THURSDAY, DECEMBER 10, 1903.

BUDDHISM IN INDIA.

Buddhist India. (Stories of the Nations Series.) By Prof. Rhys-Davids. Pp. xv + 332. (London: Fisher Unwin, 1903.) Price 5*s*.

THE keynote to Prof. Rhys-Davids's work on Buddhist India is to be found in his preface. He presents to us a picture of Indian social existence at the time when Buddhism first dawned on the world, avowedly depicted from the point of view of the Rajput rather than from that of the Brahmin. Nor is any apology needed for assuming this position. A history of England completed entirely from such references to its social and economic condition from time to time as might be found in the theological treatises of eminent churchmen would certainly not be regarded as satisfactory, and it is an immense gain to our power of realising past problems of Oriental life and civilisation that the learned professor should have been able to marshal so many points of valuable information from independent lay sources, and to give us new views from a new standpoint. He is at great pains to show the real position which the priesthood of India held in the seventh century A.D., when the world was ripe for Buddhism; and he deduces from an analysis of Pali writings (previous to the general adoption of Sanscrit as the classical language of literature) a very clear idea of early Brahminism in days when the alphabet, indeed, had long been introduced to India from Mesopotamia, but when "literature" existed in men's memories and not in the concrete form of manuscript. All this part of the book is excellent. We see the Kshatriyas—of the noble "colour" (not caste)—in their proper position of relative importance to the Brahmin, and the latter by no means enjoying that social status of dominant and arrogant priesthood which we have always been accustomed to regard as even more distinctive of early Brahminism than of the Brahminism of to-day.

The early Brahmin is now to be regarded as the thinker and learner, the philosopher and minister, ready to adapt his views to those of the public if necessary, with wide toleration seeking to preserve his influence by the adoption of elastic principles. His very gods changed with the times, and both free-thinking and free discussion were not only permitted, but encouraged to an extent probably unparalleled in the history of the world. The soul of the Upanishads had already become the one primeval world-soul from which all other souls emanated, when Buddhism arose; and the remarkable feature about this approximation to a great central truth was that it owed its existence, not to Brahmin philosophy, but to the conception of lay speculation. Thus Buddhism entered the world at the right psychological moment. The world of India at least was ready for it.

But deeply interesting as is this scholarly inquiry into the conditions of literature and religion which prevailed at the time of Buddha's birth, perhaps a little too much space in what is necessarily a crowded work has been devoted to it. It is true that we have graphic pictures presented to the imagination of village and town life, of social intercourse and the relations subsisting between the various grades of a society in which caste distinctions were real enough, but possibly not more pronounced than analogous distinctions in European countries at the same date; but they are restricted to Buddhist India, which was, after all, only a part of India, and we have very scanty glimpses of the relations existing between Buddhist India and the rest of the continent. Nor does the book much assist us to define the geographical boundaries of Buddhist India.

Buddhism was the paramount faith only at certain centres; these centres were far apart, necessitating long and weary pilgrimages from one to another. The earliest Buddhist records contain a "stock" list of the sixteen Powers which constituted Buddhist India, but this list is geographically deficient, for it ignores the whole of south India and Ceylon, and only deals with the area of northern India bounded by the Himalayas on the north, the Vindhyas on the south, the Ganges on the east, and the mountains beyond the Indus on the west. Undoubtedly the most remarkable feature about Buddhism is its absolute extinction in India, the land of its birth, at the hands of the Brahmins, and its extraordinary development in countries beyond India, where it is still a living and a proselytising faith. The connection between Buddhist India and the countries of the borderland, the gradual spread of the faith to the valley of the Kabul River and beyond Kabul to Bamian and Haibak; or to the Swat Valley and Dir, and over the Himalayas to the cities (now buried beneath the sand) of Khotan, would have been an interesting subject of inquiry, for it would illustrate the enormous influence of Buddhist India in the process of civilising the rest of Asia.

The apostles of Buddhism claim that it has been the greatest civilising agent in the world. It has left no mark in India—what has it done elsewhere? Long after the Mohammedan wave of conquest swept through Sind to the Punjab in the eighth century A.D. we know that a Buddhist province of Sind (called Bodh) still retained its infidel proclivities, and the capital of it (Gandhar or Kandhar) is not far from the Gandāva of to-day. Buddhist priests had ruled at Las Bela, where Buddhist caves are to be found near by. Was this the last stand made by Buddhism on the Indian side of the mountains west of the Indus?

There is a passage in the book which might be misunderstood. It is said of the fifteenth of the sixteen "Great countries"—or Powers—that

"Gandhāra, modern Kandahar, was the district of eastern Afghanistan, and it probably included the north-west of the Punjab. Its capital was Taxila."

Gandhāra *was* the north-west of the Punjab (as rightly shown in the little sketch map at the end of the book), but it had nothing to do with "modern Kandahar," or even with that other ancient Kandahar (or Kandhar) of which we have just spoken. It was the almost universal goal of the pilgrims from China who flocked in large numbers through the then open routes of Takla Makan in Chinese Turkesan, across

the Hindu Kush, and through the terrible passes and defiles of Darél to the lower Swat Valley and to the monasteries and monuments of the Punjab.

It would have been interesting, too, if something of the northern art of Buddhist India had been illustrated, as well as the sculptures of Sanchi. It is in the north that the Greek influence is so marked in sculptural art as to render it quite distinct in character from the rude and riotous productions of the indigenous artist of the south, probably educated in Hindu schools.

But it is impossible within the limits of a popular historiette to compass more than a cursory account of so astonishing a moral phenomenon in the world's history as the rise of Buddhism and its marvellous outspread; or to present a view of Indian existence other than that which marked certain phases of its career. Prof. Rhys-Davids has done invaluable service in illustrating the earliest phase of Buddhist inception, and in giving to the world a far more lucid idea of the character of the three great Buddhist kings and heroes —Chandragupta, Asoka, and Kanishka—than is to be found elsewhere in the popular literature of the day. For it is only a great scholar who could have done this so well.

The work is scholarly throughout, as well as popular, and fully maintains the high standard of the fascinating series of "stories" of which it forms a noteworthy unit.

ACETYLENE.

Acetylene: its Generation and Use. By F. H. Leeds and W. J. A. Butterfield. Pp. x+276. (London: C. Griffin and Co., Ltd., 1903.) Price 5*s.* net.

THE steady advance made during the past few years by this beautiful illuminant fully justifies the production of the practical handbook which Messrs. Leeds and Butterfield have now placed before the public.

In this work they have described and explained the physical and chemical phenomena attending the generation and combustion of the gas, and also its employment in the various directions in which it has of late been used.

The subject is thoroughly dealt with, and the book contains an enormous amount of information and common-sense advice, the only general criticism that can be urged against it being, perhaps, that of the occasional repetitions which are inseparable from dual authorship.

In the introductory chapter, whilst considering the advantages of acetylene as an illuminant, the authors deal with a point which, up to the present, has been too much overlooked with regard to illumination by flames, and that is the importance of the action that these have in burning up and destroying considerable quantities of the organic impurities present in the air of an inhabited room, a function which is of the utmost importance, and the absence of which is a considerable factor in the unpleasant nature of the atmosphere often found in rooms lighted by incandescent electric lamps.

An interesting feature is also to be found in the authors' attempt to compare the relative merits and cost of lighting by various illuminants on the basis of illuminating effect rather than illuminating power. That this difference does exist as a most important factor in illumination has long been recognised, and a moment's consideration will convince anyone that although a particular burner may yield a light of 25 candles, it will not be in any way equivalent in its power of effectively lighting a room to 25 candles distributed over the area of the room. If a satisfactory unit of comparison and an accurate method of determining the results could be obtained, this method of comparison would offer enormous advantages over the ordinary photometric method.

