most recently issued number of the *Proceedings* of the Royal Society (No. 438) contains a paper by Dr. McFadyen, Dr. Morris and Mr. Rowland on the subject of Buchner's zymase, which is held by many observers to be the alcohol-producing enzyme of yeast.

The authors describe a long series of experiments which they have carried out, partly on Buchner's lines, and partly by new methods of their own. They find, as Buchner and other investigators have done, that yeast will, under proper conditions, yield up an extract which can set up alcoholic fermentation in a solution of cane sugar. Many very interesting points have come out during the progress of their work, the explanation of which is not at present very obvious; their conclusion, however, seems to call for a very careful scrutiny of the operations, especially as it has been advanced by other writers also. They state at the end of their paper that their experiments cause them to doubt the existence of an enzyme, and lead them rather "in the direction of a theory which refers the phenomenon to the vital activity of the yeast-cell protoplasm" (p. 265).

In reviewing their experiments it is noticeable that, in their preparation, the yeast was mixed with a certain proportion of kieselguhr, and subjected in this condition to the enormous pressure of 200–300 atmospheres (p. 252). The liquid thus expressed was capable of filtration under pressure through a Chamberland or Berkefeld filter (p. 259) without losing its properties, though the process decreased its power. It was miscible with, or soluble in, a small quantity of water or solution of cane-sugar without being altogether destroyed, though too much of the solvent inhibited its action (p. 262). The experiments were conducted throughout in the presence of antiseptics, such as 1 per cent. of sodium arsenite, thymol, or toluol (p. 254).

It will be difficult for physiologists to accept a conception of a protoplasm which is not destroyed by such a pressure as was used, and which afterwards becomes to some extent soluble in water, or, at any rate, miscible with it, which can be filtered through a porcelain filter without destruction, and which can carry on an anabolic and subsequently a katabolic process (p. 265) in the presence of such antiseptics as were used.

The authors say in an earlier part of the paper (p. 253) that such a kieselguhr "sponge" as they obtained during the extraction of the yeast was capable of retaining almost entirely the globulins of eggs, and, to a large extent, albumin and serum proteids. It seems strange after this to find them holding the view that protoplasm itself was not retained by such a "sponge."

It is a little difficult to reconcile their concluding theory of a fluid protoplasm with their statement (p. 253) that the juice they obtained and used was in every case far removed in nature from the condition in which it existed when alive in the yeast cell, even if one were to admit that the *juice* was ever living at all. Is it possible, in their opinion, for the anabolic and katabolic activities of protoplasm to be manifested in such a juice as they describe in those words? Yet their final hypothesis is that the yeast juice exhibits the "vital activity of the yeast-cell protoplasm."

I venture to disagree with their conclusion. In my own experiments, which were published in the *Annals of Botany*, vol. xii (1898), p. 491, I found that an active preparation could be obtained by grinding the yeast with kieselguhr in such proportion that a perfectly dry impalpable powder resulted, and then extracting the latter with a solution of cane-sugar. It is hardly credible that protoplasm without the protection of cell-walls, can resist desiccation. The action of the extract in my experiments, as in theirs, was considerable in the presence of antiseptics which, in the proportions used, were inevitably and rapidly fatal to the life of protoplasm.

Cambridge, November 19. J. REYNOLDS GREEN.

Euclid i. 32 Corr.

MR. TUCKER is right (p. 58) in his conjecture that Clavius was not the first to publish these corollaries.

References:—P. Ramus (ob. 1572), "Scholar^m. Math^m. Libri unus et triginta. *A Lazaro Schonero recogniti et emendati*,"

p. 180. Francofurti, 1599; H. Billingsley, the first English translation of the "Elements of Euclid," Fol. 42. (London, 1570); N. Tartalea Brisciano, "Euclide," Fol. 32. (Venetia, 1565); J. Peletarius, "In Euclidis Elementa Geometrica Demonstrationum Libri sex." Prop. 32. *Appendix a Campano*, pp. 33, 34. (Lugduni, 1557).

It is much to be regretted that in this country so little importance is attached to the history of mathematics; otherwise, such mistakes as those mentioned by Mr. Tucker would not be repeated from one text book to another.

Galway, November 17. GEORGE J. ALLMAN.

Instruments of Precision at the Paris Exhibition.

IN your issue of November 15 (p. 61) is an account of "Instruments of Precision at the Paris Exhibition," in which it is stated that a catalogue of 250 pages has been prepared by the German Association of Mechanicians and Opticians. May I ask you to state in some future issue how that catalogue can be obtained, as I am anxious to get a copy of it?

E. T. WARNER.

H.M.S. *Britannia*, Dartmouth, November 21.

I AM much interested in the article in the number of NATURE for November 15, on optical and other instruments at the Paris Exhibition. Although I visited the exhibition, I did not see the exhibit, as I went too soon after the opening. I should much like to obtain the catalogue mentioned. Will you kindly tell me where I should be able to obtain one by writing for it?

H. DAVIDGE.

Seafield Park College, Crofton, Hants, November 17.

[For information as to the German Catalogue of Scientific Instruments, application should be made to Dr. Robert Drosten, Bureau de l'Exposition allemande des Instruments de Precision, Classe 15, Section 3, Exposition Universelle, Paris. If Dr. Drosten is not in Paris, letters will probably be forwarded. The secretary of the German Committee of Management is Prof. St. Lindeck, Reichsanstalt, Charlottenburg, Berlin, who no doubt would send a catalogue.—ED. NATURE.]

ON SOLAR CHANGES OF TEMPERATURE AND VARIATIONS IN RAINFALL IN THE REGION SURROUNDING THE INDIAN OCEAN.[1]

I.

THE fact that the abnormal behaviour of the widened lines in the spectra of sunspots since 1894 had been accompanied by irregularities in the rainfall of India suggested the study and correlation of various series of facts which might be expected to throw light upon the subject.

The conclusions already arrived at from bringing together the results of several investigations undertaken with this view may be stated as follows:—

(1) It has been found from a discussion of the chemical origin of lines most widened in sunspots at maxima and minima periods that there is a considerable rise above the mean temperature of the sun around the years of sunspot maximum and a considerable fall around the years of sunspot minimum.

(2) It has been found from the actual facts of rainfall in India (during the S.W. monsoon) and Mauritius, between the years 1877 and 1886,[2] as given by Blanford and Meldrum, that the effects of these solar changes are felt in India at sunspot maximum, and in Mauritius at sunspot minimum. Of these the greater is that produced in the Mauritius at sunspot minimum. The pulse at Mauritius at sunspot minimum is also felt in India, and gives rise generally to a secondary maximum in India.

India therefore has two pulses of rainfall, one near the maximum and the other near the minimum of the sunspot period.

(3) It has been found that the dates of the beginning of these two pulses on the Indian and Mauritius rainfall are related to the sudden remarkable changes in the behaviour of the widened lines.

(4) It has been found from a study of the Famine Commission reports that all the famines therein recorded which have devastated India during the last half century (we have not yet carried the investigation further back) have occurred in the intervals between these two pulses.

(5) It has been found from the investigation of the changes in (1) the widened lines, (2) the rainfall of India and (3) of the Mauritius during and after the last maximum in 1893 that important variations from those exhibited during and after the last maximum of 1883 occurred in all three.

It may be stated at the same time that the minimum of 1888–1889 resembled the preceding minimum of 1878–1879.

(6) It has been found from an investigation of the Nile curves between the years 1849 and 1878 that all the lowest Niles recorded have occurred between the same intervals.

(7) The relation of the intervals in question to the droughts of Australia and of Cape Colony, and to the variations in the rainfall of extra tropical regions generally has not yet been investigated. We have found, however, a general agreement between the intervals and the rainfall of Scotland (Buchan), and have traced both pulses in the rainfalls of Córdoba (Davis) and the Cape of Good Hope.

(8) We have had the opportunity of showing these results to the Meteorological Reporter to the Government of India and Director-General of Indian Observatories, John Eliot, Esq., C.I.E., F.R.S., who is now in England, and he allows us to state his opinion that they accord closely with all the known facts of the large abnormal features of the temperature, pressure and rainfall in India during the last twenty-five years, and hence that the inductions already arrived at will be of great service in forecasting future droughts in India.

Solar Physics Observatory, October 26.

ADDENDUM.

Since Meldrum and one of us called attention, in 1872 to a possible connection between sunspots and rainfall, there has been a large literature upon the subject which it is not necessary for us to analyse; it may be simply stated that, in spite of the cogent evidence advanced since, chiefly by Meldrum, and in later years by Mr. Hutchins,[1] it is not yet generally accepted that a case for the connection has been made out.

What has been looked for has been a change at maximum sunspots only; the idea being that there might be an effective change of solar temperature, either in excess or defect, at such times; and that there would be a gradual and continuous variation from maximum to maximum.

At the same time, it is possible that the pressure connection, first advanced by Chambers, is now accepted by meteorologists as a result of the recent work of Eliot.

The coincidence, during the last few years, of an abnormal state of the sun with abnormal rain in India, accompanied by the worst famine experienced during the century, suggested to us the desirability of reconsidering the question, especially as we have now some new factors at our disposal. These have been revealed by the study, now extending over twenty years, of the widened lines in sunspots, which suggested the view that two effects ought to be expected in a sunspot cycle instead of one.

[1] By Sir Norman Lockyer, K.C.B., F.R.S., and W. J. S. Lockyer, M.A. (Camb.), Ph.D. (Gött.). Paper read before the Royal Society on November 22.

[2] This period was selected because the Kensington observations of widened lines only began in 1879, and the collected rainfall of India has only been published to 1886.

[1] "Cycles of Drought and Good Seasons in South Africa, 1889."

The Widened Lines.

It will be gathered from previous communications to the Royal Society[1] that, on throwing the image of a sunspot on the slit of a spectroscope, it is found that the spectrum of a spot so examined indicates that the blackness of the spot is due, not only to general, but to selective absorption,[2] and that the lines widened by the selective absorption vary from time to time.

Since the year 1879, the *selective* absorption in spots has been observed for every spot that was large enough to be spectroscopically examined ; the method adopted being as follows :—

The regions of the spectrum investigated lie between F—*b* and *b*—D, and an observation consists in observing the six most widened lines in each of these regions. These lines are then identified on the best solar spectrum maps available and their wave-lengths determined.

An examination of many years' records of these widened lines has shown that at some periods they are easily traceable to *known* elements, while at others their origins have not been discovered, so the latter have been classed as "unknown" lines. If we compare these two periods with the sunspot curve as constructed from the measurements of the mean spotted area for each year, it is found that when the spotted area is greatest the widened lines belong to the "unknown" class, while when the spotted area is least they belong to the "known" class.

The majority of the lines traced to some terrestrial origin belong to iron, but the lines of other elements, such as titanium, nickel, vanadium, scandium, manganese, chromium, cobalt, &c., are also represented in a less degree.

It is quite likely that some of the "unknown" lines are higher temperature (enhanced) lines of known chemical elements.

In our laboratories we have means of differentiating between three stages of temperature, namely, the temperature of the flame, the electric arc, and the electric spark of the highest tension. At the lowest temperature, that of the flame, we get a certain set of lines ; a new set is seen as the temperature of the electric arc is reached. At the temperature of the high tension spark we again have many new lines, called enhanced lines, added, while many of the arc lines wane in intensity.

It is found that at sunspot minimum, when the "known" lines are most numerous, the lines are almost invariably those seen most prominent in the arc. Passing from the sunspot minimum towards the maximum the "unknown" lines gradually obtain the predominance. As said before, they may be possibly "enhanced lines" —that is, lines indicating the action of a much higher temperature on *known* substances.

Unfortunately the records of enhanced lines at South Kensington, having been obtained from photographs, are chiefly confined to a region of the spectrum not covered by the visual observations of widened lines in sunspot spectra.

We can only point to the evidence acquired in the case of one metal—iron, for which photographs of the enhanced lines in the green and yellow parts of the spectrum have been obtained.

This evidence quite justifies the above suggestion, for the enhanced lines of iron can be seen revealing themselves as the number of unknown lines increases.

We are, therefore, quite justified in assuming a very great increase of temperature at the sunspot maximum when the "unknown" lines appear alone.

The curves of the "known" and "unknown" lines have been obtained by determining for each quarter of a year the percentage number of known and unknown lines and plotting these percentages as ordinates and the time elements as abscissæ. Instead of using the mean curves for all the known elements involved, that for iron is employed, as it is a good representative of "known" elements, and has been best studied. When such curves have been drawn they cross each other at points where the percentage of unknown lines is increasing, and that of the iron or known lines are diminishing, or *vice versâ*.

[1] *Proc. Roy. Soc.*, vol. xl. p. 347, 1886 ; vol. xlii. p. 37, 1887 ; vol. xlvi. p. 385, 1889 ; vol. lvii. p. 199, 1894.
[2] *P.R.S.*, Lockyer, 1866, October 11.

We seem, therefore, to be brought into the presence of three well-marked stages of solar temperature.

When the curves of known and unknown lines cross each other, that is, when the number of known and unknown lines is about equal, we must assume a mean condition of solar temperature. When the unknown lines reach their maximum we have indicated to us a + pulse or condition of temperature. When the known lines reach their maximum we have a – pulse or condition of temperature.

The earliest discussion showed that, generally speaking, the unknown-lines curve varied directly, and the iron-lines curve varied inversely with the spot-area curve. The curves now obtained for the whole period of twenty years not only entirely endorse this conclusion, but enable more minute comparisons to be drawn.

The "widened line" curves are quite different from those furnished by the sun-spots. Ascents and descents are both equally sharp, changes are sudden, and the curves are relatively flat at top and bottom. The crossings are sharply marked.

During the period since 1879 three such crossings have occurred, indicating the presence of mean solar temperature conditions, in the years 1881, 1886-7,[1] and 1892. It was expected that another crossing with the known lines on the rise would have occurred in 1897, indicating thereby the arrival of another mean condition of solar temperature, but as yet no such crossing has taken place.

The following tabular statement shows the years of those crossings, together with the probable dates, in brackets, of the two previous crossings, as determined by the time of occurrence of the preceding sun-spot maximum.

Rise of	Years		
Unknown lines ...	(1869)	1881	1892
Known lines ...	(1876)	1886–7	?

Comparison of Solar and Terrestrial Weather.

It has long been known that a cycle of solar weather begins in about lat. 32° N. and S., and in a period of 11 years ends in about lat. 5° N. and S.

Just before one cycle ends another commences. The greatest amount of spotted surface occurs when the solar weather-changes produced in the cycle reach about lat. 16° N. and S.

It becomes, therefore, of the first importance to correlate the times of mean solar temperature, and of the + and – heat pulses, with the solar weather cycle, in order to arrive at the temperature-history of the sun during the period which now concerns us. This may be done as follows :—

Solar cycles				→				→		→
Lat. of spots	19°	16°	12°	9°	18°	17°	10°	7°	19°	18°
Heat condition	mean	+	mean	–	mean	+	mean	–	mean	+
Years	1869	1870–5	1876	1877–80	1881	1882–6	1886–7	1888–91	1891–2	1892–

[1] According to the observations the mean was reached in December 1886, or January 1887.

Connection of the Spots with Prominences.

In 1869, when a sun-spot maximum was approaching, the prominences were classified by one of us into *eruptive* and *nebulous;* the former showing many metallic lines, the latter the hydrogen and helium lines chiefly. This conclusion, which was published in 1870, was subsequently confirmed and adopted by Secchi, Zöllner, Spörer, Young and Respighi.