In compiling the table the authors have taken as the standard of a well-lighted room the being able to read with ease ordinary print in every part of it, but it is clear that so much depends upon the personal factor that whilst one observer may look up a train in Bradshaw with ease and comfort, another might find a difficulty in dealing with fair-sized print, and on such a basis it is hard to found a satisfactory unit of comparison.

In dealing with the physics and chemistry of the actions taking place between carbide and water in the generation of acetylene, the whole question is very carefully and thoroughly treated, but in referring to the power of water in dissipating the heat generated during the action, a little too much stress is laid on the power of water in keeping down the temperature. The statement that

"if an excess of water is employed in an acetylene generator the temperature inside can never, except quite locally, exceed 100° C. however fast the carbide be decomposed"

is although perfectly correct, a little misleading. The importance of reducing the temperature in an acetylene generator to the lowest possible point is to prevent the formation of certain compounds which afterwards give rise to trouble in the consumption of the gas, and with a large generator of the type in which carbide is fed into water, although the water may be in very large excess, it is by no means unusual to find in the centre of the decomposing mass on the bottom of the apparatus a temperature capable of melting lead, this being due to the fact that when the carbide is fed in in large quantities, a crust of lime forms on the outside of the mass which becomes toughened by tarry products formed by the heat on the acetylene generated in the interior of the mass, and this partly by acting as a non-conductor and partly by keeping the carbide away from the large excess of water, allows an undue rise of temperature, and the acetylene generated is found as a result to contain considerable amounts of products of polymerisation.

In referring to the combustion of acetylene and its illuminating power, the authors conclude that it would be clearer to state the illuminating power of acetylene as 48 candles per cubic foot, rather than by accepting the arbitrary nomenclature of gas photometry to speak of it as 240 candles, inasmuch as in determining the illuminating power, the gas has to be burnt at the rate best suited for developing its light-giving properties, and the results so obtained calculated to a consumption of 5 cubic feet.

It is not clear, however, that the statement of 48 candles per cubic foot would not be equally misleading, as the light emitted from good acetylene burners varies enormously with the rate at which the gas is consumed, so that with small burners the illuminating value of the gas is rarely more than 20 candles a foot, whilst with 1-foot burners it is a remarkably good burner that gives 42 candles per cubic foot of gas consumed.

In referring to the formation of carbonaceous growths at the burner tips, the authors point out that although this has been put down to the action of heat on polymerisation products in the acetylene, yet that if this were the case the trouble should disappear entirely if the gas were washed with heavy oil before entering the burners, this procedure, however, not giving entire freedom from the trouble. In this criticism, however, they evidently overlook the fact that not only does polymerisation of the acetylene take place where there has been undue heating in the generator, but that no matter how thoroughly the gas may be purified before reaching the burner, a further, though small, polymerisation will take place in its flow through the heated steatite tips at which it is burning, and that the trace of benzene so formed is quite capable of giving the trouble.

The practical details given as to size of pipes and other points upon which little or no knowledge exists amongst generator makers are of the greatest value, and the book may be most heartily recommended to all interested in the production and use of acetylene.

THE TSETSE FLIES.

A Monograph of the Tsetse Flies (Genus Glossina, Westwood). Based on the Collection in the British Museum. By E. E. Austen, with a Chapter on Mouth-Parts by H. J. Hansen, Phil. Doc. Pp. ix+319. (London: Printed by Order of the Trustees, 1903.) Price 15*s*.

SOME fifty years ago J. O. Westwood gave a description of a "destructive species of dipterous insect known under the name of Tsetse," and referred it to the genus Glossina, first established twenty years previously by Wiedemann. From that time onwards references to the tsetse fly and its association with a mysterious disease fatal to horses, cattle, and other animals become very numerous in the writings of travellers and naturalists, and various were the theories propounded to explain the relation of the fly to the disease. Drysdale, in 1879, seems to have been the first to suggest that the tsetse fly disease might be of an infective nature, the infecting agent being conveyed by the bite of the fly. In 1895 and 1897 the well-known reports of Lieut.-Colonel Bruce appeared. He described the tsetse fly disease or nagana met with in Zululand, and established the fact that it is due to a protozoan blood parasite, the *Trypanosoma Brucei*, which is conveyed by the bites of the tsetse fly from affected to healthy animals. As horses and cattle are unable to exist in the districts inhabited by the fly, the problem of transport in these "fly belts" is a serious one, and the tsetse fly and its distribution have assumed great economic importance. In India and Burma there is a similar, if not identical, disease known as surra, which is also conveyed by a biting fly, perhaps a species of Stomoxys.

Within the last few months evidence has been accumulating, through the work of Castellani, Bruce and others, that sleeping sickness, the ravages of which have assumed alarming proportions, may be caused by a trypanosome (*T. Castellanii*) attacking the central nervous system (see NATURE, vol. lxviii. p. 116).

From analogy with nagana and other facts (see NATURE, vol. lxix. p. 34) it would seem probable that a tsetse fly conveys the infection in this disease, and therefore that measures of prevention and extermination directed against the fly might stamp out sleeping sickness. Other diseases also, *e.g.* trypanosoma fever, are caused by species of trypanosomes, and these, too, may very likely be conveyed by tsetse flies.[1]

In view, therefore, of the practical importance of an accurate knowledge of the genus Glossina, the Trustees of the British Museum have been well advised to publish this monograph upon the tsetse flies, the preparation of which has been entrusted to Mr. Austen. We may say at once that Mr. Austen has produced a work which must for some time remain the standard one upon the subject. He gives both a popular and a scientific description of the flies, a full bibliography with copious abstracts, the whole being illustrated with many figures in the text, with a map showing the geographical distribution, with beautiful coloured plates of the seven known species from drawings by Signor Terzi, and with two plates of the mouth-parts of Glossina and Stomoxys. The latter, together with a description, are by Dr. Hansen, and will enhance the value of the volume to the dipterologist.

In the first place it is to be noted that, although the term "the tsetse *fly*" is usually employed, there are at least seven species, so that "tsetse" becomes a *generic* rather than a specific name. By some the original *Glossina morsitans* has been called the "true tsetse." The name "tsetse" is of obscure origin, but is certainly onomatopoetic, derived from the peculiar buzzing sound made by the fly on the wing. The tsetses are confined to Africa, are always met with in the neighbourhood of water, and are often restricted to peculiarly well-defined tracts of country. Mr. Austen's description of them may be reproduced here, since NATURE may reach many who may not have access to this monograph:—

"The tsetses are ordinary-looking sombre brownish or greyish-brown flies varying in length (excluding the proboscis) from 3½ to 4⅝ lines (7½–10 mm.) in the case of *Glossina morsitans* to about 5½ lines (11½ mm.) in the case of *Gl. fusca* or *longipennis*, with a prominent proboscis in all species. The hinder half of the body, or abdomen, in the best known species, though not in all, is of a paler colour and marked with sharply defined dark brown bands, which are interrupted on the middle line; the abdomen, however, is invisible when the insect is at rest, as it is then concealed by

[1] Since the above was written, a further report on sleeping sickness by Col. Bruce has been issued. In this much additional evidence is given of the correctness of these views of the nature of sleeping sickness and of its transference by a tsetse. Trypanosoma fever may be the early stage of sleeping sickness.

the wings. . . . In *the resting position* their identification is easy. In this attitude they can be distinguished from all other blood-sucking Diptera . . . by the fact that the brownish *wings lie closed flat over one another down the back*, like the blades of a pair of scissors, while *the proboscis projects horizontally in front of the head*" (p. 3)

There is one peculiarity of *Gl. morsitans* that may be noted, viz. it does not lay eggs as do the majority of the Diptera, but extrudes a yellow-coloured larva nearly as large as the abdomen of the mother. Whether this process is the same in all species has yet to be determined. Of the seven species of tsetse described, one (*Gl. pallidipes*) is new, and appears to be the East African representative of *Gl. longipalpis*. The work concludes with some valuable appendices of information from travellers, Government reports, the reports of Colonel Bruce and others.

When the transmission of malaria by the mosquito was proved, the authorities of the British Museum rose to the occasion and published the magnificent monograph upon the Culicidæ by Mr. Theobald; again they have not disappointed us. In conclusion we would direct attention to the series of models in the entrance hall of the Natural History Museum of the trypanosome and tsetse fly, and of the malaria parasite and mosquito; they should be studied by all who may have the opportunity of increasing our knowledge of these and other tropical diseases.

R. T. H.

METALLURGY OF STEEL.

Hardening, Tempering, Annealing, and Forging of Steel. By Joseph V. Woodworth. Pp. 288. (Westminster: Constable and Co., Ltd.) Price 10s. net.

TO students who have ploughed through the weary sands of recent steel literature, Mr. Woodworth's book will appear somewhat in the nature of an oasis in the desert. The author does not appear to be versed in the "ites" of metallography, or fully to have grasped the allotropic theory of hardening, but, nevertheless, he does thoroughly understand tool-steel. Authors of papers on the restoration by heat treatment of faulty steel will hardly be prepared to acquiesce in a statement made by Mr. Woodworth on p. 18 of his book, namely,

"Heating for forging is, in its way, quite as important as heating for hardening; care and uniformity in the application of heat in the first instance is very essential. Should the steel be over-heated in this process, no amount of care afterwards will restore the steel to its former state or remedy the evil."

With the words above quoted everyone who has had an extensive practical experience of steel metallurgy will be more than inclined to agree.

On p. 24 attention is directed to the fact that steel as delivered from the manufacturer is always more or less decarbonised on the surface.

"For this reason, do not select a piece of steel which will just 'skin' up, but take a piece large enough to require taking a good-sized cut before reaching the finished surface."

This is good advice, not only to mechanics, but also to scientific men making researches on the magnetic properties of steel. Mr. Woodworth, in concise and lucid terms, deals at considerable length with the machining, hardening, and tempering of nearly every class of steel tools, and the value of his letter-press is enhanced by a series of admirable illustrations (chiefly in perspective) of turning tools, taps, reamers, and an excellent set of milling cutters.

A brief illustrated article on muffle furnaces (pp. 92–94) is well worth the attention of British artisans, as showing American practice, which is, on an average, undoubtedly superior to that obtaining in this country.

That portion of Mr. Woodworth's book dealing with the manufacture of dies and of drop forgings must necessarily be interesting to British manufacturers and workmen, because America was the birthplace of drop forgings, which were first manufactured by Colonel Colt, of revolver fame, in 1853.

Another feature of the work now under review is the fairly complete and beautifully illustrated chapter on the emery-grinding of steel tools. Mr. Woodworth advocates as the highest type of forgings material which has been quenched in oil and subsequently tempered to remove contraction stresses. The views he expresses have already found favour with many experienced British steel metallurgists.

On p. 162 Mr. Woodworth leaves, for the time being, a branch of steel metallurgy in which he is evidently a past master, and becomes controversial on the well-worn argument of steel *v.* wrought iron forgings. In deciding upon the superiority of steel, the author perhaps a little overdoes it, and his quotation from the report of the American Government tests on alternating stresses will hardly convince steel metallurgists who have closely studied this matter.

The tests he quotes show that wrought iron is capable of enduring only 50,000 alternations. Steel, with 0·25 per cent. of carbon, endures, before fracture, 229,000 alternations, whilst steel with 0·45 per cent. of carbon sustains almost a million alternations. The author considers that these figures

"have given engineers an idea of the comparative endurance of wrought iron and steel in such service as that to which crank-pins, shafting, &c., are subject."

Had Mr. Woodworth seen a verbatim report of the trial to decide the cause of the disaster on H.M.S. *Bullfinch*, which occupied several days at the King's Bench in the summer of 1902, he would probably have expressed a much modified opinion on the question at issue. Broadly speaking, the connecting rods of the *Bullfinch* were of the higher carbon limit just quoted; the rods of H.M.S. *Snapper* contained about the lower limit mentioned, namely, 0·25 per cent. of carbon. The rods of the *Bullfinch* snapped on her trial trip, causing lamentable loss of life. Those of the *Snapper* were taken out intact after the destroyer had run her trial trips and been four years in commission.

An interesting portion of this book is the description of the Taylor-White process, which was the pioneer of those steels known as "speedy-cut," but quite naturally Mr. Woodworth does not specially direct

attention to the fact that since the inauguration of this process its product has been distinctly eclipsed by steels manufactured in several famous Sheffield works.

Mr. Woodworth's book has been written by an able man, thoroughly interested in his craft, and it is to be hoped that it will find its way into the hands of a large number of British artisans.

J. O. ARNOLD.

OUR BOOK SHELF.

Macedonian Folklore. By G. F. Abbott, M.A. Pp. xii+372. (Cambridge: University Press, 1903.)

THIS somewhat dainty little volume on Macedonian folklore, with its blue and white binding, will be welcomed by many readers, first, because the print and paper are good, and next, because the work is pleasantly written, and every paragraph is of interest. The results collected in the work before us by Mr. G. F. Abbott, of Emmanuel College, Cambridge, are the fruits of a series of researches into the folklore of the Greek-speaking parts of Macedonia, carried on by the author under the auspices of the electors to the Prendergast studentship of the governing body of Emmanuel College, Cambridge, and there can be no doubt that the materials here gathered together amply justify the selection of Mr. Abbott for his mission by the powers that be.

The reader or student who is familiar with the sound and solid work of Prof. E. B. Tylor, and the wonderful volumes of his friendly rival, Mr. J. G. Frazer, will not expect to find in this monograph the vast knowledge and mature thought which are so characteristic of the works of these eminent scholars, but it is pleasant to see that the influence of both of them is visible in Mr. Abbott's treatise, and we therefore look forward to other works from his pen with confidence. "Macedonian Folklore" contains nineteen chapters, six appendices, and an index; the last-named section is very short, and we think it should have been made fuller. After a short description of the sources of the facts which he prints, and a narrative of some amusing personal experiences, Mr. Abbott proceeds to deal with the folklore of the Macedonian year, which he treats in four chapters. Many of the saws are familiar enough to us in other forms, but there are several auguries and prophecies about the weather which are worthy of note for comparative purposes.

The section on divination is of considerable interest, and it seems that the Macedonians divine by means of coffee, instead of by tea as Europeans in the west do. The expert will have no difficulty in tracing a connection between some of the divination practices here described with those of many nations, but there are many which have no parallels among other peoples, so far as we know, and these, of course, form one of the most valuable parts of Mr. Abbott's book.

The chapters on birth, marriage, and funeral rites are lengthy, but very interesting, and the numerous extracts which we have from the songs of the people enable us to judge of the accuracy of the deductions set forth in them. The original Greek is given, in all cases, with an English translation, and this plan is a handy one and one to be commended. We cannot refer to details, for want of space forbids, and we therefore pass on to mention the chapters on Alexander the Great and Philip in folk-tradition, to the series of pretty bird-legends which are printed on pp. 291–294, to notes on the game of morra, fire-ordeal, the perils of portraiture, &c., and to the collections of riddles, mystic poems, love-couplets, &c., which bring the book to an end. Mr. Abbott's contribution to the science of Macedonian folklore is opportune, and the modesty of the work and the care with which it has been performed merit praise.