In the same year prominences on the sun's disc were also observed by one of us by means of the C and F lines.[1]

The eruptive prominences, unlike the nebulous ones, were not observed in all heliographic latitudes; but, according to the extended observations of Tacchini and Ricco, had their maxima in the same latitude as the spots. This is especially well shown by the diagrams illustrating the distribution of spots, faculæ, eruptions and protuberances which are given by Tacchini for 1881–1887 in the *Memoria della Soc. degli Spettroscopisti Italiani*, 1882–1888. These curves show in the most unmistakable manner that the spots, faculæ and eruptive or metallic prominences have their maximum frequency in the same solar latitudes while the nebulous or quiet prominences are more uniformly distributed, and even have maxima in zones where spots are rarely observed. This is corroborated by what Prof. Respighi many years ago stated:

"In correspondence with the maximum of spots, not only does the number of the large protuberances increase, but more than this—their distribution over the solar surface is radically modified."

In his observations, Prof. Young found that the H and K lines of calcium were reversed in the chromosphere as constantly as *h* or C, and the same lines "were also found to be regularly reversed upon the body of the sun itself, in the penumbra and immediate neighbourhood of every important spot."[2] This result was confirmed by the early (1881) attempts of one of us to photograph the spectra of the chromosphere and spots, and also by eclipse photographs. In the photographic spectrum, the H and K lines are by far the brightest of the chromospheric lines, and this fact has been utilised by Hale and Deslandres acting on a suggestion due to Janssen, for the purpose of photographing at one exposure the chromosphere and prominences, as well as the disc of the sun itself, in the light of the K line.

These photographs thus give us in K light the phenomena which one of us first observed by the lines C and F of hydrogen, and thereby present a record of the prominences across the whole disc of the sun as well as at the limb.

In such photographs near sunspot maximum, the concentration of the prominences in zones parallel to the equator is perfectly obvious at a glance. Eruptive or metallic prominences are thus seen to cover a much larger area than the spots, so that we have the maximum of solar activity indicated, not only by the increased absorption phenomena indicated by the greater number of the spots, but by the much greater radiation phenomena of the metallic prominences; and there seems little doubt that in the future the measure of the change in the amount of solar energy will be determined by the amount and locus of the prominence area.

Spots are, therefore, indications of excess of heat, and not ,of its defect, as was suggested when the term "screen' was used for them. We know now that the spots at maximum are really full of highly heated vapours produced by the prominences, which are most numerous when the solar atmosphere is most disturbed.

The Indian meteorologists have abundantly proved that the increased radiation from the sun on the upper air currents at maximum is accompanied by a lower temperature in the lower strata, and that with this disturbance of the normal temperature we must expect pressure changes. Chambers was the first to show that large spotted area was accompanied by low pressures over the land surface of India ("Abnormal Variations," p. 1).

Passing, then, from the consideration of individual spots to the zones of prominences, with which they are in all probability associated, it is of the highest interest to note the solar latitudes occupied when the crossings previously referred to took place, as we then learn the belts of prominences which are really effective in producing the increased radiation. The area of these is much larger, and therefore a considerable difference of radiation must be expected.

The greater disturbance of certain zones of solar latitude seems to be more influential in causing the + pulse than the amount of spotted area determined from spots in various latitudes.

It is all the more necessary to point this out because the insignificance of the area occupied by the spots has been used as an argument against any easily recognised connection between solar and terrestrial meteorological changes.[1]

Assuming two belts of prominences N. and S., 10° wide, with their centres over Lat. 16°, a sixth of the sun's visible hemisphere would be in a state of disturbance.

(*To be continued.*)

[1] *P.R.S.*, 17, p. 415.
[2] "Catalogue of Bright Lines in the Spectrum of the Chromosphere" (1872).

THE KITE WORK OF THE UNITED STATES WEATHER BUREAU.

EARLY in the year 1898, the Congress of the United States granted a sum of money, to be expended under the direction of the Chief of the Weather Bureau, for the establishment and maintenance of a series of stations at which observations of the upper free air were to be made by means of automatically recording mechanisms attached to kites. This work was to be undertaken primarily in the hope that daily simultaneous observations might be obtained at definite altitudes, thus permitting the construction of daily synchronous charts of pressure, temperature, and wind direction and velocity, which, when studied in connection with corresponding surface charts, would admit of some advance being made in the present system of weather forecasting, both in accuracy and in the duration of the periods forecasted for.

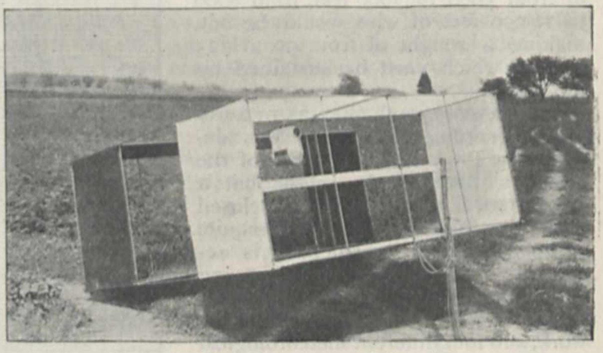


FIG. 1.—Kite with meteorograph in position.

Seventeen stations were established in the spring of

[1] "So far as can be judged from the magnitude of the sun-spots, the cyclical variation of the magnitude of the sun's face free from spots is very small compared with the surface itself; and consequently, according to mathematic principle, the effect on the elements of meteorological observation for the whole earth ought also to be small" (Eliot, "Report on the Meteorology of India in 1877," p. 2).

the year 1898, mostly in the great river valleys and the upper portion of the region of the Great Lakes. The form of kite used was the Hargrave cellular (Fig. 1), with such modifications and improvements as trial and experiment dictated. The surface dimensions of the kites varied from 45 to 72 square feet. The kite line was carried on a large iron drum or reel, capable of resisting a crushing pressure of at least 1000 tons, and consisted of steel piano-wire ·028 inch in diameter, and weighing 2·15 pounds to the thousand feet, or 11·35 pounds to the mile. The tensile strength of this wire at the breaking-point was about 200 pounds.

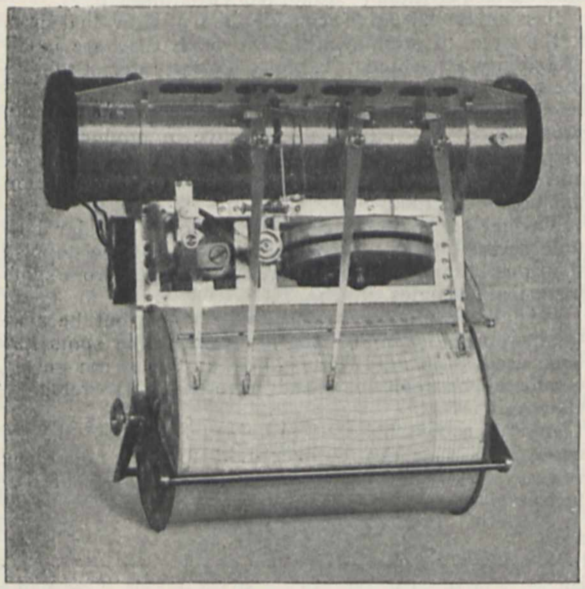


Fig. 2.—Kite meteorograph.

With a kite flying at an elevation of from 5000 to 7000 feet, from 8000 to 10,000 feet of wire would be out, making a weight of from 90 to 115 pounds which must be sustained by the kite.

The meteorograph (Fig. 2), or automatic recording apparatus, was devised by Prof. C. F. Marvin, of the Weather Bureau. It weighs but a fraction over two pounds, is inclosed in an aluminium case, and, while quite complicated in construction, is remarkable for its compactness and lightness. The cylinders carrying the record sheets are actuated by clockwork, and four different meteorological conditions are recorded, viz., pressure, temperature, relative humidity and wind velocity (Fig. 3). The wind direction, of course, becomes apparent by observing the azimuth of the kite.

It soon became evident that there was no possibility of obtaining a daily synchronous chart. The principal difficulties were the very frequent absence of sufficient wind to sustain the kites, and inability to obtain ascensions in stormy weather. Taken as a whole, ascensions were possible during only 46 per cent. of the time from May to October, inclusive, the percentage varying from 75 at Dodge, Kansas, to 12 at Knoxville, Tennessee. The hours of the day at which ascensions could be made also varied greatly.

But however disappointing the results obtained may have been from the viewpoint of the weather forecaster, they were not so when considered from another. Much valuable data was obtained from the 1217 ascensions and 3835 observations, particularly regarding vertical temperature gradients, and it is believed that there has been a very material contribution made to our previous knowledge of this subject. Briefly summarised, the results of the observations were as follows:—

The mean rate of diminution of temperature with increase of altitude was found to be 5° F. for each 1000 feet, or only $0{\cdot}4^\circ$ less than the true adiabatic rate. The gradient was greatest up to 1000 feet, where it was $7{\cdot}4^\circ$ F.; from thence up to 5000 feet there was a steady decrease to $3{\cdot}8^\circ$ a thousand feet, the rate of decrease varying inversely with the altitude. Above 5000 feet there was a tendency toward a slight increase.

The mean gradients on the Atlantic coast were much smaller than those in the interior, the difference being mainly due to the lower morning values of the former, those of the afternoon differing but slightly. Inversions of temperature were quite frequent, and were most pronounced when the upper air currents were from south-east to south-west. Clouds, as a rule, caused a decrease in the rate of temperature fall, sometimes so decided as to result in an actual temperature inversion. A series of observations was made at Pierre, South Dakota, during the winter of 1898–99, and a cursory examination of the records there made showed such persistent temperature inversions during periods of cold weather as to furnish convincing evidence that during a cold wave the stratum of cold air is not much over one mile in height, and frequently but little over half a mile.

The relative humidity at and above the earth's surface differed but little, and, generally speaking, the upper air percentages were the lower. The mean results were 60

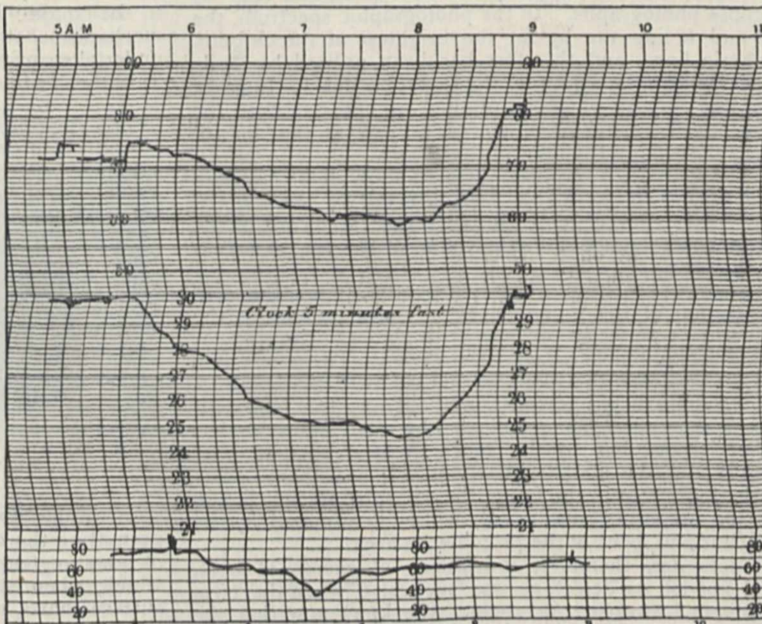


Fig. 3.—Record obtained at Arlington, Virginia, on June 14, 1898.

and 58 per cent. respectively, a difference of 2 per cent. There were, however, some marked differences at individual stations. At Washington, D.C., it was 14 per cent.; at Omaha, Nebraska, 29 per cent.; and at Spring-field, Illinois, 21 per cent. At Fort Smith, Arkansas, the difference was 12 per cent., but with reversed conditions, the upper air humidity being the higher.

The vapour pressures were compared with others obtained at various times at equal altitudes by means of balloons and mountain observations, and found to be somewhat lower. The average value was 59 per cent., as compared with 68 for the balloon and 66 for the mountain observations. In these data the vapour pressures were represented in percentages obtained by the formula $\frac{p}{p^0}$, p representing the vapour pressure at any given altitude, and p^0 that observed simultaneously at the earth's surface.

Differences in wind direction above and at the surface were for the most part confined to a deflection toward the right at the kite. This deflection frequently increased with the altitude, but rarely exceeded 90 degrees. In some few instances, chiefly during unsettled weather, the deflection was toward the left, but not to any great extent.

At the present time efforts are being made to obtain a more improved and satisfactory vehicle for the meteorograph. If such an one can be devised, it is yet possible that the desire of the forecaster will finally be gratified with great resultant benefit both to the cause of science and to the world at large. H. C. FRANKENFIELD.

THE PRESENT CONDITION OF THE INDIGO INDUSTRY.

SINCE a previous article upon the above subject (November 1) was written, a report of the opening of the Hofmann House in Berlin has appeared in the *Times.* At the opening ceremony Prof. von Baeyer and Dr. Brunck delivered lectures upon the synthetical production of indigo. Von Baeyer's lecture dealt chiefly with the theoretical side of the question, while that of Dr. Brunck, who is one of the managing directors of the Badische Anilin und Soda Fabrik, dealt more upon the manufacturing side. As the work of von Baeyer is so well known and was referred to in the previous article, attention will only be drawn to the extremely interesting speech of Dr. Brunck.

In the first place, Dr. Brunck drew attention to the advantages of synthetic over natural or vegetable indigo, owing to its uniformity of composition, fine state of division, ready reducibility, &c. He claimed that a much less skilled operator may be employed in manipulating the dye bath than when natural indigo is used. He then went on to describe the prejudice which the synthetical indigo ("indigo pure") had to contend with when it was first placed on the market in 1897; it being stated by some that it was merely specially refined natural indigo, and by others that it was a substitute for indigo. It is extraordinary how difficult it is to make the public believe that it is possible to prepare in the laboratory a product which is identical in *every* respect to one which is of vegetable origin. In the case of indigo, however, there is perhaps some excuse, because the manufacturers of coal-tar products have often brought out colours which dye practically the same shades as indigo, but though not readily distinguished from it even by experts, have lacked one of the chief characteristics of indigo—fastness. But notwithstanding prejudice and keen competition, the development of the manufactory has been enormous. Dr. Brunck states that about 900,000*l.* has been invested in the indigo department of the Badische Company, and that the quantity of indigo now annually manufactured by this company alone would require the cultivation of nearly 250,000 acres of land in India.