Practical Physics for Schools. I. Mensuration, Mechanics, and Hydrostatics. Pp. 72. II. Light and Heat. Pp. 79. By C. J. L. Wagstaff, M.A., and G. C. Bloomer, B.A. (Cambridge: W. Heffer and Sons, 1903.) Price 1*s.* 6*d.* each.

THE authors say in their preface that these notes have been used for the teaching of practical physics at the Bradford Grammar School during the last three years, and the presumption is that experience has proved their usefulness and suitability. An examination of the volumes, however, suggests that the notes have in practice probably been supplemented by judicious additions by the teachers, or the results of the instruction would have been less satisfactory. The volumes contain no illustrations to show pictorially the arrangements of the apparatus described; one page only seems to be devoted to the plotting of curves, and on this page there is by no means enough explanation to explain to a young student the method and meaning of such graphic representation; and, more than this, under the section Boyle's law, the pupil is instructed to plot a curve connecting P and 1/V, and in another place to plot a curve connecting the square root of the length of a pendulum and the time of swing, though the only remarks on curve plotting, instead of preceding these instructions, follow in another experiment. In several places, too, the verbal instructions seem inadequate to the needs of beginners. In describing the screw gauge the authors content themselves by saying that the zero error must be ascertained carefully, and give no directions as to how this should be done. The account of the vernier is similarly too brief. To secure the best results in a physical laboratory the student should be in possession of directions explicit enough to avoid the waste of time caused by waiting for the master to arrive to clear up a difficulty, and these directions should be obtainable from the book or be given in a preliminary demonstration. Notwithstanding the remark of the authors that experimental work in sound is only suitable for a later stage, there are many experiments in this branch of physics that interest young people and are understood by them. On the whole, however, the course is comprehensive and generally in accordance with the experience of good laboratory practice.

Flora of the Upper Gangetic Plain and of Adjacent Siwalik and Subhimalayan Tracts. Vol. i., part i. By J. F. Duthie, B.A., F.L.S. Pp. xvii + 403. (Calcutta: Office of the Department of Government Printing, 1903.) Price 15*s.*

IT is only by a very liberal interpretation of the term that this book can be referred to as a *local* flora, seeing that it deals with an area of 196,000 square miles, which includes not only the North-West Provinces up to the Subhimalayan slopes, but extends southwards to the Vindhaya Mountains, and thus takes in portions of some dependent States. But as a comparative term, when contrasted with Sir J. Hooker's "Flora of British India," the expression has been applied both to this flora and also to Dr. T. Cooke's "Flora of the Bombay Presidency." A very satisfactory feature of the book is the facility which is offered for obtaining information quickly and easily. A synopsis of the natural orders is given, arranged on principles similar to those which are so well known from Hooker's "Student's Flora," arrangement being based primarily on the characters of the ovary. For each order and genus full descriptions and determining keys are provided, and for the species references, synonyms, locality

and distribution are added. These, in conjunction with a glossary of terms, render the book available to everyone possessed of an elementary knowledge of botany. In addition to the descriptive text, Mr. Duthie has collected into the notes appended to the species a vast amount of information dealing with the identification and economic uses of the plants, both indigenous and cultivated. A perusal of the book not only serves to indicate how large a proportion of the Indian plants possess valuable properties, but also cannot fail to impress one with the comprehensive knowledge which has been acquired by the assiduous work of the author and other botanists in India who have occupied similar responsible positions. This part includes the orders Ranunculaceæ to Cornaceæ; the first volume will extend to the Campanulaceæ, and two volumes will complete the work.

A Laboratory Guide to Qualitative Analysis with the Blowpipe. By F. W. Martin, Ph.D. Pp. iv+47. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 2*s.* 10*d.*

THE author regards the restricted employment of the blowpipe in analysis as due to the lack of a convenient manual or work of reference, which this modest little volume of fifty pages is now intended to supply.

It may be questioned whether, in a well-equipped laboratory, the use of the blowpipe as a delicate instrument for qualitative analysis will supersede other methods. For the mineralogist, and especially for the mining prospector, the classic of Plattner-Richter, which has been translated into English by Cornwall, will always hold its place.

There is nothing in the present volume to call for special notice. The matter is very condensed, occasionally at the risk of becoming confused. This is a description of a coal gas flame:—"Its luminosity is due to superheated, separated carbon set free from acetylene, an easily decomposed gas, which is formed from other hydrocarbons composing the gas used as fuel by the heat of combustion in the outer envelope." One is accustomed to the American spelling of "luster," "vapor," &c., but the omission of the final e in "oxid," "sulfid," "chlorid," &c., if intentional (*oxide* also occurs), is un-English.

J. B. C.

Elementary Experimental Science. Physics. By W. T. Clough. *Chemistry.* By A. E. Dunstan, B.Sc. Pp. vi+239. (London: Methuen and Co., 1904.) Price 2*s.* 6*d.*

THE course of work provided in this little book is intended for young beginners who propose to present themselves for examinations of the standard of the University Junior Locals. The book aims at supplying the necessary general information, and also sufficiently explicit instructions for laboratory work. In the physics section 157 experiments are provided, and in chemistry there are 110, but a number of them are more suitable for lecture demonstrations than for laboratory exercises. A pupil who works through the book, performing the more important of the experiments given, cannot fail to obtain a fair knowledge of the fundamental principles of physical and chemical science.

Notes from a Lincolnshire Garden. By A. L. H. A. Pp. 93. (London: Elkin Mathews, 1903.) Price 2*s.* 6*d.* net.

THESE notes are chatty, interesting, and intelligent. The writer loves the garden and everything that happens in or near it. The book is an instance of the humanising effect of nature-study undertaken for the love of the subject. The little book may be recommended to all lovers of country gardens.

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.*]

Heating Effect of the Radium Emanation.

IN a letter to NATURE of November 5, Prof. Schuster has made some remarks on a letter published by us the week previously, containing a brief account of some experiments to show that the heating effect of radium is temporarily reduced by the removal of the emanation, and that the tube containing the emanation separated from the radium shows a considerable heating effect.

The difficulty felt by Prof. Schuster apparently arose from the fact that we included in the heating effect of the emanation not only that due to the emanation itself, but also that due to the secondary products to which the emanation gives rise. It was an oversight on our part to have omitted in the sentence "more than two-thirds of the heating effect is not due to the radium at all, but to the radio-active emanation which it produces from itself," the words "together with the secondary products to which the emanation gives rise." We were fully aware that the heating effect was in part due to the "excited activity" produced by the emanation. We specially mentioned the gradual decay of the heating effect of radium to a minimum in the course of a few hours, and the increase of the heating effect of the emanation tube during the same period. These effects are connected with the gradual decay and rise, respectively, of the excited activity produced by the radium emanation. The results would have little meaning if we believed the heating effect was due to the emanation alone, for, as Prof. Schuster quite correctly points out, the heating effect in such a case should at once drop to a minimum after removal of the emanation, and the heating effect of the tube containing the emanation should not at first increase.

On account of the rapid rise of the excited activity in a tube containing the radium emanation, the separation of the heating effect of the emanation from the complicated secondary changes which result from it is a difficult experimental problem.

Our letter was merely a preliminary announcement of the results of our experiments. It is not possible to discuss the consequences to be deduced from the experiments without entering into a detailed description of the measurements. We hope to publish shortly a full account of our work on the various heating effects.

McGill University, November 20.

E. RUTHERFORD.
H. T. BARNES.

The Pearl-Oyster Parasite in Ceylon.

MR. JAMES HORNELL, who is still in Ceylon carrying on the investigation of the pearl-oyster fisheries which I started in 1902, tells me in a letter just received that he has now succeeded in finding the final stage of the cestode larva which we found to be the nucleus of the best Ceylon pearls. We found this larva (a Tetrarhynchus), in the spring of 1902, in the pearl-oyster, and, later on, what we took to be its later stages in the file-fishes (Balistes) which feed upon the pearl-oysters, and we felt pretty certain (as I stated in the first part of my report, now published) that the adult would be found in Trygon or some other large Elasmobranch. Mr. Hornell writes from Trincomalie, November 16, as follows:—"Just a line to tell you that I have found the final host of *Tetrarhynchus unionifactor*.[1]

"It occurs, as surmised, in one of the large rays—a Trygon, I believe, but I have no work on fishes, and cannot identify at present.

"There is, I believe, practically no doubt as to species, in the stomach of the ray being two Balistes entire, and apparently just devoured, and plenty of bones. In the folds

[1] The name we gave to this Tetrarhynchus larva in our notes and letters until it was ascertained whether the species was known or new.—W. A. H.

of the spiral valve various Tetrarhynchids, *mature*, of two sizes—I fancy of [two] species—which bears out Shipley's belief of 2 species being in Balistes. In the stomach a larval Tetrarhynchid just where a larva should be—the adults being further along the canal."

The rest of the letter, hurriedly written to catch the mail, refers to other matters.

Mr. Arthur Shipley, who is writing a joint paper with Mr. Hornell on the parasites of the pearl-oyster for my report, will no doubt discuss the matter fully later on, when he has examined the specimens, but it is, I think, only due to Mr. Hornell, who is working most energetically in the wilds far from books of reference or any other scientific help, that his interesting announcement should be made public as soon as possible. W. A. HERDMAN.

University, Liverpool, December 9.

The Late Leonid Meteor Shower.

SUSPECTING that the tail or following segment of this swarm, owing to its enormous length, might be outside the sphere of influence of Saturn in 1870, and Jupiter in 1898, the writer kept watch as follows to see how far this suspicion might prove to be correct :—

Friday morning, November	13,	... ...	...	Overcast
Saturday ,,	,,	14, 3 to 4 ...	...	No Leonids
Sunday ,,	,,	15, 12 to 2.30	...	2 Leonids
		5 to 5.30	...	No Leonids
Monday ,,	,,	16, 12 to 4.15	...	Intense shower
Tuesday ,,	,,	17, ...	...	Overcast
Wednesday ,,	,,	18, 5 to 5.30	...	3 Leonids

One of the two Leonids observed at about 12.30 on November 15 diverged with a long, slow motion from Zeta Leonis to below the stars Nu and Zeta, Ursa, giving one the impression of its being an almost "end on" one from near the radiant, while the other, at about 2 a.m., passed high up on the right with a bright flash or streak. A further short watch was kept from 5 to 5.30 with no results; hence the conclusion that the shower would be of no very imposing character. This, however, proved to be incorrect, as on the following morning, November 16, at 12.30, a bright flash overhead, and shortly afterwards two fine meteors diverging right and left from a point near Zeta inside the Sickle, indicated increased activity.

The display rapidly increased, the meteors coming apparently in little flocks or shoals, the majority from an area of, say, 6 degrees by 3 degrees along Leo, with an hourly rate which he estimated as high as from 80 to 100, but this would seem to be below the mark. Between 3 and 4 a.m. several bright meteors diverged upwards and downwards from the Sickle, thus enabling him to fix the radiant as close by its old position at 149°+22°. The following morning, November 17, was overcast, but the radiant was still active on November 18, one of the three Leonids observed radiating upwards over Eta from within the Sickle as usual. A remarkable feature was that many of the meteors diverged upwards towards the S.W., whilst others diverged downwards N.E., as if conforming to the ecliptic, an appearance which may have been due to the rotation of the earth, and had been noticed before in connection with other well-known showers. Many of the larger meteors lit up the atmosphere with fine, bright, steel-like flashes.

At 4.15 the sky became overcast, but as he turned in he could still see meteors falling in the west and north-west, and it would appear, from observations made elsewhere, that the maximum occurred during the next two hours, *i.e.* from 4 to 6. It may here be remarked that this shower seemed in previous years to be at its best about an hour or so before daylight, owing, no doubt, to its then high altitude.

Altogether, the display was much above the average, and would appear to have justified the anticipation that the tail end held on its course. At any rate, we get another glimpse into the mechanics of a meteor stream, and more particularly into that of the Leonid, and the distribution around the orbit of the latter, should it still intersect the path of the earth, is a question for the future.

W. H. MILLIGAN.

2 Barronville, Holywood, Co. Down, November 30.

MR. HENRY'S letter in your issue of November 26 contains several notable points which confirm my own observations. Being engaged on other work (which entailed long spells within the observatory and the dark room) throughout the night of November 14 and early morning of November 15, I noticed only a few meteors, and, as the sky became overcast here at 4.45 a.m., it is evident that, according to Mr. Denning's account, observations of the maximum display were impossible at South Kensington.

However, on the early morning of November 16, 2.15–3.50 a.m., my watch was rewarded by the appearance of more than fifty Leonids, some of which were exceedingly bright and lasting. Facing the south-east, I had familiar constellations (Orion, &c.) in the field of view, and was consequently able to record the trails among the stars with a fair amount of certainty.

The most striking point on which Mr. Henry's observations are confirmed by mine is that there were decidedly *two* apparent separate radiants, the one very near to, or coincident with, that given by Mr. Denning in NATURE for November 12, and another, from which quite half of the observed meteors seemed to emanate, at about R.A. = 145°, Dec. = +17°. Several Leonids with short trails were seen quite near to "the Sickle," and indicated by their direction the existence of this second radiant point. One long-trail Leonid occulted ξ Geminorum, and if the trail had been prolonged (it stopped short about two or three degrees from Betelgeuse) it would have passed between α, γ, and λφ Orionis. The majority of the meteors observed by me passed from the direction of Leo towards Gemini, Orion, or Canis Minor. WILLIAM E. ROLSTON.

Solar Physics Observatory, South Kensington, S.W., December 5.

Weather Changes and the Appearance of Scum on Ponds.

SOME years ago I also observed the phenomenon of a sudden appearance of scum on the surface of a pond similar to that mentioned by "Platanus orientalis" in NATURE, November 5.

The explanation, however, given by Dr. Mill in the same number of NATURE, namely, that the appearance of scum is occasioned by an accelerated flow of springs rising through the chalk of the floor of the pond, does not apply to the case which I have observed. That pond had no springs of the kind, but was fed by a very small and slow creek emptying into the pond at its upper extremity. Although the pond was pretty large, the scum did not appear near the inlet only, but all over the pond at the same time.

I wish to offer the following explanation of the phenomenon so far as it came under my observation, and I am inclined to believe that it applies to the case of "Platanus" just as well.

Our pond was very rich in marsh gas, a fact which could be easily ascertained by thrusting an oar into the soft bottom, when large bubbles of this gas would come to the surface. Now it is quite natural that this gas, slowly generated as it is, within the layer of decaying vegetable matter at the bottom of the pond, will gather in little bubbles, and these in turn will rise, provided they have acquired a sufficient buoyancy to break through their mouldy matrix, tearing off and carrying some of the solid matter up to the surface.

Ordinarily, this will take place all the time at regular intervals, but at a very slow rate, and would, therefore, escape observation. In time of a sudden fall of atmospheric pressure, however, the case is different. Then all the gas bubbles which are more or less ready to rise under normal conditions will suddenly expand and rise simultaneously, carrying upward not only a few isolated particles, but entire layers of soft material. I have often observed this very phenomenon, although I failed to notice the atmospheric condition at the time.

The material itself which was thus thrown to the surface consisted, so far as I can recollect, of black-brown vegetable matter, derived chiefly from leaves that had fallen into the pond, and of a green slime, consisting of numerous algæ.