The method of manufacture employed by the Badische Company is that of Heumann, in which phenylglycine-ortho-carboxylic acid (anilido-acetic acid) is fused with caustic soda (*c.f.* NATURE, this volume, p. 9). When this process was first discovered, the cost of the out-going products was so great that indigo so prepared could not compete with the natural product. *The Badische Company employ more than* 100 *highly-trained research chemists;* to some of these the work of endeavouring to elucidate the problem, how to manufacture phenylglycine-ortho-carboxylic acid cheaply, was entrusted. Taking naphthalene, which is obtained in enormous quantities from coal tar, as starting product, the following process was worked out. The naphthalene is oxidised by highly concentrated sulphuric acid in presence of mercury or mercury salts, with production of phthalic acid. The phthalic acid is then, by a series of reactions, converted into anthranilic acid which, when combined with monochloracetic acid, produces phenylglycine-ortho-carboxylic acid. During the oxidation of naphthalene with sulphuric acid large quantities of sulphur dioxide are produced, the loss of which would be a very serious expense. In preparing indigo upon the scale in which it is now manufactured, from 25,000 to 30,000 tons of sulphur dioxide are produced annually. But this is not lost; it is mixed with air and passed over heated oxide of iron, and is thus by catalytic action converted into sulphuric anhydride, and this by the action of water into sulphuric acid. Chlorine is required in order to prepare chloracetic acid, and caustic soda to fuse the phenylglycine-ortho-carboxylic acid. These two products are obtained by the electrolysis of sodium chloride. As, however, the chlorine as it is first produced is not sufficiently pure, it is purified by condensing it to the liquid condition. Attention has been drawn to the details of the manufacturing process, in order to show what a determined and powerful competition the Indian indigo producer has to face.

Synthetical indigo is being used in this country, but there is a considerable difference of opinion as to whether it is as easy to dye with the artificial as with the natural product. Some dyers state that there is a difficulty in obtaining the requisite bloom and that, therefore, materials dyed with it have a flat or dead appearance; other operators seem to find no such difficulty. Practically the only drawback to materials dyed with indigo is that the dye is inclined to rub. Some dyers say that goods dyed with synthetical indigo rub more than when dyed with the vegetable indigo. This, again, is denied by others. There is also said to be a difficulty in reducing synthetical indigo. In print-work synthetical indigo certainly appears to possess an advantage, owing to its fine state of division and to the fact of its containing no foreign matter which might scratch and injure the rollers. Before natural indigo can be employed, it is necessary to have it in an exceedingly fine state of division, and in order to ensure this it is usually ground in a mill with water for several days. The artificial product, on the other hand, is sent into the market as a very fine powder or in the form of a paste. One drawback to natural indigo is the varying amounts of indigotin which different samples contain. Artificial indigo contains not only a very high percentage of indigotin, but practically no foreign matter.

Dr. Brunck is sanguine that the synthetical product will shortly overcome all competition and drive the natural product from the market; and in his address, with a *disinterestedness* which cannot but be admired, advises the Government of India to ascertain in what manner the land which has been employed for growing indigo may be best cultivated. If the advice of Dr. Brunck is taken, there will be no doubt as to the success of the artificial indigo. As showing the vast importance of the question to India, the following statistics are given. In Northern Behar there are from 250,000 to 300,000 acres of land devoted to the cultivation of indigo, and nearly one and a half million people are employed in the industry, while three years ago the capital invested in this province was estimated at over 4,000,000*l*. The land under cultivation in Bengal was, in 1899, estimated at 452,700 acres. There seems at last to be some movement among the dry bones; the Indigo Planters' Association have employed Mr. Rawson, who is an expert upon the chemistry of dyeing, to endeavour to improve the process of manufacturing indigo, and appeals are made to the Government for help. The Government is doing its part, and has ordered that all blue cloth supplied to the Army and Navy Clothing Departments shall be dyed with *natural* indigo. At the present time the price of natural and synthetic indigo is almost the same. What will the Government do if the price of synthetic indigo becomes much less than that of natural indigo? Sir William Hudson, in August of this year, applied to the Government for a loan for a scheme of sugar cultivation, suggesting that indigo and sugar-cane should be grown in rotation. The Government, although not able to accede to his request, has sanctioned a committee to inquire into the possibilities of establishing the sugar industry in Behar.

When attention is drawn to the perilous position of the Indian indigo industry, letters are written to the papers by those connected with the production of indigo, making light of the danger, and referring to the "*real* indigo dye and German imitation." But, as Mr. Rawson, who at least is not likely to overrate the artificial indigo, said in his admirable lecture, delivered before the Society of Arts at the end of March, "all chemists who have studied the question agree that synthetic indigo is *identically* the same compound as the indigotin of natural indigo"; and again, "Providing the synthetic dye can be produced in sufficient quantity, the whole question of artificial *versus* natural indigo will resolve itself into one of cost. The Badische Company have spent nearly a million pounds in improving the manufacture of artificial indigo; at Höchst, the "Farben Fabrik" is also manufacturing artificial indigo, though at present they are only supplying the German market. In a letter to the *Times* on April 24, Prof. Armstrong asks, "Have we spent 5000*l*. in the endeavour to set our Indian indigo house in order?" For every British chemist employed it is safe to say the Germans are employing fifty; for every pound spent they are spending thousands. Is it not time to appoint a committee or commission of experts to see whether it may not be possible to increase the yield and quality of the indigo produced, and at the same time to produce it more economically?

F. MOLLWO PERKIN.

NOTES.

PROF. POINCARÉ has been elected a foreign member of the Munich Academy of Sciences.

PROF. KLEIN has been elected a correspondant of the Paris Academy of Sciences, in the section of mineralogy. Prof. Haller has been elected a member of the Academy in succession to the late M. Grimaux.

THE Rammelsberg Memorial Lecture will be delivered at the Chemical Society by Prof. H. A. Miers, F.R.S., on Thursday, December 13.

WE notice in *Science* the announcement that Prof. Schiaparelli retired on November 1 from the directorship of the observatory at Milan, where he has been at work for the past forty years. His successor is Prof. Celoria, heretofore assistant astronomer at the observatory.

AT the annual meeting of the Royal Geological Society of Cornwall, Dr. Le Neve Foster was presented with the William Bolitho gold medal in recognition of the distinction which he has attained as a mineralogist and also of the great services rendered by him to the society as curator during the period when he held the appointment of inspector of mines for Cornwall and Devon.

IT is reported that M. Daniel Osiris, a Greek millionaire residing in Paris, has instituted a prize on the lines laid down by Mr. Nobel, though his offer is for Frenchmen only, except in a Paris Exposition year, when it becomes universal. He has set aside a sum to be awarded every three years in perpetuity to the discoverer, inventor or producer of the most noteworthy idea or object for the benefit of humanity. The prize is to be never less than 100,000 francs, and may be double that sum.

A RUMOUR, which we profoundly regret, has reached us to the effect that, owing to increasing financial difficulties, the Government of Jamaica, W.I., is obliged to retrench in the work of the museum, and that the curator, Dr. J. E. Duerden, A.R.C.S. (London), will be shortly returning to England. During his appointment in the Colony, Dr. Duerden has carried out investigations on the local aboriginal Indian remains and in marine zoology. Among the important results obtained may be mentioned the discovery of the free-swimming female medusoids of Millepora; the discovery that the addition of new mesenteries and septa in the coral Porites takes place in a bilateral manner at the dorsal or ventral aspect of the polyp, recalling the method probably followed in the ancient Rugose corals; the establishment of the fact that the order of septal formation in most Madreporaria follows closely the law ascertained long ago by Prof. Lacaze-Duthiers for the cycles of tentacles in Actiniæ. Can nothing be done to save the Colony from the opprobrium which must follow the forsaking of pure science?

THE value of anti-plague serum is a very vexed question. Yersin in 1896, in China, claimed a mortality of only 7·6 per cent. in twenty-six cases treated with his serum, and the same observer in 1897, in India, using Roux's serum, stated that the mortality was only 49 per cent., as compared with 80 per cent. among the cases not treated with serum. The Indian medical officers and the German Commission, however, reported unfavourably upon his results, and the serum treatment of plague has not been adopted in India. Clemow, in India in 1899, employed both Yersin's and Lustig's sera, but was unable to observe any good results from the use of either. On the other hand, in the outbreak of plague in Oporto last year, Calmette and Salimbeni claim to have obtained excellent results with the use of serum prepared at the Pasteur Institute by the most recent method—viz. by treating horses with increasing doses, first of dead and afterwards of living cultures, of plague bacilli, administered by intravenous injection during a period of five or six months. The mortality of the cases treated with serum was 15·3 per cent., as against 63·7 per cent. for the untreated cases. Calmette holds that for successful treatment the anti-plague serum must be administered in large doses, intravenously to commence with, and afterwards by repeated subcutaneous injection, early treatment being essential. The experimental results are distinctly in favour of the value of anti-plague serum both as a preventive and as a curative agent.

MR. R. HEDGER-WALLACE, formerly of the Department of Agriculture, Victoria, is giving a course of lectures on the "First Principles of Colonisation and Plantation," at the Gardens of the Royal Botanic Society of London. The remaining lectures will be delivered on November 30 and December 7 at three o'clock.

IN consequence of the annual dinner of the Institution of Electrical Engineers being fixed for Monday, December 3, the second lecture of Prof. Fleming's Cantor course at the Society of Arts, on "Electric Oscillations and Electric Waves," announced for that date will be postponed until the following day, Tuesday, December 4, to suit the convenience of members and others who might be prevented by the dinner from attending it.

THE Council of the Institution of Engineers and Shipbuilders in Scotland is arranging an International Engineering Congress, under the presidency of Lord Kelvin, in connection with the Glasgow International Exhibition of 1901. The leading engineering and kindred societies have already accorded their hearty support to the congress. An influential London Committee has been formed, and the congress gives every promise of being a success.

SIR WILLIAM MACCORMAC, president of the Royal College of Surgeons of England, has received the Royal licence and authority that he may accept and wear the Cross of Commander of the Legion of Honour, conferred upon him by the President of the French Republic, in recognition of services which he rendered to the French wounded during the war of 1870-71, as well as to the International Congress of Medicine held during the recent Paris Exhibition.

AT the end of this year Dr. H. R. Mill will retire from the post of librarian to the Royal Geographical Society, and will be succeeded by Mr. E. Heawood. The scientific appointment which he has accepted will enable him to devote more attention to the investigation of meteorology and oceanography in their relation to the configuration of the ground than has been possible during his nine years' librarianship.

AT the Imperial Institute on Monday an illustrated public lecture was delivered by Mr. Clement L. Wragge, Government Meteorologist of Queensland, on "The Work of the Queensland Weather Bureau, in its Relation to the Natural Resources and Commerce of Australasia." The work of the Queensland Weather Bureau is divided into two main parts, (1) the investigation of local climates, climatology, and (2) forecasting the weather. In speaking of the daily forecasting service, Mr. Wragge said that by an Inter-colonial system of exchange of data his Bureau is daily placed in possession of barometric and other meteorological readings from every part of Australasia, and the forecasts prepared therefrom are published in the principal daily Australasian papers. He advocated the American system of hoisting flags of different designs and colours at the telegraph offices of every town. The comparison of simultaneous observations of the upper regions of the air, made at mountain observatories, with those made at the nearest point on the sea level, are of great value, as meteorologists are thus enabled to obtain practically vertical sections of the atmosphere.

WE have received the twenty-second report of the Deutsche Seewarte, Hamburg, referring to the work of that important institution for the year 1899. The meteorological services of Germany are divided into two parts. The Central Office at Berlin, whose report we noticed in our issue of last week, deals with the climatological observations over the whole Empire, in co-operation with the various States of Germany; while the Hamburg Office deals with everything appertaining to maritime meteorology, including storm warnings, and for this purpose has under its control a number of independent stations, especially along the sea coasts. In carrying out these objects, Dr. Neumayer has the assistance of Drs. Köppen, van Bebber and other well-known men of science. In glancing through the report, one is at once struck by the persistent and successful endeavours to collect observations made at sea; the complete logs and abstract books received during the year from the ships of the Navy and Mercantile Marine numbered no less than 818. For the supply of log-books the consuls in various parts of the world, including this country, act as agents of the Seewarte. The results are published in valuable tables and charts, which are frequently referred to in these columns. For the purpose of issuing weather forecasts and storm warnings the institution is in daily telegraphic communication with all the meteorological services of Europe; upwards of 3000 telegraphic storm warnings were issued to various stations during the year 1899, and the daily and ten-daily weather reports furnish most trustworthy and useful information, the latter relating to weather conditions over an area extending from North America across the North Atlantic, and far into the continent of Asia.

SOME interesting particulars respecting the growth of the acetylene gas industry are given in a recent report by the British Consul at Stuttgart. Calcium carbide has been known to chemists as an interesting chemical compound for several years, but until recently it was practically unknown to the public. Now its production is one of the most important chemical industries. Germany was foremost to recognise the new illuminant, and it has secured the principal place in its production. At present there are at least 200,000 jets of acetylene gas in use in the country, and it is, the Consul says, impossible to predict the result of the competition between it and its rival illuminants. Probably petroleum will suffer most; coal gas will be superseded to a great extent, especially in lighting small towns, but electricity will not be appreciably affected. No other branch of industry can point to such a large and steady increase in the number of patents, showing that it has encouraged great fertility of invention. Besides producing it at home, German capital has gone abroad to produce carbide, especially to Norway and Switzerland. One of the greatest successes of the industry has been its application to the lighting of railway carriages on German Government lines. During the current year the consumption of carbide in the country is estimated at 17,000 tons, equal in illuminating power to about seven millions of gallons of petroleum. Thirty-two small towns, with populations up to 5000, are lighted by acetylene, and many more contemplate its adoption; and the progress of the system of lighting, says the Consul, is "another striking instance of the manner in which the magnificent system of technical education has prepared the way for the introduction of new scientific achievements." The economic importance of the industry appears from the fact that Germany annually pays about five millions sterling to the United States for petroleum, while acetylene is a purely German industry, carbide being manufactured in the country, which possesses in various parts all the necessary raw materials.

WE have received a copy of an illustrated memoir by Signor Rina Monti, published in the *Memorie* of the Royal Institute of Lombardy (vol. xix. pt. i.), detailing the results of experiments on the power of regeneration displayed by marine planarians. It was found that if one of these creatures was cut into two or more portions by transverse section, as many complete individuals were produced.

To the November number of the *Zoologist* Mr. A. H. Meiklejohn contributes a paper on the origin and meaning of the names of British birds, a subject which, according to the author, has hitherto received but little attention. "In most birds' names," he writes, "special stress is invariably laid on some well-known or easily distinguished peculiarity either in cry, flight or appearance." Names from the cry, such as pipit, crake, cuckoo, hoopoe and kittiwake, are especially numerous. To the origin of some, like gull, auk and garganey, there is no clue.

SINCE the publication, some years ago, by Prof. D'Arcy Thompson, of a paper on the affinities of the Eocene American cetacean, commonly known as Zeuglodon, very little advance in our knowledge of the genus has taken place. It is, therefore, satisfactory to find Mr. F. A. Lucas, in the *Proceedings* of the U.S. Museum (vol. xxiii. pp. 327–331), giving an account of the pelvis and thigh-bone. Both these bones are relatively small, and in life were probably completely buried in the flesh. Although the relationship may be remote, the author considers that Zeuglodon was certainly related to the seals; adding that it probably represents a side branch of the ceto-phocic stock which left no descendants. It is also mentioned that the abundance of its remains in certain districts of the United States has been much exaggerated.

PROF. W. A. HERDMAN has drawn up a scheme of investigations for submission to the Committee of the Lancashire and Western Sea Fisheries. These investigations, it is suggested, should be carried out systematically by the Committee's new steamer, commencing with the new year. The questions as to whether a particular fishery is on the wane or the increase, or whether "nurseries" are already overstocked with young fish or stand in need of replenishing by artificially hatched fish, can only, according to Prof. Herdman, be solved by means of accurate information connected with the abundance, movements and life-histories of the species of fish concerned; and such information can only be acquired by a practical scientific investigation of our seas. The tables drawn up for recording the observations taken during each cruise seem admirably adapted for their purpose. It is proposed that a certain amount of the steamer's time should be devoted to the taking of regular periodic observations at fixed points according to the plan of these tables.

WE have received from the publishers, Messrs. Gurney and Jackson, a copy of the second edition of Mr. H. Goss's valuable pamphlet on the "Geological Antiquity of Insects," the first edition of which was noticed in these columns. In the preface the author expresses regret that he has had neither time nor energy to incorporate the new matter which has been published since the appearance of the first edition, so that the present issue is mainly a reprint of the latter.

MR. A. S. PACKARD describes some tracks of Crustaceans found in rocks of the Chemung stage (Upper Devonian), and in upper Carboniferous of Pennsylvania and elsewhere (*Proc.* Amer. Acad., July 1900). These tracks he attributes to Limuloids akin to the Carboniferous genus Prestwichia. Mr. Packard also describes a new fossil crab (*Cancer proavitus*), from the Miocene of Gay Head, Martha's Vineyard. He remarks that the extinct species appears to be the stem or ancestral form from which have descended the two species now living in the waters of Vineyard Sound.

THE geological section of the Leicester Literary and Philosophical Society is doing excellent work under the chairmanship of Mr. H. Alfred Roechling. Excursions have this year been made to Atherstone, Polesworth, Ashby-de-la-Zouch and other places, concerning which concise reports have been printed, together with sections and geological maps (on a scale of two inches to a mile). These maps and sections are the work of Mr. C. Fox Strangways, who has acted as geological leader on many of the excursions.

IN the *Astrophysical Journal* (vol. xii. pp. 167–175), Prof. H. Crew describes some very interesting experiments he has recently made on the differences in the spectra of various metals when the arc producing the light was surrounded by ordinary air or hydrogen. The investigation was undertaken in the hope that the new condition might have some selective effect on the spectrum lines, and thereby facilitate their grouping into series. The arc was produced in a brass hood made in two halves; into one of these the two electrodes were fitted by insulated bearings, provision being made for one of the electrodes being rotated from outside. The opposing edges of the two hemispheres were then screwed together, and a gas-tight joint obtained. Opposite the space between the poles, the hood was provided with an opening carrying a brass tube some 12 inches long, having at its outer end a quartz lens which served to project an image of the enclosed arc on to the slit of a concave Rowland spectrograph of 10-feet radius. The hydrogen was supplied from three large electrolytic cells, and, after passing through a drying tube, was allowed to continually pass through the brass hood, the surplus being ignited at a stopcock. The first indication of the effect of the hydrogen was to materially diminish its intensity, so much so that in some cases the exposure had to be from five to one hundred times that necessary in air only. In addition, there is a most conspicuous change of relative intensity among the lines of any one substance. Tables are given of the lines affected in the cases of magnesium, zinc and iron. In magnesium, the characteristic line at $\lambda 4481$ has an intensity in hydrogen ten times as great as in air, this change being similar to that obtained in passing from the arc to the induction spark. In the case of iron many lines are greatly enhanced in intensity, but these are not the same lines which are enhanced in substituting the spark for the arc condition; but the author states that all lines in the arc spectrum which are affected by the hydrogen atmosphere, whether enhanced or diminished in intensity, belong to the spark spectrum also. On the other hand, the lines which belong to Kayser and Runge's series are unaffected by the change from air to hydrogen.

MESSRS. PERKEN, SON AND CO., LTD., have just issued a new catalogue of photographic apparatus, magic lanterns and accessories.

FOLLOWING the example of Cornell University, the New Mexico Normal University has commenced the publication of instructive bulletins to encourage interest in nature study. The subjects of the first two bulletins are house flies and pigments.

IN his letter on the optics of acuteness of sight (p. 83), Dr. A. S. Percival pointed out that as the angle subtended by Jupiter's edge and his first satellite at the observer's eye is greater than one and a half minutes of arc, there is no reason why the four satellites should not be seen by the naked eye. The angle is 1′33″, and not 1·33″ as it was printed.

WE have received from the firm of Gebrüder Borntraeger, Berlin (London: Williams and Norgate), the second fasciculus of the second volume of "Symbolae Antillanae seu fundamenta Florae Indiae occidentalis," edited by Herr J. Urban. The new part deals with the Cyperaceæ, Acanthaceæ, new Lauraceæ and Bromeliaceæ, and new and little known Leguminosae.

PROF. CORFIELD'S Harveian lectures on "Disease and Defective House Sanitation," of which translations into French and Hungarian have already been published by the Royal Society of Public Health of Belgium and the Hungarian Society of Public Health respectively, have now been translated into Italian by Dr. Soffiantini, of Milan, and are being published, with illustrations, in *Il Monitore Tecnico*.

MESSRS. J. AND A. CHURCHILL have published a fourth edition of Dr. E. H. Starling's "Elements of Human Physiology." As an introduction to the larger text-books the volume is admirable, and it has proved a serviceable guide to many students since the original volume was published in 1892. A review of the book appeared in NATURE eight years ago (vol. xlvii. p. 146), and we are glad to know that the merits which have made it successful were then fully recognised.

THE second fasciculus of the first volume of the "Conspectus florae graecae," by Dr. E. de Halácsy, has been published by Mr. W. Englemann, of Leipzig (London: Williams and Norgate). Nearly a century has elapsed since the appearance of

Sibthorp and Smith's "Prodromus florae graecae," and other works on the subject have been issued; but the conspectus now in course of publication will be the first attempt to give anything like a complete account of the flora of Greece, inclusive of Epirus, Crete and neighbouring islands. The work will be entirely in Latin, and will be completed in from eight to ten parts, each of about 160 pages. It is estimated that about five years will elapse before the last part has appeared.

A FIFTH edition, rewritten and enlarged, of the "Handbook of Practical Botany," translated by Prof. W. Hillhouse from Prof. Strasburger's "Praktikum," has been published by Messrs. Swan Sonnenschien and Co., Ltd. The translation is based upon the third German edition of Prof. Strasburger's well-known work, issued in 1897. A number of new figures have been added, and the notes introduced by Prof. Hillhouse in earlier editions have now been incorporated in the text. The bibliographical notes formerly appended to the chapters have been omitted. For nearly fourteen years Prof. Hillhouse's translation of Prof. Strasburger's text-book has been in use in botanical laboratories, and has shown many students the way to become acquainted with the broad facts of scientific structural botany and the methods of microscopical work. In its revised form the book will be welcomed by all who are interested in the practical study of botany.

THE publication of a bibliography, guide and index to bacteriological literature has been commenced in *The Scientific Roll*, conducted by Mr. Alexander Ramsay. The first title included in the part of the general bibliography just issued is "Arcana naturæ detecta," by Leeuwenhoek (1680), and the list extends to 1875 and includes one hundred and one papers published in that year. The works are arranged alphabetically, according to authors. Though the list is not exhaustive it will provide people interested in bacteria with a ready means of finding what has been published on bacteriological subjects, and of tracing the growth of the science. Mr. Ramsay invites authors to send him copies of their papers so that he may make the bibliography as complete as possible. The publisher of the list is Mr. R. L. Sharland, 38, Churchfield-road, Acton, London, W.

A WORK of interest to students of ethnology, containing the results of the journey to Algeria made by Messrs. D. Randall-MacIver and A. Wilkins, is about to be published by Messrs. Macmillan and Co., under the title of "Libyan Notes." The object of the expedition was to establish if possible any trace of a connection between the Berber tribes and Egypt—a trace finally discovered in the pottery of the Kabyles—but incidentally the writers undertook and recorded a general investigation of the indigenous white race of Northern Africa known to Rome as the Numidians, Gœtulians or Mauri—who figure as a white race on Egyptian monuments as far back probably as 1300 B.C. Thus in addition to the special chapters on the Kabyle pottery and the evidences of a Libyo-Egyptian connection, the book will contain remarks on the Berber history, their language, their interesting political and social organisation; detailed descriptions both of the Aurès and Kabylia, their inhabitants and the local industries; observations and statistics on the physical type of the Berbers based on measurements; and finally some account of the rude stone monuments of Algeria.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mrs. Henry Lazarus; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Mr. H. A. Loop; an Egyptian Jerboa (*Dipus aegyptius*) from North Africa, presented by Mr. K. Riccardo; four Black-backed Jackals (*Canis mesomelas*) from South Africa, presented by Mr. J. E. Matcham; an African Civet Cat (*Viverra civetta*) from West Africa, presented by Mr. R. H. Brady; a Puffin (*Fratercula arctica*), European, presented by Mr. E. T. Norris; a Common Roe (*Capreolus caproea*, albino), European; a One-wattled Cassowary (*Casuarius uniappendiculatus*) from New Guinea, a Yellow-rumped Parrakeet (*Platycercus flaveolus*) from Queensland, an Ocellated Monitor (*Varanus ocellatus*) from East Africa, five Blue Lizards (*Gerrhonotus coeruleus*) from Western North America, three Undulated Lizards (*Sceloporus undulatus*) from South-east United States, deposited; an Axis Deer (*Cervus axis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER.

Dec. 4. 18h. 41m. to 18h. 45m. Moon occults 13 Tauri (mag. 5·4).
5. 6h. 11m. to 6h. 46m. Moon occults ω^2 Tauri (mag. 4·6).
5. 16h. 5m. to 17h. 0m. Moon occults DM + 20°, 785 (mag. 5·8).
7. 15h. Mercury at greatest elongation, 20° 50′ W.
8. 13h. 32m. to 14h. 37m. Moon occults DM + 17° 1596 (mag. 5·6).
10. 8h. 56m. to 9h. 52m. Moon occults κ Cancri (mag. 5·0).
10–12. Epoch of Geminid meteoric shower (Radiant 108° + 33°).
11. 12h. 36m. Minimum of Algol (β Persei).
12. 13h. Mars in conjunction with moon. Mars 8° 26′ N.
13. 21h. Jupiter in conjunction with the sun.
14. 9h. 25m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc = 0·836.
Mars. " " " = 0·907.
16. Saturn. Outer minor axis of outer ring = 15″·40.
17. 6h. 14m. Minimum of Algol (β Persei).
18. 19h. Venus in conjunction with the moon. Venus 2° 19′ N.
19. 16h. Neptune in opposition to the sun.
20. 0h. Mercury in conjunction with moon. Mercury 0° 2′ N.
26. Eros makes nearest approach to the earth.
26. 7h. 42m. to 8h. 33m. Moon occults 51 Aquarii (mag. 5·8).
29. 1h. Saturn in conjunction with sun.

NEW VARIABLE STARS.—*Cygnus.*—Herr T. Köhl, writing from an observatory at Odder, Denmark, to the *Astronomische Nachrichten* (Bd. 154, No. 3673), draws attention to the variability of the star B.D. + 46°·2970, whose co-ordinates are

R.A. = 20h. 28m. 33·7s.
Decl. = + 46° 4′·2 } (1855).

A note by Herr E. Hartwig suggests that the period of this variable is more than a year.

Aquila.—Dr. T. D. Anderson, in the same journal, announces the variability of the star B.D. + 9°·4205, having the position

R.A. = 19h. 33m. 48·2s.
Decl. = + 9° 35′·4 } (1855).

Using four neighbouring stars for comparison, the following values were obtained:—

		Mag.
1900 Sept.	18 =	9·2
	24 =	9·2
Oct.	1 =	9·4
	25 =	10·0
Nov.	9 =	10·6

Pegasus.—Dr. Anderson also finds the star A.G. Leipzig I. 8381 to be variable. Its position is

R.A. = 21h. 6m. 15·0s.
Decl. = + 12° 12′ 26″ } (1855),

The following estimations of its magnitude have been made:—

		Mag.
1900 Sept.	26 =	9·1
Oct.	27 =	9·5
Nov.	10 =	10·1

EPHEMERIS FOR OBSERVATIONS OF EROS.—The following abridged ephemeris will serve for finding the planet during the month of December :—

Ephemeris for 12h. Berlin Mean Time.

1900.		R.A. h. m. s.		Decl. ° ′ ″
Dec. 1	...	1 27 19·27	...	+50 23 49·6
3	...	26 42·70	...	49 43 44·9
5	...	26 33·12	...	49 1 40·7
7	...	26 50·26	...	48 17 51·2
9	...	27 33·77	...	47 32 28·9
11	...	28 43·13	...	46 45 46·0
13	...	30 17·82	...	45 57 53·5
15	...	32 17·24	...	45 9 2·7
17	...	34 40·66	...	44 19 24·0
19	...	37 27·28	...	43 29 7·2
21	...	40 36·30	...	42 38 20·6
23	...	44 6·85	...	41 47 12·2
25	...	47 57·92	...	40 55 49·0
27	...	52 8·49	...	40 4 17·1
29	...	1 56 37·43	...	39 12 40·8
31	...	2 1 23·61	...	+38 21 3·0

DISTRIBUTION OF MINOR PLANETS.—M. Freycinet has a further article in the *Comptes rendus* (vol. cxxxi. pp. 815-821), in which he discusses the distribution of the zone of asteroids more critically than in his previous paper in *Comptes rendus*, cxxx. pp. 1145-1154. On the assumption that these small bodies are the product of disruption of a former ring of matter revolving round the central body, he calculated the mean eccentricities of the several rings into which it might be expected to divide. On examination of the elements of 428 of the planets, it has been possible to divide them into eight groups, the members of each group having similar eccentricity and inclination of orbit. The numbers of separate bodies in each zone vary greatly—from 1 to 170. The mean thickness of the rings is 0·278, the radius of the earth's orbit being taken as unit, the individual rings varying from 0·22 to 0·36. In each ring the mean eccentricity of the members situated in the inner or inferior half is greater than that of the members occupying the superior or outer half; and comparing two rings, it is found that the mean eccentricity of the planets in the inferior part of the outer ring is greater than that of those occupying the superior part of the inner ring. In one ring—the fifth—consisting of 69 planets, the mean eccentricities of the two halves are identical, and it will be interesting to examine the places occupied by asteroids discovered in the future as to their effect on the constants of this region of the swarm.

THE NOVEMBER METEORS.—In the *Comptes rendus* (vol. cxxxi. pp. 821-825) Dr. Janssen describes the special preparations made for observing, from balloons, the meteors expected during the past month. A few Leonids were seen, but no indication of any special fall. In the description of the ascents, mention is made of the observers having to pass through several cloud belts, suggesting that in future an altitude of some 6000 metres should be attained to ensure more certainty of a clear sky.

M. Deslandres also gives, in the same issue (pp. 826-7), the results of the observations made at the Meudon Observatory. They were both visual and photographic, the latter being made with six cameras having apertures from 6 to 2 inches. All were carried by a single equatorial mounting so as to be under the control of one observer.

On the night of November 14, from 9h. 30m. to 1h., traces of 16 meteors were secured, of which 6 were Leonids, 5 Andromedes and 2 sporadic. On the night of the 15th, after 9h. 30m. 5 traces were obtained, 3 of which were Leonids.

HUXLEY'S LIFE AND WORK.[1]

II.

ANOTHER remarkable side of Huxley's mind was his interest in and study of metaphysics. When the Metaphysical Society was started in 1869, there was some doubt among the promoters whether Huxley and Tyndall should be invited to join or not. Mr. Knowles was commissioned to come and consult me. I said at once that to draw the line at the opinions which they were known to hold would, as it seemed to me, limit the field of discussion, and there would always be doubts as to when the forbidden region began; that I had understood there was to be perfect freedom, and that though Huxley's and Tyndall's views might be objectionable to others of our members, I would answer for it that there could be nothing in the form of expression of which any just complaint could be made.