FRED. J. HILLIG.

St. John's College, Toledo, Ohio, U.S.A.

SOME SCIENTIFIC CENTRES.

VI.—THE CAVENDISH LABORATORY.

SINCE its foundation, the Cavendish Laboratory of Cambridge has held a very prominent position, not only as the home of the teaching of physical science in one of our great universities, but also as the centre of a vigorous and prolific school of scientific research. The history of the laboratory must always be intimately associated with the scientific labours of the three distinguished holders of the chair of experimental phyics in the University of Cambridge, J. Clerk Maxwell, Lord Rayleigh, and J. J. Thomson, each of whom, in his own direction, has exerted an unusually marked influence in the advance of physical science.

The laboratory is of relatively recent foundation in comparison with some of our older scientific centres like the Royal Institution, but yet it may claim to be one of the first of those modern laboratories which have now sprung up in almost all the larger universities where adequate provision is made for the advancement of scientific research as well as for the teaching of science. In 1870 the Duke of Devonshire, who was then chancellor of the university, signified his desire to build and equip a physical laboratory for Cambridge. In his capacity as member of the Royal Commission of Education, he had recognised the value of such an institution. The chair of experimental physics was founded as a result of this offer in 1871, and in the same year James Clerk Maxwell was appointed to the position. It was enacted that it should be "the principal duty of the professor to teach and illustrate the laws of Heat, Electricity, and Magnetism; to apply himself to the advancement of the knowledge of such subjects; and to promote their study in the University."

For several years after his appointment Maxwell was occupied in designing and attending to the construction of the laboratory, and equipping it with suitable apparatus. The building was not ready for work until 1874, when the chancellor of the university formally presented his gift to the university.

The laboratory is an unpretentious solid three story building of stone. At the present time the ground floor is taken up partly by a series of rooms devoted to research and by a large and admirably equipped workshop and a small battery room. One of these rooms was for many years used by Dr. Glazebrook, secretary of the British Association Committee of Electrical Standards, as a standardising laboratory, and here were kept the electrical standards of the Association. On the walls, as one ascends the stone stairway, hang a painting of the founder, a picturesque print of Cavendish, that eccentric man of science who did such admirable electrical work more than a century ago, a small painting of Maxwell, and fine enlarged photographs of Lord Rayleigh, Sir George Stokes, and Lord Kelvin. The first floor is occupied by a large laboratory for practical work, a lecture and preparation room, and a neatly arranged apparatus room. Here are kept some scientific apparatus of unusual historic interest, including the original British Association revolving coil, with which the first determination of the value of the ohm was made, the revolving coil used by Lord Rayleigh for the same purpose, and the oscillation apparatus used by Maxwell in his determination of the viscosity of gases. Among many other pieces of apparatus devised by Maxwell may be mentioned his model for illustrating the induction of electric currents, and spinning tops and plaster casts made by his own hands to illustrate Willard Gibbs's heat surfaces. The second floor consists of a laboratory devoted to advanced practical work and four research rooms. In 1896, on account of lack of accommodation, another wing was built to the laboratory. This includes a large well-lighted laboratory devoted to the practical work in physics of the medical students, a small lecture room, several smaller research rooms, and a basement which can be used as a constant temperature room.

The laboratory, at the time of its foundation, was one of the largest and best equipped then in existence. The fame of Maxwell immediately attracted round him men eager to undertake research under his guidance. Among others, it is interesting to recall the well-known names of Chrystal, Garnett, W. D. Niven, Schuster, and Gordon. One of the first pieces of important research undertaken in the laboratory was a verification of Ohm's law by Chrystal. The experiments of previous observers and Weber's theories had thrown doubt on its validity, but Chrystal showed that the law held with great accuracy over a wide range, and he was able also to explain the apparent discrepancies observed by others. Maxwell himself during his tenure of the professorship was mainly occupied in superintending the work of others, in preparing for the press his celebrated treatise on electricity and magnetism, his treatise on heat, and in the editing of the Cavendish papers. The "small book on a great subject" entitled "Matter and Motion" was also published during the same period. The greater portion of his energies during the closing years of his life was devoted to the editing of the electrical researches of the Hon. Henry Cavendish, F.R.S., great uncle of the Duke of Devonshire, the founder of the laboratory. Cavendish, at his death, had left behind a mass of unpublished manuscript containing an account of his electrical researches. An examination of these papers showed that Cavendish was far in advance of his time in knowledge of electricity, and had made many important discoveries.

Although Maxwell did not find time to do very much experimental research in the Cavendish, his influence in directing the work of others and in infusing fresh life into the mathematical studies at Cambridge cannot be overestimated. In the "Life of Maxwell," Lord Kelvin, writing in 1882, gives the following important testimony:—"The influences of Maxwell at Cambridge had undoubtedly a great effect in directing mathematical studies into more fruitful channels than those in which they had been running for many years. His published scientific papers and books, his action as examiner at Cambridge, and his professorial lectures, all contributed to this effect; but, above all, his work in planning and carrying out the arrangements of the Cavendish Laboratory. There is, indeed, nothing short of a revival of physical science at Cambridge within the last fifteen years, and this is largely due to Maxwell's influence."

Maxwell's reputation, although great during his lifetime, has continued to grow steadily since his death. His work on the kinetic theory of gases, on dynamical subjects, and on the theory of colours was sufficient to place him in the very first rank of scientific investigators, but it is on his great work in electromagnetic theory that his fame will ultimately mainly rest. Maxwell's views of the electromagnetic field and his electromagnetic theory of light were generally accepted among English physicists, but on the Continent, where rival theories held the field, were practically unknown except to a few. The brilliant experiments of Hertz and others on the production and properties of electrical waves verified in a most conclusive manner Maxwell's theory that light was an electrical disturbance in the luminiferous ether. This gave a great impetus to the study of Maxwell's theory of the electromagnetic field, and it is safe to say that practically all the mathematical theory of the last

fifteen years on the subject has been based on Maxwell's fundamental equations, and is largely a result of his theoretical views.

On Maxwell's death (1879) Lord Rayleigh was appointed, and held the chair until 1884, when he resigned to take the place in the Royal Institution vacated by the retirement of Tyndall. His short tenure of the Cambridge chair was marked by a series of classical researches in the Cavendish Laboratory on the value of the electrical units. Lord Rayleigh undertook a determination of the three fundamental units, the ohm, the volt, and the ampere, and performed this work with an accuracy that has left little room for improvement. It is hardly necessary to speak here of his valuable work in this connection, which is so well known to every physicist, but it suffices to recall his experiments on the ohm with a modified form of the British Association revolving coil, his determination of the electrochemical equivalent of silver and the E.M.F. of the Clark cell by means of his current balance, and his determination with Mrs. Sidgwick of the specific resistance of mercury. At the same time he determined in absolute measure the rotation of the plane of polarised light of carbon bisulphide in a magnetic field. In addition to this electrical work, a number of optical papers of great value were written within this period. We have confined our attention to the work of Lord Rayleigh in the Cavendish Laboratory. To the great mass of valuable work produced before and after his stay in Cambridge (now collected and published in four large volumes) it is impossible even to refer in this short article.