The society consisted of about forty members, and when we consider that they included Thompson, Archbishop of York, Ellicott, Bishop of Gloucester and Bristol, Dean Stanley and Dean Alford as representatives of the Church of England; Cardinal Manning, Father Dalgairns and W. G. Ward as Roman Catholics; among statesmen, Gladstone, the late Duke of Argyll, Lord Sherbrooke, Sir M. Grant Duff, John Morley, as well as Martineau, Tennyson, Browning, R. H. Hutton, W. Bagehot, Frederic Harrison, Leslie Stephen, Sir J. Stephen, Dr. Carpenter, Sir W. Gull, W. R. Greg, James Hinton, Shadworth Hodgson, Lord Arthur Russell, Sir Andrew Clark, Sir Alexander Grant, Mark Patteson, and W. K. Clifford, it will not be wondered that I looked forward to the meetings with the greatest interest. I experienced also one of the greatest surprises of my life. We all, I suppose, wondered who would be the first President. No doubt what happened was that Roman Catholics objected to Anglicans, Anglicans to Roman Catholics, both to Nonconformists; and the different schools of metaphysics also presented difficulties, so that finally, to my amazement, I found myself the first President! The discussions were perfectly free, but perfectly friendly; and I quite agree with Mr. H. Sidgwick, that Huxley was one of the foremost, keenest and most interesting debaters, which, in such a company, is indeed no slight praise.

We dined together, then a paper was read, which had generally been circulated beforehand, and then it was freely discussed, the author responding at the close. Huxley contributed several papers, but his main contribution to the interest of the Society was his extraordinary ability and clearness in debate.

His metaphysical studies led to his work on Hume and his memoirs on the writings of Descartes.

One of his most interesting treatises is a criticism of Descartes theory of animal automatism. Descartes was not only a great philosopher, but also a great naturalist, and we owe to him the definite allocation of all the phenomena of consciousness to the brain. This was a great step in science, but, just because Descartes' views have been so completely incorporated with everyday thought, few of us realise how recently it was supposed that the passions were seated in the apparatuses of organic life. Even now we speak of the heart rather than the brain in describing character.

Descartes, as is known, was much puzzled as to the function of one part of the brain—a small, pear-shaped body about the size of a nut, and deeply seated. Known as the pineal gland, he suggested that it was the seat of the soul; but it is now regarded, and apparently on solid grounds, as the remains of the optic lobe of a central eye once possessed by our far-away ancestors, and still found in some animals, as, for instance, in certain lizards. Descartes was much impressed by the movements which are independent of consciousness or volition, and known as reflex actions—such, for instance, as the winking of the eye or the movement of the leg if the sole of the foot is touched. This takes place equally if, by any injury to the spinal marrow, the sensation in the legs has been destroyed.

Such movements appear to be more frequent among lower animals, and Descartes supposed that all their movements might be thus accounted for—that they were, like the movements of sensitive plants, absolutely detached from consciousness or sensation, and that, in fact, animals were mere machines or automata, devoid not only of reason, but of any kind of consciousness.

It must be admitted that Descartes' arguments are not easy to disprove, and no doubt certain cases of disease or injury—as, for instance, that of the soldier described by Dr. Mesnet, who, as the result of a wound in the head, fell from time to time into a condition of unconsciousness, during which, however, he ate, drank, smoked, dressed and undressed, and even wrote—have supplied additional evidence in support of his views. Huxley, while fully admitting this, came, and I think rightly, to the conclusion that the consciousness of which we feel certain in ourselves must have been evolved very gradually, and must therefore exist, though probably in a less degree, in other animals.

[1] The first "Huxley Memorial Lecture" of the Anthropological Institute, delivered on November 13, by the Rt. Hon. Lord Avebury, F.R.S., D.C.L., LL.D. Continued from p. 96.

No one, indeed, I think, who has kept and studied pets, even if they be only ants and bees, can bring himself to regard them as mere machines.

The foundation of the Metaphysical Society led to the invention of the term "Agnostic."

"When I reached intellectual maturity," Huxley tells us, "and began to ask myself whether I was an atheist, a theist or a pantheist, a materialist or an idealist, a Christian or a freethinker, I found that the more I learned and reflected, the less ready was the answer; until, at last, I came to the conclusion that I had neither art nor part with any of these denominations except the last. The one thing in which most of these good people were agreed was the one thing in which I differed from them. They were quite sure they had attained a certain "gnosis"—had, more or less successfully, solved the problem of existence; while I was quite sure I had not, and had a pretty strong conviction that the problem was insoluble . . . ."

These considerations pressed forcibly on him when he joined the Metaphysical Society.

"Every variety," he says, "of philosophical and theological opinion was represented there, and expressed itself with entire openness; most of my colleagues were "ists" of one sort or another; and, however kind and friendly they might be, I, the man without a rag of a habit to cover himself with, could not fail to have some of the uneasy feelings which must have beset the historical fox when, after leaving the trap, in which his tail remained, he presented himself to his normally elongated companions. So I took thought, and invented what I conceived to be the appropriate title of agnostic. It came into my head as suggestively antithetic to the gnostic of Church history, who professed to know so much about the very things of which I was ignorant; and I took the earliest opportunity of parading it at our Society, to show that I, too, had a tail like the other foxes."

Huxley denied that he was disposed to rank himself either as a fatalist, a materialist, or an atheist. "Not among fatalists, for I take the conception of necessity to have a logical, and not a physical, foundation; not among materialists, for I am utterly incapable of conceiving the existence of matter if there is no mind in which to picture that existence; not among atheists, for the problem of the ultimate cause of existence is one which seems to me to be hopelessly out of reach of my poor powers."

The late Duke of Argyll, in his interesting work on "The Philosophy of Belief," makes a very curious attack on Huxley's consistency. He observes that scientific writers use "forms of expression as well as individual words, all of which are literally charged with teleological meaning. Men even who would rather avoid such language if they could, but who are intent on giving the most complete and expressive description they can of the natural facts before them, find it wholly impossible to discharge this duty by any other means. Let us take as an example the work of describing organic structures in the science of biology. The standard treatise of Huxley on the 'Elements of Comparative Anatomy,' affords a remarkable example of this necessity, and of its results. . . .

"How unreasonable it is to set aside, or to explain away, the full meaning of such words as 'apparatuses' and 'plans,' comes out strongly when we analyse the preconceived assumptions which are supposed to be incompatible with the admission of it. . . .

"To continue the use of words because we are conscious that we cannot do without them, and then to regret or neglect any of their implications, is the highest crime we can commit against the only faculties which enable us to grasp the realities of the world." Is not this, however, to fall into the error of some Greek philosophers, and to regard language, not only as a means of communication, but as an instrument of research. We all speak of sunrise and sunset, but it is no proof that the sun goes round the earth. The Duke himself says elsewhere :—

"We speak of time as if it were an active agent in doing this, that and the other. Yet we are quite conscious, when we choose to think of it, that when we speak of time in this sense, we are really thinking and speaking, not of time itself, but of the various physical forces which operate slowly and continuously in, or during, time. Apart from these forces, time does nothing."

This is, it seems to me, a complete reply to his own attack on Huxley's supposed inconsistency.

Theologians often seem to speak as if it were possible to believe something which one cannot understand, as if the belief were a matter of will, that there was some merit in believing what you cannot prove, and that if a statement of fact is put before you, you must either believe or disbelieve it. Huxley, on the other hand, like most men of science, demanded clear proof, or what seemed to him clear proof, before he accepted any conclusion; he would, I believe, have admitted that you might accept a statement which you could not explain, but would have maintained that it was impossible to believe what you did not understand; that in such a case the word "belief" was an unfortunate misnomer; that it was wrong, and not right, to profess to believe anything for which you knew that there was no sufficient evidence, and that if it is proved you cannot help believing it; that as regards many matters the true position was not one either of belief or of disbelief, but of suspense.

In science we know that though the edifice of fact is enormous, the fundamental problems are still beyond our grasp, and we must be content to suspend our judgment, to adopt, in fact, the Scotch verdict of "not proven," so unfortunately ignored in our law as in our theology.

Faith is a matter more of deeds, not of words, as St. Paul shows in the Epistle to the Hebrews. If you do not act on what you profess to believe, you do not really and in truth believe it. May I give an instance? The Fijians really believed in a future life, according to their creed, you rose in the next world exactly as you died here—young if you were young, old if you were old, strong if you were strong, deaf if you were deaf, and so on. Consequently it was important to die in the full possession of one's faculties, before the muscles had begun to lose their strength, the eye to grow dim, or the ear to wax hard of hearing. On this they acted. Every one had himself killed in the prime of life; and Captain Wilkes mentions that in one large town there was not a single person over forty years of age.

That I call faith. That is a real belief in a future life.

Huxley's views are indicated in the three touching lines by Mrs. Huxley, which are inscribed on his tombstone :—

> Be not afraid, ye wailing hearts that weep,
> For still He giveth His beloved sleep,
> And if an endless sleep He wills—so best.

That may be called unbelief, or a suspension of judgment. Huxley doubted.

But disbelief is that of those who, no matter what they say, act as if there was no future life, as if this world was everything, and in the words of Baxter in "The Saints' Everlasting Rest," profess to believe in Heaven, and yet act as if it was to be "tolerated indeed rather than the flames of Hell, but not to be desired before the felicity of Earth."

Huxley was, indeed, by no means without definite beliefs. "I am," he said, "no optimist, but I have the firmest belief that the Divine Government (if we may use such a phrase to express the sum of the 'customs of matter') is wholly just. The more I know intimately of the lives of other men (to say nothing of my own), the more obvious it is to me that the wicked does not flourish nor is the righteous punished."

One of the great problems of the future is to clear away the cobwebs which the early and mediæval ecclesiastics, unavoidably ignorant of science, and with ideas of the world now known to be fundamentally erroneous, have spun round the teachings of Christ; and in this Huxley rendered good service. For instance, all over the world in early days lunatics were supposed to be possessed by evil spirits. That was the universal belief of the Jews, as of other nations, 2000 years ago, and one of Huxley's most remarkable controversies was with Mr. Gladstone and Dr. Wace with reference to the "man possessed with devils," which, we are told, were cast out and permitted to enter into a herd of swine. Some people thought that these three distinguished men might have occupied their time better than, as was said at the time, "in fighting over the Gaderene swine." But as Huxley observed :—

"The real issue is whether the men of the nineteenth century are to adopt the demonology of the men of the first century as divinely-revealed truth, or to reject it as degrading falsity."

And as the first duty of religion is to form the highest conception possible to the human mind of the Divine Nature, Huxley naturally considered that when a Prime Minister and a Doctor of Divinity propound views showing so much ignorance of medical science, and so low a view of the Deity, it was time that a protest was made in the name, not only of science, but of religion.

Theologians themselves, indeed, admit the mystery of existence. "The wonderful world," says Canon Liddon, "in which we now pass this stage of our existence, whether the higher world of faith be open to our gaze or not, is a very temple of many and august mysteries. . . . Everywhere around you are evidences of the existence and movement of a mysterious power which you can neither see, nor touch, nor define, nor measure, nor understand."

One of Huxley's difficulties he has stated in the following words: "Infinite benevolence need not have invented pain and sorrow at all—infinite malevolence would very easily have deprived us of the large measure of content and happiness that falls to our lot."

This does not, I confess, strike one as conclusive. It seems an answer—if not perhaps quite complete, that if we are to have any freedom and responsibility, the possibility of evil follows necessarily. If two courses are open to us, there are two alternatives; either the results are the same in either case, and then it does not matter what we do; or the one course must be wise and the other unwise. Huxley, indeed, said in another place:—"I protest that if some great power could agree to make me always think what is true, and do what is right, on condition of being turned into a sort of clock and wound up every morning before I got out of bed, I should instantly close with the offer. The only freedom I care about is the freedom to do right; the freedom to do wrong I am ready to part with on the cheapest terms to any one who will take it of me. But when the Materialists stray beyond the borders of their path, and talk about there being nothing else in the world but Matter and Forces and necessary laws, ... I decline to follow them."

Huxley was no enemy to the existence of an Established Church.

"I could conceive," he said, "the existence of an Established Church which should be a blessing to the community. A church in which, week by week, services should be devoted, not to the iteration of abstract propositions in theology, but to the setting before men's minds of an ideal of true, just and pure living; a place in which those who are weary of the burden of daily cares should find a moment's rest in the contemplation of the higher life which is possible for all, though attained by so few; a place in which the man of strife and of business should have time to think how small, after all, are the rewards he covets compared with peace and charity. Depend upon it, if such a Church existed, no one would seek to disestablish it."

It seems to me that he has here very nearly described the Church of Stanley, of Jowett, and of Kingsley.

Sir W. Flower justly observed that while "if the term 'religious' be limited to acceptance of the formularies of one of the current creeds of the world, it cannot be applied to Huxley; but no one could be intimate with him without feeling that he possessed a deep reverence for 'whatsoever things are true, whatsoever things are honest, whatsoever things are just, whatsoever things are pure, whatsoever things are lovely, whatsoever things are of good report,' and an abhorrence of all that is the reverse of these; and that, although he found difficulty in expressing it in definite words, he had a pervading sense of adoration of the infinite, very much akin to the highest religion."

Lord Shaftesbury records that "Prof. Huxley has this definition of morality and religion:—'Teach a child what is wise, that is morality. Teach him what is wise and beautiful, that is religion!' Let no one henceforth despair of making things clear and of giving explanations!" ('Life and Works," iii. 282).

I doubt, indeed, whether the debt which Religion owes to Science has yet been adequately acknowledged.

The real conflict—for conflict there has been and is—is not between Science and Religion, but between Science and Superstition. A disbelief in the goodness of God led to all the horrors of the Inquisition. Throughout the Middle Ages and down almost to our own times, as Lecky has so powerfully shown, the dread of witchcraft hung like a black pall over Christianity. Even so great and good a man as Wesley believed in it. It is Science which has cleared away these dark clouds, and we can hardly fail to see that it is just in those countries where Science is most backward that Religion is less well understood, and in those where Science is most advanced that Religion is purest. The services which Science has rendered to Religion have not as yet, I think, received the recognition they deserve.

Many of us may think that Huxley carried his scepticism too far, that some conclusions which he doubted, if not indeed proved, yet stand on a securer basis than he supposed.

He approached the consideration of these awful problems, however, in no scoffing spirit, but with an earnest desire to arrive at the truth, and I am glad to acknowledge that this has been generously recognised by his opponents.

From his own point of view, Huxley was no opponent of religion, however fundamentally he might differ from the majority of clergymen. In Science we differ, but we are all seeking for truth, and we do not dream that any one is an enemy to "science."

In Theology, however, unfortunately as we think, a different standard has been adopted. Theologians often, though no doubt there are many exceptions, regard a difference from themselves as an attack on religion, a suspension of judgment as an adverse verdict, and doubt as infidelity.

It is therefore only just to them to say that their obituary notices of Huxley were fair and even generous. When they treated him as a foe they did so, as a rule, in a spirit as honourable to them as it was to him.

The *Christian World*, in a very interesting obituary notice, truly observed that "if in Huxley's earlier years the average opinion of the churches had been as ready as it is now to accept the evolution of the Bible, it would not have been so startled by Darwin's theory of the evolution of man; and Darwin's greatest disciple would have enjoyed thirty years ago the respect and confidence and affection with which we came to regard him before we lost him."

"Surely it is a striking and suggestive fact that both the retiring and the incoming President of the Royal Society, by way of climax to their eulogies, dwelt on the religious side of Huxley's character. "If religion means strenuousness in doing right, and trying to do right, who," asked Lord Kelvin, "has earned the title of a religious man better than Huxley?" And similarly Sir J. Lister, in emphasising Huxley's intellectual honesty, "his perfect truthfulness, his whole-hearted benevolence," felt impelled to adopt Lord Kelvin's word and celebrate "the religion that consists in the strenuous endeavour to be and do what is right."

Huxley was not only a great man, but a good and a brave one. It required much courage to profess his opinions, and if he had consulted only his own interests he would not have done so, but we owe much to him for the inestimable freedom which we now enjoy.

When he was moved to wrath it was when he thought wrong was being done, the people were being misled, or truth was being unfairly attacked, as, for instance, in the celebrated discussion at Oxford. The statue in the Natural History Museum is very powerful and a very exact likeness, but it is like him when he was moved to righteous indignation. It is not Huxley as he was generally, as he was when he was teaching, or when in the company of friends. He was one of the most warm-hearted and genial of men. Mr. Hutton, who sat with him on the Vivisection Commission, has recorded that "considering he represented the physiologists on this Commission, I was much struck with his evident horror of anything like torture even for scientific ends." I do not, however, see why this should have surprised him, because the position of physiologists is that it is the anti-vivisectionists who would enormously increase the suffering in the world. To speak of inflicting pain "for scientific ends" is misleading. It is not for the mere acquisition of useless knowledge, but for the diminution of suffering and because one experiment may prevent thousands of mistakes and save hundreds of lives. The medical profession may be mistaken in this, but it is obvious that their conviction, whether it be right or whether it be wrong, is not only compatible with, but is inspired by, a horror of unnecessary suffering.

The great object of his labours was, in his own words, "to promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the problems of life." His family life was thoroughly happy. He was devoted to his children, and they to him. "The love our children show us," he said in one of his letters, "warms our old age better than the sun."

Nor can I conclude without saying a word about Mrs. Huxley, of whom her son justly says that she was "his help and stay for forty years, in his struggles ready to counsel, in adversity to comfort; the critic whose judgment he valued above almost any, and whose praise he cared most to win; his first care and his latest thought, the other self, whose union with him was a supreme example of mutual sincerity and devotion."

At a time of deep depression and when his prospects looked most gloomy he mentions a letter from Miss Heathorn as having given him "more comfort than anything for a long while. I wish to Heaven," he says, "it had reached me six months ago. It would have saved me a world of pain and error."

Huxley had two great objects in life as he has himself told us. "There are," he said, "two things I really care about—one is the progress of scientific thought, and the other is the bettering of the condition of the masses of the people by bettering them in the way of lifting themselves out of the misery which has hitherto been the lot of the majority of them. Posthumous fame is not particularly attractive to me, but, if I am to be remembered at all, I would rather it should be as 'a man who did his best to help the people' than by any other title."

It is not only because we, many of us, loved him as a friend, not only because we all of us recognise him as a great naturalist, but also because he was a great example to us all, a man who did his best to benefit the people, that we are here to do honour to his memory to-day.

THE ORIGIN AND PROGRESS OF SCIENTIFIC SOCIETIES.[1]

ON the present occasion I propose to say a few words on a subject of little practical importance, so far as the needs of every-day life are concerned, but still not without some general interest, and not without a direct bearing on the history of the advancement of human knowledge—the "Origin, Development and Aims of our Scientific Societies." The subject is a large one, and it will be impossible to enter into details with regard to its almost innumerable ramifications. In justification of a considerable degree of limitation, I may incidentally mention that the "Official Year-book of the Scientific and Learned Societies of Great Britain and Ireland," for the year 1900, extends over upwards of 290 octavo pages.

In England no learned society received a Royal Charter before 1662, when the Royal Society was incorporated by Charles II. It had, however, been instituted in 1660. So early, moreover, as 1645 the lovers of experimental philosophy formed a society which met weekly in London on a certain day to treat and discourse of philosophical affairs, and many of its members became subsequently the first Fellows of the Royal Society. About the year 1648–1649, this little band of students was divided into two—one part remaining in London and the other migrating to Oxford, where a Philosophical Society of Oxford was established that subsequently for some time worked in concert with the Royal Society, and did not finally cease to exist until 1690.

About the year 1572, "divers gentlemen of London, studious in antiquities, formed themselves into a College or Society of Antiquaries." The honour of this foundation is "entirely due to that munificent patron of letters and learned men, Archbishop Parker. The members met near 20 years at the house of Sir Robert Cotton, and, in 1589, resolved to apply to the Queen for a charter of incorporation, and for some public building, where they might assemble and have a library." A petition was prepared for presentation to Her Majesty Queen Elizabeth praying for the incorporation of "An Academy for the Studye of Antiquity and History," the meetings of which were to be held in the Savoy, or the dissolved Priory of St. John of Jerusalem, or elsewhere. It is uncertain whether this petition was ever presented, but the Queen seems to have given the society her countenance, and under the presidency of Archbishops Parker and Whitgift successively it flourished, and a list of thirty-eight of its members, comprising such well-known names as Camden, Cotton, Erdeswicke, Lambarde, and Stow, is still extant. For some cause or other Elizabeth's successor, James I., thought fit to dissolve the society in 1604, and though attempts were made to revive it in 1617, and though there was an Antiquaries' feast on July 2, 1659, the society remained in a dormant condition until 1707. It then held weekly meetings at the "Bear Tavern" in the Strand, and afterwards at the "Young Devil Tavern" in Fleet Street, subsequently moving to the "Fountain Tavern." In 1718 the society was reconstituted, and in 1751 a Charter of Incorporation was granted to it by George II., who declared himself the founder and patron of the Society of Antiquaries of London.

Having traced the inception of the two oldest of our learned societies, which in their early stages partook more of the nature of clubs than of what are now known as societies, I propose, before considering their further developments, to say something as to the proper aims and objects of a learned society, and the means usually adopted for carrying them into effect. Such a society is an association of persons united together by common tastes and anxious to improve or extend some particular branch of knowledge, or even the whole range of scientific inquiry. With this object in view it becomes necessary to hold periodical meetings for the discussion of subjects in which the society is interested, and for taking such action in respect of them as may seem desirable. The holding of such meetings involves an organisation and the appointment of presidents to take the chair at meetings, of secretaries to summon them, and of a treasurer to receive those subscriptions without which an association of the kind cannot exist. Moreover, for the determination of questions of policy and finance, especially when the society issued publications, a council of some kind becomes a necessity. It is on this organisation that the success or failure of a society mainly depends, and the questions as to the length of period that presidents and others should remain in office, what proportion of new blood should be infused into the council each year, and how far those in power are carrying out the views of the bulk of the members of the society, have frequently been discussed with more or less warmth. In some instances the too conservative apathy of the council has led to disruption and the foundation of new societies, or to the society under their charge being reduced to a state of inanimate slumber, while on the other hand too rapid revolutionary measures have led to diminutions in numbers, if not to absolute rebellion. Much, of course, of the welfare of a society depends upon the character of its publications being kept at a high level, and on their being brought out with scrupulous regularity.

There is one condition in the life of a scientific society which is entirely beyond its control or that of its council, and this condition may be superinduced by the activity of the society itself. As researches proceed and knowledge extends, new branches of inquiry are opened, which can only be investigated by those who apply themselves specially to the subject. New publications are required, particular days have to be set apart for the discussion of the new subject, and eventually it is found desirable to establish a separate branch of the old society, or to constitute a new one. The latter course is the one that has been most often adopted, especially in the case of biological science; and not infrequently the new society finds a home in the apartments of the parent society, and under its fostering care.

Let us now go back to the period when Charles II. granted his second Charter to the Royal Society of London for improving natural knowledge. The Society of Antiquaries was in abeyance, so that the Royal Society was practically the only institution of the kind in Britain, and its aims were naturally wide. On November 20, 1663, the society consisted of 131 Fellows, of whom 18 were noblemen, 22 baronets and knights, 47 esquires, 32 doctors, 2 bachelors of divinity, 2 masters of arts, and 8 strangers or foreign members. With the exception of the large proportion of physicians or doctors, it will be observed that the society in the main was composed of noblemen and gentlemen of independent position, and that the professional element was to a very great extent wanting. Great attention was paid to experimental methods; but "what the learned and inquisitive are doing, or have done in physick, mechanicks, opticks, astronomy, medicine, chymistry, anatomy, both abroad and at home" were subjects on which they were solicitous. Many of the branches of science diligently pursued at the present day were either unknown or in their infancy. The variation of the compass had been observed, but magnetism and electricity presented almost untrodden fields; the steam engine was in an embryonic stage; visions of space with four or more dimensions had not visited the poetical mathematical brain; microscopes and telescopes were in their infancy; the family of the planets was no more numerous than of old; the circulation of the blood had not met with universal acceptance, and the existence of *bacilli* was but dimly conceived; chemistry was of the crudest, and the elements were earth, air, fire and water; anatomy had already made notable advances, but Dermatological, Laryngological, and Odontological societies were not even dreamt of; geology was unborn, and palæontology did not exist, except in connection with Noah's Deluge.

One of the results of this very wide scope of the Royal Society was, that at its meeting the variety of subjects brought forward

[1] Abridgment of an address delivered at the opening meeting of the Society of Arts, November 21, by Sir John Evans, K.C.B., F.R.S.

for discussion was great; and the early volumes of the *Philosophical Transactions* contain a large amount of miscellaneous reading. I am not sure that, as a means of whiling away a spare half-hour, one of the first twenty volumes of the *Transactions* would not by most persons be found more attractive and amusing than the volume, say, of Series A for the year 1900.

The Society for the Encouragement of Arts, Manufactures, and Commerce was founded in 1754, but not incorporated until 1847, and this society, together with the two already mentioned, form the trio from which nearly all the numerous learned societies of the present day have sprung, by what may be regarded as a natural process of evolution.

As might have been expected, Scotland was not long in following the example set by England, and the Medical Society of Edinburgh was instituted in 1734, to be followed by the somewhat kindred Harveian Society in 1752. In the meantime, the Royal Society of Edinburgh, or, as it was originally called, the Philosophical Society, was established in 1739. The "Royal Physical Society of Edinburgh," exclusively devoted to "Natural History and the Physical Sciences," was founded in 1771, and by 1813 had absorbed no less than six other societies, which became incorporated in it.

In Ireland, the Royal Irish Academy for "the study of Science, Polite Literature, and Antiquities," was founded in 1785, and may be regarded as combining the attributes of the three parent societies in London.

Among the off-shoots of the Royal Society of London, the first perhaps is the Medical Society, founded in 1773. The Linnean Society, for the cultivation of natural history in all its branches, was founded in 1788, and has from 700 to 800 Fellows. These are the only two London societies coming under this category that date from the last century.

During the century now drawing to its close the vast advances in science, and the innumerable aspects it assumes, has led to the foundation of numerous scientific societies, each with a more or less limited scope. In natural history we have the Horticultural (1804), the Zoological (1826), the Entomological (1833), the Ornithological (1837), the Royal Botanic (1839), the Ray Society (1844), the Palæontographical (1847), and others that it would be tedious to mention.

Geology as a new science had a society founded for its study in 1807, the Geologists' Association followed in 1858, and at a later date the Mineralogical Society (1876). The Royal Astronomical Society (1820) has been supplemented by the British Astronomical Association. Mathematics and Physics have also their own societies, as have also Statistics, a subject which has a mathematical side as well as one in the direction of commerce and the affairs of ordinary life. Engineering is represented, not only by the Institution of Civil Engineers (1818), but by the Institution of Mechanical Engineers (1847), of Mining Engineers (1851), the Iron and Steel Institute (1869), and that of Electrical Engineers (1871). Geography has had its own Royal Society since 1830, Microscopy its society since 1839, and Meteorology since 1850. For medicine, pharmaceutics, pathology, neurology, anatomy, and some other branches of medical inquiry, special societies have been founded in London. The Victoria Institute or Philosophical Society of Great Britain was founded in 1865, its primary object being the attempt to reconcile apparent discrepancies between Christianity and science.

In Edinburgh and Dublin scientific societies have multiplied, though not to a similar extent; and throughout the United Kingdom there are numerous literary and philosophical societies, that of Manchester dating back to 1781. There are also several provincial geological societies, and almost every county has its natural history society or club.

Moreover, the British Association for the Advancement of Science, founded in 1831, continues to hold its annual meetings at different centres in the Empire, and helps to maintain the general interest in the advancement of knowledge and to kindle or keep alive local zeal.

The offshoots from the Society of Antiquaries have not been so numerous or important as those from the Royal Society, the field of Archæology being much more restricted than the wide domain of more purely "natural knowledge." The Society of Antiquaries of Scotland dates, however, from 1780, and that of Newcastle-on-Tyne from 1813, while the Literary and Antiquarian Society of Perth goes back to 1784. Several branches of antiquarian study have now their own societies. The Numismatic Society was founded in 1836, the Royal Historical Society in 1868, the Society of Biblical Archæology in 1871, the Palæontographical in 1873, and that for Hellenic studies in 1879. There are also special societies for the exploration of Palestine and Egypt, as well as the important Royal Asiatic Society with its different branches. The peripatetic habits of the Royal Archæological Institute and of the British Archæological Association (both 1843) help to maintain the warmth of local interest and to disseminate a certain amount of archæological information.

Anthropology and Ethnology have made great advance since the foundation of the Ethnological Society in 1843, and of the Anthropological in 1863. The two merged in 1871 to form the Anthropological Institute, which has rendered signal services to science. A minor branch of anthropology—Folk Lore—has had its own society at work since 1878.

The Society of Arts—to make use of its shortened title—can claim nearly as numerous an offspring as its elder sisters the Royal Society and the Society of Antiquaries. Her descendants, moreover, are fairly entitled to as high, if not indeed a higher, rank and importance. It is not merely the Royal Scottish Society of Arts (1821) that she can claim as an offshoot, but it was the Society of Arts that first in England devoted attention to the all-important objects of forestry and agriculture. The Royal Agricultural Society originated not earlier than 1838, though in Scotland a Society of Improvers of Agriculture was instituted in 1723, a Dublin Agricultural Society in 1731, the Bath and West of England Society in 1777, and the Highland Society in 1784.

It would, moreover, be unfair not to credit the Society of Arts as well as the Royal Society with having laid the foundations on which the Institution of Civil Engineers and the cognate bodies have been erected. The Chemical Society was established at a meeting held at the rooms of the Society of Arts in 1841. From this arose the Institute of Chemistry in 1877. The Society of Chemical Industry (1881) to a large extent grew out of the Chemical Section of the Society of Arts, which dealt for some years with the chemical industries, and was dropped on the foundation of the society. The Sanitary Institute and the other sanitary societies certainly owe their origin to the Conferences on the Health and Sewage of Towns held by the Society of Arts in 1877, 1879, and 1880. The City and Guilds' Institute also originated in consequence of the action of the society in the matter of technical education. They took up and carried on the technological examination founded by the Society of Arts.

It must never be forgotten that in its earlier days inventions of all useful kinds, and all that was new in machinery and manufactures, came within the scope of the society, which in thirty years spent many thousands of pounds in rewards and premiums for useful inventions.