On the resignation of Lord Rayleigh, J. J. Thomson was appointed, at the early age of twenty-six. Like his predecessors in the chair, Prof. Thomson is a product of the mathematical and physical school of Cambridge, first taking the mathematical tripos and then entering upon experimental work in the Cavendish Laboratory. His first piece of work, undertaken before his appointment, was a determination of "v"—that important ratio between the electromagnetic and electrostatic units to which so much attention was devoted before the verification of Maxwell's electromagnetic theory. This was followed by a notable piece of mathematical analysis dealing with the action of vortex rings on one another, which gained for him the Adams prize. In this paper he investigated with great mathematical power the stability of interlocked vortex rings, and showed that not more than seven could be linked together without breaking up into new arrangements—a result which probably indicates the reason why no element has a greater valency than seven. In this work we have the first evidence of the bent of J. J. Thomson's mind towards the study of the constitution of matter—a study to which he has devoted so much attention with such conspicuous success in recent years. Next followed the publication of a book on the application of dynamics to physics and chemistry—a notable work in which a general method of analysis, based on Lagrange's equations, was used to solve many recondite physical and chemical problems. Among these may be mentioned an investigation of the action of an electrified atom in causing the condensation of water vapour around it. This result has proved to be of great importance in connection with later work to be done in the laboratory.

The year 1887 saw the publication of a paper on the effect of a moving electrified sphere, not only remarkable for the direct results obtained, but for its indirect bearing on the question of the origin of mass. The results of a mathematical analysis showed that a moving charge of electricity possessed an apparent or electrical mass in virtue of its motion. This electrical mass was constant for slow speeds, but increased with great rapidity as the speed of light was approached until, at the velocity of light, it became infinite in value. The possibility that mass, which has been such a mystery to science, is due to electricity in motion has been recently brought much into evidence by the experiments of Kaufmann on the kathodic rays of radium. He has shown that the apparent mass of the particles constituting the kathode rays, spontaneously emitted by radium, increased with the speed in accordance with the theory first advanced by J. J. Thomson, and afterwards developed by Heaviside, Searle and Abraham. This result points to the possibility that the apparent mass of the kathodic ray particle may be accounted for by electricity in motion without the necessity of any material nucleus.

The following years were occupied partly with investigations on the electrodeless discharge, the electrification produced by falling drops of water and experiments on electrical oscillations, and also with the preparation for the press of a text-book on electricity and magnetism, and a splendid volume entitled "Recent Researches in Electricity and Magnetism." These two books are so well known to every physicist that no further mention is necessary here.

J. J. Thomson next definitely attacked the problem of the nature of the discharge of electricity through gases. A repetition of Perrot's experiments on the passage of electricity through steam and experiments in vacuum tubes led him to the view that, as in a solution, the passage of electricity through gases was accompanied by electrolysis. This theory has been modified with the growth of experimental knowledge to the view that the discharge in gases is due to the motion of charged carriers or ions. These ions are not necessarily identical with the corresponding ions in the electrolysis of solutions. There is no doubt that there is in many cases an actual electrolysis similar to solutions occurring in gases, but this seems to be the result of a secondary action.

A great impetus was given to the study of this subject by the discovery of Röntgen rays. These rays possess the power of making all gases temporary conductors of electricity. In a paper with Rutherford, J. J. Thomson advanced the view that the conductivity imparted to the gas by the rays was due to the production of positively and negatively charged ions in the gas. These ions travel in an electric field with a velocity proportional to the strength of the field. When no electric field is acting the ions gradually disappear by recombination amongst themselves. This theory was found to explain all the characteristic properties of the conducting gas. In the course of the next few years, as a result of the joint efforts of those engaged in research in the Cavendish Laboratory—among whom may be mentioned C. T. R. Wilson, Maclelland, Rutherford, Zeleny, Townsend, Langevin, H. A. Wilson, Maclennan and Strutt, and many more besides—the subject developed with great rapidity along two distinct lines. By purely electrical methods the ionisation theory of gases was shown to account for the conductivity of flames and vapours, the discharge due to ultra-violet light and to radio-active substances. At the same time the admirable experiments of C. T. R. Wilson on the detection of ions by means of their power of becoming centres for the condensation of water vapour upon them showed that charged ions actually did exist distributed throughout the gas, and were not a figment of the imagination.

During this time J. J. Thomson published a remarkable paper on the nature of the kathode rays. Since their discovery by Crookes, the nature of these rays had been the subject of what may almost be called an international controversy. The English school took the view that they consisted of a stream of matter projected with great velocity; the German school regarded them as a kind of wave motion in the ether.

The experiments of Crookes had shown they were deflected by a magnet, while Perrin much later showed that they carried with them a negative charge. If the rays consisted of negatively charged particles, they should be deviated by their passage through an electric field. Hertz had tried such an experiment, but with negative results. The remarkable experiments of Lenard and the connection in some way between Röntgen and kathode rays made the elucidation of the true nature of these rays a matter of the first importance. It was at this stage that J. J. Thomson attacked the problem. He showed that the rays were deviated by an electric field, and explained the cause of the failure of Hertz to detect the same. By two distinct methods he proved that the rays consisted of negatively charged particles projected with a velocity of about one-tenth the velocity of light. The value of the glowing carbon filament of an incandescent lamp, had the same value of e/m as the corpuscle in the vacuum tube. These results indicated that the corpuscle, or electron as it is sometimes called, was the protyle or fundamental unit of which matter is built up. He suggested that the atoms of matter were very complex systems, consisting of a great number of corpuscles and corresponding positively charged bodies. It is remarkable that corpuscles only carry with them a negative charge. The positive charge appears always to be associated with matter atomic in size.

This work was followed by a series of investigations in the laboratory on that most complicated of all types of discharge—the passage of electricity through a vacuum tube. Anyone who has witnessed the gradual exhaustion of a vacuum tube from atmospheric pressure to the lowest vacuum cannot fail to have been

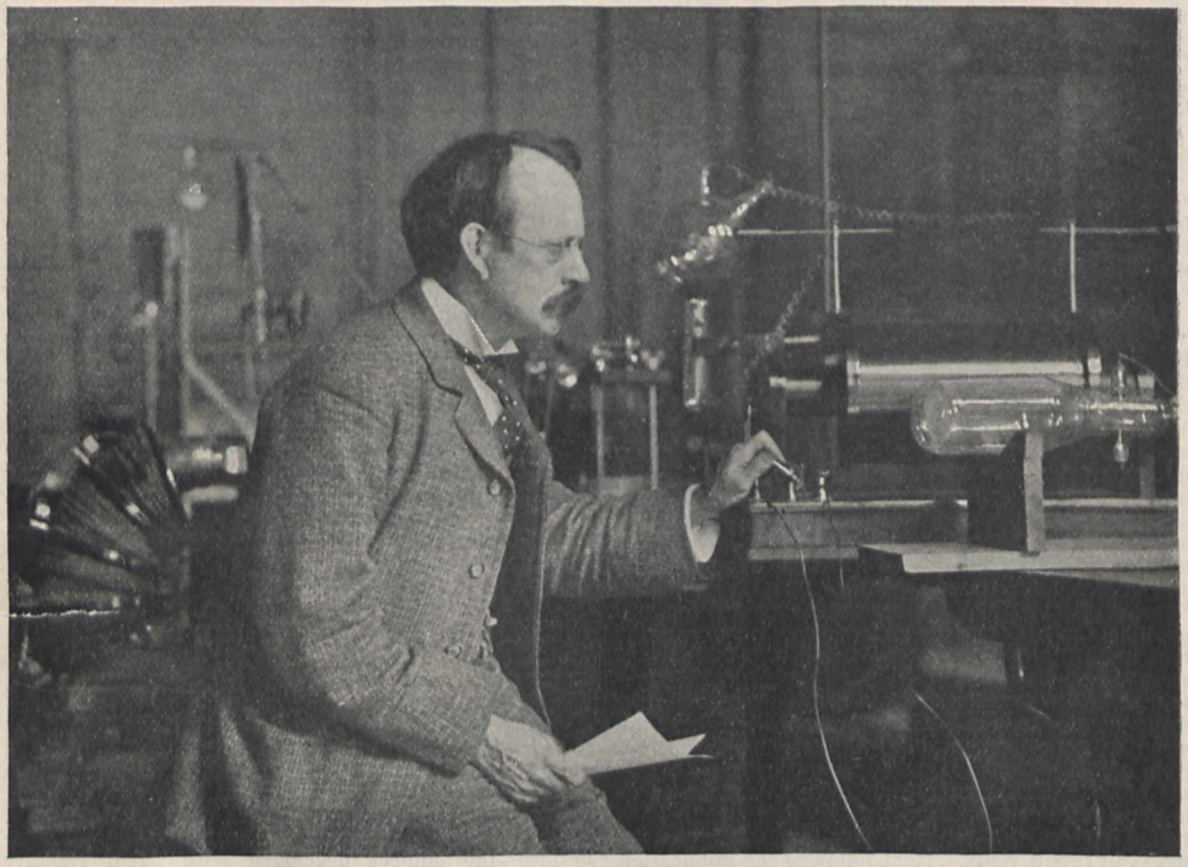

FIG. 1.—Prof. J. J. Thomson in the Laboratory.