It took a very active part in all educational movements and a warm interest in the welfare of our Colonies, and to its credit be it said that the examinations of the Society of Arts still rank among the most useful and thorough, while the existence of our Indian Section still evinces our interest in the prosperity of the dependencies of the Empire.

What the society has done for the advancement of art, it is difficult for us of the present day fully to appreciate; but it must be remembered that one of the first, if not, indeed, the first public exhibition of pictures was that held in the society's rooms in 1760, and that from this exhibition sprang the Royal Academy, the first exhibition of which, comprising one hundred and thirty-six works only, was opened in 1769. We may, therefore, here claim the Royal Academy as in a certain sense an offshoot from our body. The Royal Institute of British Architects, founded in 1835, may also in some degree be regarded as connected with the Royal Academy, which admits architects among its members. The Photographic Society also grew out of an exhibition of photographs, the first of the kind held in our rooms. The foundation of the Royal College of Music is likewise due to the exertions of the Society of Arts.

It would indeed be difficult to say how far the work done by any society would have been accomplished by the individuals composing that society, without combination or collective organisation. A society of course is only a collection of individuals, and the work of the society is the work of the individuals composing it.

A society offers opportunities for discussion, brings men of similar ideas together, and substitutes collective and organised action for isolated individual effort. It affords means of publication, organises research, records discoveries, stimulates invention, and assists students by providing a common meeting-place and centre of action. Every scientific discoverer desires immediate publication of his work, both for his own reputation and to secure the assistance of his colleagues. Every industrial inventor requires publication in order that he may secure the natural profits of his invention. A society systematises and arranges the science or study which is its subject-matter.

The present condition of science is certainly due to the organised efforts of such societies as the Royal Society and its subordinate societies in this and other countries. They secure public recognition for science and those who pursue it; they prevent overlapping; serve to deter different men from working on the same lines; and they bring influence to bear on the public and on the Government. Any individual is less powerful by himself than when he is associated with others seeking the same object. An active society is a corporation with a perpetual succession, and it never dies. The work carried on by an isolated student ceases at his death, but the work done by a number of students associated together goes on and on. As one man drops out, another takes his place.

An excellent example of the reciprocal influence of scientific workers and of a scientific institution upon each other is afforded by the Royal Institution. Without Davy, Faraday, or Tyndall, the Royal Institution would never have become the important body it now is. But without the Royal Institution neither Davy nor Faraday would have had any opportunity for carrying out their scientific work and of obtaining their scientific reputation, and perhaps the same may be said to a certain extent of Dr. Tyndall.

The history that I have been tracing comprises within it a record of the advance in many directions of our acquaintance with the secrets of nature, of our turning that acquaintance to practical account, and of the consequent progress of the nation in material prosperity. It bears witness likewise to that specialisation in science, which, though by no means an unmixed blessing, seems to be of necessity associated with all advancement in natural knowledge. The days are long since past when any single individual could attempt to cope with the whole encyclopædia of science, but the question not unfrequently arises at the present day whether the position of the specialist would not be more secure were the foundations on which he builds extended over a larger area, and were his scientific sympathies somewhat wider in their character.

Another question that may be asked is whether there is any need for this multiplicity of societies. The answer from any one who in whatever manner believes in evolution will be, that at the time of founding each society a necessity for it must at all events have been thought to exist, and that the analogous societies at that time in being must have been either unable or unwilling to adjust or expand themselves so as to include the subject for the study of which the new society was instituted. Many of the subjects, for instance, that originally came within the domain of the Royal Society, and indeed are still included within it, have by degrees been not absolutely banished from it, but relegated in the main to other societies, founded more especially for the study and illustration of such subjects. The Linnean, the Astronomical, the Chemical, and the Geological Societies afford instances in point, and any attempt to suppress such societies, and to bring their members all within the fold of the Royal Society, would have a disastrous effect on the advance of science, and would absolutely overweight the powers of the Royal Society itself. At the same time it must be remembered that accounts of important discoveries in any of these branches of knowledge are cordially welcomed by the Royal Society, and that it is usually the case that the leading Fellows of these special societies are also Fellows of the Royal Society. The same in a lesser degree holds good with the Society of Antiquaries, as archæological discoveries, especially when bearing on the early history of man, are welcomed alike on both sides of the quadrangle at Burlington House.

Turning to the more purely philosophical societies that have been established in London, it would seem as if for some reason or other the soil was not congenial for their growth or longevity. The Dialectical Society, founded in 1865, was dissolved in 1888; the Psychological, founded in 1875, ceased to exist in 1879, but was resuscitated under the name of the Society for Psychical Research in 1882. The Zetetical Society, established in 1878, and the Aristotelian in 1880, do not appear in Whitaker's List of Societies and Institutions, though the latter, notwithstanding that its members are few, is still in active operation. Altogether the number of those interested in abstract philosophy seems to bear no proportion to that of the votaries of the study of nature in all its phases and of those who devote themselves to the application of science to the good of mankind.

In the Institut de France, one of the Académies is that of Sciences Morales et Politiques, which, however, is divided into five sections. Of the eight places devoted to philosophy, only six were filled at the beginning of the present year, but this may have been purely accidental. The mention of the Institut suggests the question how far a similar association of academies would meet the requirements of this country. Such a question is beyond the limits of the present address, but in passing I may say that the necessary limitations of the Institut, the payment for attendance, the method of election of its members, and its close connection with the Government of the day, all present features which are hardly in accordance with our insular traditions. In Paris itself the Institut has had to be supplemented by various important scientific societies, such, for instance, as the Geological Society and the Society of Antiquaries of France.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Dr. S. H. Hodgson has been appointed an elector to the White's professorship of moral philosophy in succession to the late Prof. Henry Sidgwick.

It will shortly be proposed in Convocation to confer the degree of D.Sc., *honoris causa*, upon Dr. Oliver J. Lodge, principal of the University of Birmingham.

Science scholarships are announced for competition on December 4 at Balliol College, Trinity College and Christchurch; on December 11 at Magdalen College; on January 15 at Jesus College.

CAMBRIDGE.—The complete degree of M.A., *honoris causa*, is to be conferred on Mr. G. H. F. Nuttall, M.D. California, Ph.D. Göttingen, University lecturer in bacteriology and preventive medicine, and on Mr. T. Strangeways Pigg, Advanced Student of St. John's College, University demonstrator of pathology.

The Special Board for Medicine propose a new scheme for the degrees of M.B. and B.C., whereby candidates shall be required to pass a suitable examination in pharmacology (*i.e.* the physiological actions of remedies), and in general pathology and the elements of hygiene, before admission to the final or qualifying examination in medicine, surgery and midwifery.

THE new Ravenscroft metallurgical laboratory of the Birkbeck Institution will be opened on Saturday next, December 1.

DR. BRILLOUIN has been nominated to succeed the late Prof. Bertrand as professor of general and mathematical physics at the Collège de France.

DR. THOMAS BUZZARD, a Fellow and member of the Council of King's College, London, has been appointed one of the representatives of the college upon the Senate of the University of London, in succession to Lord Lister, who has resigned.

AT a meeting of the associates of the Owens College, Manchester, held on November 21, Prof. J. J. Thomson, F.R.S., who is himself an associate, was elected a representative of the associates on the Court of Governors of the college for a period of five years.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, August 21.—"Note on the Occurrence of a Seed-like Fructification in certain Palæozoic Lycopods." By D. H. Scott, M.A., Ph.D., F.R.S.

The specimens described in the present note show that seed-like bodies, identical with those figured by Williamson under the name of *Cardiocarpon anomalum*, were borne on Lepidodendroid cones, otherwise indistinguishable from *Lepidostrobus*. They thus prove that under the genus *Cardiocarpon*, and even under the "species" *C. anomalum*, totally different objects have been confounded, namely, the seeds of Cordaiteæ or Cycads on the one hand, and the integumented megasporangia of certain Palæozoic Lycopods on the other. The latter organs present close analogies with true seeds, but are wholly distinct in detailed structure from the Gymnospermous seeds above mentioned. The discovery of the specimens of the new cone is due to Messrs. J. Lomax and G. Wild, who recognised it as a *Cardiocarpon*-bearing strobilus, resembling a *Lepidostrobus*. The original specimens, which are calcified and generally well preserved, were derived from the Ganister beds of the Lower Coal-measures of Lancashire. A closely similar fructification occurs, at a much lower horizon, in the Burntisland beds of the Calciferous Sandstone Series.

The strobilus is of the ordinary *Lepidostrobus* type. The cylindrical axis bears numerous spirally disposed sporophylls, each of which consists of a long horizontal pedicel, expanding at the distal end into a rather thick lamina, which turns vertically upwards. Anatomically, the structure is also that of a *Lepidostrobus*. The ligule is sometimes well preserved; it is seated in a depression of the upper surface of the sporophyll, at the distal end of the sporangium, and is thus in the normal position.

With one exception, the specimens of the strobilus are immature, and their tissues not quite fully differentiated. These younger specimens bear sporangia which are essentially those of a *Lepidostrobus*. A single large sporangium is seated on the upper surface of the horizontal pedicel of each sporophyll, to the median line of which it is attached along almost its whole length. The sporangial wall has the structure characteristic of *Lepidostrobus*. Within the sporangial cavity, the membranes of the megaspores are usually preserved; a single large megaspore almost fills the sporangium, but smaller, abortive spores, with thicker walls, are also present. It appears that a single tetrad was developed in each megasporangium, and that of the four sister-cells one only came to perfection, constituting the functional megaspore.

In one specimen, discovered by Mr. Wild, the strobilus is in a more advanced condition. In its upper part the sporophylls simply bear sporangia, as above described, but lower down in the cone these are replaced by integumented, seed-like structures, identical with the detached bodies called *Cardiocarpon anomalum* by Williamson. Mr. Wild's specimen, then, demonstrates that the *Cardiocarpon anomalum* of Williamson was borne on a cone with all the characters of a *Lepidostrobus*, and that it represents the matured condition of the megasporangium and sporophyll.

The detailed comparison of specimens in the young and the mature condition has shown the nature of the change, which converts the megasporangium, together with its sporophyll, into a seed-like organ. A thick integument has grown up from the sporophyll, completely overarching the megasporangium, except for a narrow crevice left open at the top. When seen in a section tangential to the strobilus as a whole, this crevice is cut across, and presents exactly the appearance of a micropyle; in reality it differs from a micropyle in being a narrow slit, extending almost the whole length of the sporangium, in the radial direction, whereas the micropyle of an ordinary seed is a more or less tubular passage.

In a strobilus associated with the seed-like specimens, and probably of the same species, but bearing microsporangia, it was found that the latter, like the megasporangia of the female cone, are provided with integuments.

The Burntisland specimens, which from their horizon are presumably of a distinct species, are of interest for two reasons: in one specimen the ligule is clearly shown, enclosed by the integument, the only example of this organ so far observed in the mature, seed-like stage of the fructification. Another of the Burntisland specimens was the first observed in which the prothallus was present. It fills a great part of the functional megaspore, which is almost co-extensive with the sporangial cavity, and consists of a large-celled tissue, resembling the prothallus of *Isoetes* or *Selaginella*. The peripheral prothallial cells are smaller than the rest, but no archegonia could be detected. [In a section, since examined, cut by Mr. Lomax from one of the Coal-measure specimens, the prothallus is even better preserved. October 9, 1900.]

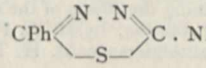
The bodies described in this note resemble true seeds in the possession of a testa or integument, and in the fact that one megaspore or embryo-sac alone came to perfection; the seed-like organ was likewise shed entire, and appears to have been indehiscent. In many points of detail, however, the reproductive bodies in question differ from the seeds of any known Gymnosperms; they afford no proof of the origin of the latter class from the Lycopods. The newly-discovered fructification nevertheless shows that certain Palæozoic Lycopods crossed the boundary line which we are accustomed to draw between Sporophyta and Spermophyta. As these fossils appear worthy of generic rank, it is proposed to found the genus *Lepidocarpon* for their reception.

Physical Society, November 23.—Prof. Everett, F.R.S., Vice-President, in the chair.—A paper on a self-adjusting Wheatstone's Bridge, by E. H. Griffiths and W. C. D. Whetham, was read by Mr. Whetham. The object of this paper is to describe a cheap and easy method of getting a self-adjusting bridge to show on a scale the actual resistance of any wire. Contact with the bridge wire is made by means of a light horozontal bar, which is suspended by a phosphor-bronze strip from the coil of the d'Arsonval galvonometer used with the instrument. A second bar, parallel to and above the first, is rigidly connected with the coil. A wooden beam, worked by clockwork, moves up and down between the bars and clamps them alternately. When the beam is down contact is made with the bridge wire. If this contact is not at the zero point a current will flow through the coil, and if the cell is connected up the proper way, it will turn the coil so as to bring the upper bar nearer to the null point. This puts a twist into the phosphor-bronze strip, and when the beam rises and clamps the upper bar the torsion comes into play, and brings the lower bar under the upper one. The beam then descends and makes contact at this point, and if any current flows through the galvanometer there is further movement until the null point is reached. Any alteration in the resistance of the wire under experiment causes a movement of the zero point on the bridge wire, and this is followed by the lower arm. The position of the lower arm can be directly indicated by means of a scale. Prof. S. P. Thompson asked how the scale was calibrated. Mr. Whetham said the scale was arbitrary, but it could be calibrated by the known resistance of the bridge wire per unit length. Extension of the range can be obtained by shunting the bridge wire with various resistances. Mr. Glazebrook asked how sensitive the bridge was. Mr. Whetham said that working with a dry cell it could easily indicate one degree on a platinum thermometer. Mr. Blakesley pointed out that if the cell was connected up the wrong way the zero point would be an unstable one.—A paper on the liquefaction of hydrogen was read by Dr. M. W. Travers. These experiments were undertaken in order to provide liquid hydrogen in sufficient quantity for the separation of neon from the helium with which it is usually mixed. The separation is effected by cooling the gases to the temperature of hydrogen boiling at atmospheric pressure. The principles and conclusions do not differ from those of Dewar, but as the production of liquid hydrogen is neither difficult nor costly, an account of the experiments is given. In 1884 Wroblewski showed that strongly cooled and compressed hydrogen, on being allowed to expand, formed mist or spray in the tube; and later Olszewski repeated these experiments on a larger scale and determined the temperature of the liquid. Other methods of liquefying hydrogen have been suggested by Lord Rayleigh and Kammerlingh Onnes. In the case of many gases a fall of temperature takes place on free expansion, but under ordinary circumstances the temperature rises in the case of hydrogen and helium. The principle of free expansion was first applied by Hampson and Linde to the liquefaction of air. Within the last two years Dewar has shown that, at a temperature close to $-200°$ C., hydrogen behaves as an imperfect gas and becomes cooled when allowed to expand. This principle has been applied by Dewar to the liquefaction of hydrogen in quantity. In the author's experiments, hydrogen under a pressure of 200 atmospheres passes through a coil which is cooled to $-80°$ C. by a mixture of solid carbonic acid and alcohol. It then enters another coil contained in a chamber which is continually replenished with liquid air. The lower portion of this coil passes into another chamber, which is closed and communicates through a pipe with an exhaust pump. Liquid air flows continuously from the first chamber into the second through a pin valve controlled by a lever. The liquid air, boiling under a pressure of 100 mm. of mercury, lowers the temperature to $-200°$ C. The gas then passes into a regenerator coil, which is enclosed in a vacuum vessel, and expanding at a valve, passes upwards, through the interstices of the coil and the annular space surrounding the chambers through which the gas first passes, to an outlet whence it can return to the main supply pipe. The liquid which separates from the gas is ultimately collected in a vacuum vessel. The apparatus, with the exception of the compressor, motor and Hampson air liquefier, is comparatively inexpensive. About 50*l*. is required for the additional apparatus, and each time liquid hydrogen is made involves a further expenditure of about a sovereign. Dr. Hampson said he would like to offer a correction. Dr. Travers had said that he (Dr. Hampson) was the first to liquefy air by the application of the counter current process to the Joule-Thomson effect. Although he was the first to make the proposal he was not the first to apply it. He made the proposal to Prof. Dewar's assistant in 1894, and air was liquefied by Prof. Dewar by this method. Dr. Travers had referred at length to a valve which he (Dr. Hampson) had devised, but as it was straightforward common sense he did not wish to accept any credit for the use it had been to the author in his experiments. He would like to call attention to the remarkable features of the work in two respects—the economy of means and the magnitude of results. By means of liquid hydrogen Prof. Ramsay and Dr. Travers had succeeded in obtaining the physical and other properties of some of the rarer gases. Prof. S. P. Thompson said the author had asserted that the Joule-Thomson effect for hydrogen changes in sign at some temperature, and expressed his interest in the fact that it was possible to get a cooling effect by allowing hydrogen to expand. Mr. Boys asked if it was necessary or desirable to allow the hydrogen to expand to atmospheric pressure. Dr. Travers said the mechanical advantages of this were great. Dr. Lehfeldt asked if there had been any attempt to determine the temperature of the liquid, and, secondly, if the apparatus could be employed to determine the magnitude of the Joule-Thomson effect. Dr. Harker asked if the temperature at which the Joule-Thomson effect changes sign was known. Dr. Donnan said that the effect changed sign at the temperature at which "PV" was a minimum. Dr. Travers, in reply to Dr. Lehfeldt, said he had not determined the temperature of the liquid, and the apparatus was not suitable for measuring the Joule-Thomson effect. He should say that the change of sign occurred about -150° C. It was Daniel Berthelot who first pointed out that the change of sign corresponded with the minimum value of "PV," but the experiments of Amagat on the relation between pressure and volume were not sufficiently accurate to fix the temperature.—A paper on the anomalous dispersion of carbon, by Prof. R. W. Wood, was taken as read. Experiments were made with smoke films and with films deposited on plate glass in a vacuum by an incandescent lamp. The dispersion was first measured with a Michelson interferometer, illuminated with monochromatic light of various colours, obtained by prismatic analysis. The fringes were photographed and measured, readings being obtained between wave-lengths ·000040 cm. and ·000066 cm. The results show a steady increase of refractive index from blue to red. The refractive index for sodium light was measured by estimating the thickness of the film and the fringe displacement, and was found to be 2·2. A prismatic deposit of smoke was then made by allowing a piece of plate glass to move uniformly backwards and forwards over the top of a small flame. The deviation produced by this prism was measured by means of a direct vision spectroscope with the prisms removed. Experiments were performed with red and blue light. The mean deviation of red and blue was taken for sodium light, and this result was in good agreement with the deviation obtained by the interferometer method.—A paper on the refraction of sound by wind, by Dr. E. H. Barton, was taken as read. Assuming that the wind is everywhere horizontal, and does not vary in any one horizontal plane, but is different at different levels, then the following results are obtained for rays in the same vertical plane as the wind: (1) The direction of propagation is not usually at right angles to the wave front where there is a wind, consequently the cosecant law for the wave front needs supplementing by another expression giving the direction of the ray. (2) Total reflection cannot occur if the wave front is initially horizontal. (3) In a region where the horizontal wind increases uniformly as we ascend, the rays, instead of forming a catenary, describe a more complicated curve, which, however, reduces to a parabola in the special case of rays whose wave fronts are horizontal. In the paper the relation between direction of propagation and wave front is first worked out and then the refraction of waves and rays on crossing into a new wind zone is considered. This principle is then applied to the diffraction through any number of parallel wind zones, and it is shown that the final inclinations of wave fronts and rays are independent of the characteristic constants of the intermediate zones. It is shown that since a cosecant cannot have a value between $+1$ and -1, total reflexion becomes possible. If, however, the wave front is initially horizontal there is no refraction of the wave front and no total reflexion, but the ray deviates without limit from the vertical, and tends to correspond with the wave front. When reflexion occurs it follows the ordinary optical law. The society then adjourned until December 14, when the meeting will be held at the Royal College of Science, South Kensington.

Chemical Society, November 15.—Prof. Thorpe, President, in the chair.—The following papers were read:—Trichlorobenzoic acid, by F. E. Matthews. Benzonitrile hexachloride is acted upon by alcoholic soda with production of a mixture of trichlorobenzoic acids from which a new trichlorobenzoic acid was isolated; the new acid gives an ester with hydrogen chloride and alcohol and is, therefore, the 1 : 2 : 4-trichloro-3-benzoic acid.—Oxidation of benzalthiosemicarbazone, by G. Young and W. Eyre. Benzalthiosemicarbazone,

$$CHPh : N . N : C(SH) . NH_2,$$

is oxidised to amidophenylthiodiazole,



by ferric chloride. Similar oxidation products are obtained from the 4-substituted methyl and phenyl benzalthiosemicarbazones.—The nitration of benzeneazosalicylic acid, by J. T. Hewitt and J. J. Fox. With dilute nitric acid, benzeneazosalicylic acid yields benzeneazoorthonitrosalicylic acid, whilst with strong nitric acid, paranitrobenzeneazosalicylic acid is obtained.—Upon the collection and examination of the gases produced by bacteria from certain media, by W. C. C. Pakes and W. H. Jollyman. The strictly ærobic organism *Bacillus pyocyaneus* grows in media containing 1 per cent. of potassium or ammonium nitrate under anærobic conditions; the authors conclude that the terms ærobic and anærobic must be extended so as to include the presence of oxygen in the form of nitrates. The gases produced by this organism from nitrated media contain nitrogen and small quantities of oxygen.—The bases contained in Scottish shale oil, by F. C. Garrett and J. A. Smythe. The basic mixture separated from Broxburn shale oil seems to contain no pyridine; α-picoline, $\alpha\gamma\alpha'$-trimethylpyridine, and $\alpha\beta$- and $\alpha\beta'$-dimethylpyridine were isolated from it.—On a simplified method for the spectrographic analysis of minerals, by W. N. Hartley and H. Ramage.

PARIS.

Academy of Sciences, November 19.—M. Maurice Lévy in the chair.—Note on the telescopic planets, by M. de Freycinet. The asteroids studied, 428 in number, appear to belong to eight independent rings, each of which, before breaking up into fragments, turned as one piece round the sun. This hypothesis as to their formation requires three conditions, all of which are shown to be fulfilled.—On the aërostatic observation of the Leonids, by M. J. Janssen. The observations from the balloons ascending from Paris were obscured by clouds, although an altitude of over 13,000 feet was attained. Observations at other stations were also spoiled by the state of the weather.—Sir Joseph Hooker was elected a Foreign Associate in the place of the late Prof. R. Bunsen.—Observations of the Leonid swarm at Meudon, by M. H. Deslandres. Only nine Leonids were seen on the two nights.—On some applications of non-euclidian geometry, by M. Servant.—On the summation of series, by M. Émile Borel.—On a new shadow analyser, by M. J. Macé de Lépinay. The new analyser may be used for any simple rays, and preserves its sensibility in convergent light. By applying a modification of Mouton's method, it is possible to measure easily thicknesses up to several centimetres with an accuracy of 0·14 μ.—On the electrocapillary properties of mixtures and electrocapillary viscosity, by M. Gouy.—The direct combination of nitrogen with the metals of the rare earths, by M. Camille Matignon. A mixture of the oxide of the rare earth with aluminium and magnesium is heated in a tube containing air and connected with a manometer. Under these conditions, with lanthanum, praseodidymium, neodidymium and samarium, the absorption of the oxygen and nitrogen is very rapid; with cerium and thorium the absorption, although complete, is slower.—Relation between the chemical constitution of the colouring materials derived from triphenylmethane and their absorption spectra in aqueous solution, by M. P. Lemoult. All the dyes examined gave in aqueous solution an absorption spectrum possessing a red luminous band, the centre of which was fixed in position ($\lambda = 6860$).—On blue chlorophylline, by M. M. Tsvett. By a particular mode of treatment, which is described in detail, the author has succeeded in obtaining crystals of a chlorophylline of a pure blue colour, apparently different from the phyllocyanine of Frémy and the chlorophyllines of Sorby and Gautier.—Cryoscopy of human sweat, by M. P. Ardin-Delteil. Normal sweat from a healthy man has an average freezing point of $-0^{\circ}\cdot24$ C. It may vary in individual cases between $-0^{\circ}\cdot08$ and $0^{\circ}\cdot46$ C., the oscillations being in great part due to the variations in the quantity of common salt contained in the perspiration.—On the development of *Sclerostomum equinum*, by M. A. Conté.—On the exosmosis of diastases by plantules, by M. Jules Laurent. Seeds during germination may give out a portion of the diastases necessary to the digestion of their food reserves, and thus utilise certain insoluble organic materials, such as starch, but the phenomenon stops when germination ceases.—Origin of an ochreous clay, characteristic of the red diluvium, by M. Stanislas Meunier.—The uses of transparencies for combining the effects of the synodic revolution with those of terrestrial rotation, by M. A. Poincaré.—Observations on the Leonids at Algiers, by M. H. Tarry.

CAPE TOWN.

South African Philosophical Society, October 3.—T. Stewart, Vice-President, in the chair.—The Secretary communicated a paper by Dr. R. Broom, on *Ictidosuchus primaevus, nov. spec.* The paper contained a description of the remains of a small Theriodont reptile from the Karroo Beds of Pearston. The form is specially interesting as illustrating a new Theriodont type, and one which has many affinities with the Dicynodonts.—Prof. J. T. Morrison read a paper on some periodical changes in the rainfall at the Royal Observatory, Cape of Good Hope, since 1841. Prof. Morrison dealt with the records of rainfall that have been kept at the Royal Observatory since the year 1841. These showed certain regularities attended by many apparent irregularities. The author subjected the records to the process of mathematical analysis discovered by Fourier, and so showed evidences of two sets of fluctuations running simultaneously through the monthly amounts of rainfall. These fluctuations completed themselves in approximately nine and ten years respectively. The question of the reality of these fluctuations was considered, and tested by comparing their effects in producing apparent fluctuations of slightly different times, such as the well-known sun-spot period of about eleven years. The agreement was such as to make it probable that the two first-mentioned fluctuations are the two prevailing periodicities. The approximate values of some of their part-periods had been computed, and the totals gave a fair approximation to all the more striking changes that have occurred in the rainfall at the Observatory from year to year for the last sixty years. The author concluded that the coincidences were sufficient to warrant a careful investigation of the exact times of the chief fluctuations, and a computation of the magnitude of their sub-periods. He intends to prosecute the research.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 29.

GOLDSMITHS' INSTITUTE CHEMICAL SOCIETY, at 8.30.—The Profession of an Industrial Chemist: Dr. J. Lewkowitsch.

MONDAY, DECEMBER 3.

VICTORIA INSTITUTE, at 4.30.—The Proceedings of the Congress for the History of Religion, Paris: Theophilus G. Pinches.

TUESDAY, DECEMBER 4.

SOCIETY OF ARTS, at 8.—Electric Oscillations and Electric Waves: Prof. J. A. Fleming, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be discussed*: Machinery for the Manufacture of Smokeless Powder: Oscar Guttmann.—*Papers to be read, time permitting*: The Signalling on the Waterloo and City Railway; and Note on the Signalling of Outlying Siding Connections: A. W. Szlumper.—Signalling on the Liverpool Overhead Railway: S. B. Cottrell.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Lantern Slides, Pastoral and Sundry: Colonel J. Gale.

ZOOLOGICAL SOCIETY, at 8.30.—On the Breeding Habits of *Protopterus Symnarchus*, and some other West African Fishes: J. S. Budgett.—On the Mammals collected during the "Skeat Expedition" to the Malay Peninsula 1899–1900: J. Lewis Bonhote.—On the Habits and Natural Surroundings of Insects and other Animals observed during the "Skeat Expedition" to the Malay Peninsula, 1899–1900: Nelson Annandale.

WEDNESDAY, DECEMBER 5.

SOCIETY OF ARTS, at 8.—Road Traction: Prof. H. S. Hele-Shaw, F.R.S.

GEOLOGICAL SOCIETY, at 8.—Bajocian and Contiguous Deposits in the Northern Cotteswolds: the Main Hill-Mass: S. S. Buckman.—On the Corallian Rocks of St. Ives (Hunts.) and Elsworth: C. B. Wedd.—The Unconformity of the Upper Coal Measures to the Middle Coal Measures of the Shropshire Coalfield, and its Bearing upon the Extension of the Latter under the Triassic Rocks: W. J. Clarke.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Examination of Extract o Malt: Dr W. J. Sykes and C. A. Mitchell.—(1) Note on the Estimation of Glycerine; (2) The Examination of Gum Resins: Dr. J. Lewkowitsch.—Note on the Occurrence of Barium in the Spring Water of Boston Spa: Percy A. E. Richards.—On the Analysis of Samarskite: Arthur G. Levy.

ENTOMOLOGICAL SOCIETY, at 8

THURSDAY, DECEMBER 6.

ROYAL SOCIETY, at 4.30.—*Probable* papers: The Histology of the Cell Wall, with Special Reference to the Mode of Connection of Cells. Part I. The Distribution and Character of "Connecting Threads" in the Tissues of *Pinus sylvestris* and other Allied Species: W. Gardiner, F.R.S., and A. W. Hill.—On the "Blaze Currents" of the Frog's Eyeball; Dr. A. D. Waller, F.R.S.—On a Bacterial Disease of the Turnip (*Brassica napus*): Prof. M. G. Potter.—The Micro-organism of Distemper in the Dog, and the Production of a Distemper Vaccine: Dr. S. M. Copeman.—On the Tempering of Iron Hardened by Overstrain: J. Muir.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows.—Santalenic Acid: A. C. Chapman.—Ammonium Bromide and the Atomic Weight of Nitrogen: A. Scott, F.R.S.—Interaction between Urethanes and Primary Benzenoid Amines: Dr. A. E. Dixon.—The Decomposition of Chlorates. Part III. Calcium Chlorate and Silver Chlorate: W. H. Sodeau.—Nitride of Iron: Gilbert J. Fowler.—The Heat of Formation and Constitution of Iron Nitride: Gilbert J. Fowler and Philip J. Hartog.—Relationships of Oxalacetic Acid: H. J. H. Fenton, F.R.S., and H. O. Jones.

RÖNTGEN SOCIETY, at 8.—Exhibition and Description of a Stereoscopic Fluoroscope and a New Rotary Mercury Break: J. Mackenzie Davidson.

LINNEAN SOCIETY, at 8.—On some New Foraminifera from Funafuti: C. Chapman.—On British Thrifts: G. Claridge Druce.

FRIDAY, DECEMBER 7.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Dock Gates: F. K. Peach.

GEOLOGISTS' ASSOCIATION, at 8.—The Zones of the White Chalk of th English Coast. II. Dorsetshire: Dr. A. W. Rowe.

CONTENTS.