struck with the variety and complexity of the phenomena displayed by the electric discharge through it. While much work still remains to be done, it may safely be said that the main phenomena are now fairly well understood, and can be satisfactorily explained on the ionisation theory of gases.

In addition to this work on the passage of electricity through gases, J. J. Thomson has also attacked the allied problem of the passage of electricity through metals. A theoretical paper on this subject was contributed by him to the International Scientific Congress at Paris in 1900, in which the negatively charged corpuscles in the metal were considered to be the chief factors in the transmission of electricity. Two possible experimental methods of attack on the question were suggested—the effect of a transverse mag-

e/m, the ratio of the charge on the particle to its mass, was about 1000 times greater than the value of e/m for the hydrogen atom in the electrolysis of water. If the charge is the same for both, this shows that the mass of the kathode ray particle, or corpuscle as it was termed, is only about $1/1000$ of the mass of the hydrogen atom. The great penetrating power of the corpuscles and the law of their absorption in matter all supported the idea that the corpuscle was small compared with the molecules of matter. The value of e/m of the corpuscle was found to be independent of the gas in the vacuum tube.

A series of experiments was then undertaken which led to very remarkable results. J. J. Thomson found that the negatively charged particles, released by the action of ultra-violet light on a zinc surface, and from

netic field on the resistance, and the increase in specific resistance of very thin films. Mr. Patterson, working in the Cavendish Laboratory, has followed out these lines of attack with considerable success. The results obtained were in agreement with the predictions of the theory. While we must await the result of other lines of research for a further knowledge of this important question, a very promising beginning has already been made.

The great mass of work published during the last seven years by J. J. Thomson and those working under him in the Cavendish Laboratory has enormously increased our knowledge of the nature of the electric discharge, and has worked a veritable revolution in ideas of the constitution of matter. When sufficient time has elapsed for the importance of this work, and of the consequences that follow from it, to be more accurately estimated, it is not too much to say that it will be recognised as marking an epoch in the history of physical science.

It is now necessary to speak of a movement for the promotion of research that has been fraught with important consequences to the Cavendish Laboratory and to Cambridge University in general. In 1895 the Universities of Oxford, Cambridge, Edinburgh, and Glasgow arranged to admit graduates from other universities to a course of post-graduate study without any examination or restrictions. These advanced students are allowed at once the position and privileges of the Bachelor of Arts of the university. If the advanced student devotes himself entirely to research under some recognised teacher, he may obtain the degree of B.A. without examination after two years' work, provided the results of the investigation submitted are "of distinction as a record of original research." In practice the standard of this research degree is equivalent to that of the degree of Doctor of Science in most other universities. The result of this wise legislation was at once made manifest. Large numbers of advanced students, not only from the universities of Great Britain, but also from her colonies, from America, and from the Continent, have come to Cambridge to take advantage of her unequalled facilities for advanced work and research. In no department has this influx of advanced students been more numerous or its influence more strongly felt than in the Cavendish Laboratory. Attracted by the genius of the professor, those anxious to pursue research in physical science have come from all parts of the world. The numbers were small at first, but have steadily increased until this year nearly thirty young men have been engaged in research in the Cavendish Laboratory alone. The gathering is a thoroughly cosmopolitan one. Here we find working together graduates not only of most of the universities in Great Britain, but also from Canada and Australasia, from the United States of America, with an occasional representative from France, Germany, and Austria. The mutual influence of such a number of young investigators, each engaged in the pursuit of science for its own sake, cannot be too highly estimated. Unlike some foreign laboratories, there is a thorough freemasonry among the workers in Cambridge. Beside his own research, a student is acquainted with that of twenty others working beside him. He knows their difficulties and the methods of overcoming them, and at the same time is able to see within a short period the cumulative effect of their labours.

The influence towards research exerted by Prof. Thomson on all those who have worked under him is no evanescent one, for his students continue to do good original work and to foster the spirit of investigation, whether they reside in Great Britain or in her colonies. As a sign of their appreciation of the services of J. J. Thomson, the past and present workers in the laboratory have had painted an excellent portrait of the professor, which has just been hung in the laboratory.

The amount of work involved in the superintendence of the researches of so many students is necessarily very great, yet this is undertaken by Prof. Thomson with the utmost willingness and individual interest. Every morning the professor goes the round of the laboratory and inquires of each student the progress of his work. When difficulties arise he is always ready to give the student the benefit of his knowledge and experience, and to make valuable suggestions for future work. In the afternoon there is a social gathering for tea in the professor's room, where he is always ready to discuss scientific matters or to enjoy the latest joke.

Few men are capable of working so steadily and at such high pressure as Prof. Thomson. Besides superintending the teaching and research work of the laboratory and delivering courses of advanced lectures, he is continuously engaged in scientific investigation.

In the preparation of his experiments he is assisted by Mr. Everett, whose skill in glass blowing and manipulation is always kindly placed at the disposal of the laboratory. In addition to a great amount of experimental work, Prof. Thomson, in conjunction with Prof. Poynting, has found time to publish a series of valuable text-books. Two works on sound and properties of matter have already appeared, and a third is in the course of preparation. At the same time, a volume on the discharge of electricity through gases has lately been published. Much of the work has been done by Prof. Thomson and his students in the Cavendish Laboratory, and an account of this important subject is awaited with much interest by physicists.

Prof. Thomson has not confined his energies to England, but has, during his Cambridge vacations, twice visited the United States of America by invitation to deliver courses of lectures. In the first visit he gave a course of lectures at Princeton University which has been published in book form. In his second visit this year, he gave courses of lectures at both Yale and Johns Hopkins Universities. The American physicists are second to none in their admiration of the work done by Prof. Thomson, and his lectures have been attended in great numbers by physicists from all parts of the States. Anyone who has been in America must have been struck by the deep impression created by these lectures.

The large amount of research carried on in the laboratory has not been allowed to interfere to an undue extent with the regular teaching and practical courses. The Cavendish Laboratory was one of the first to appreciate the great importance of practical work in the teaching of science. The excellent laboratory courses now provided for all classes of students are to a large extent due to the labours of Glazebrook, Shaw, Newall, Fitzpatrick, Wilberforce, Skinner, and Searle.

Mr. Fitzpatrick and Mr. Skinner have organised an elementary practical course of instruction for the medical students, while Mr. Searle has devised an admirable course of physical experiments for students taking the first part of the science tripos. The advanced course of practical instruction is at present supervised by Mr. C. T. R. Wilson.

The amount of apparatus required for such a large number of students engaged in research has naturally proved a severe drain on the resources of the laboratory. As in many other scientific laboratories in England, the funds for improving the equipment have been limited. The University of Cambridge has always been liberal in the support of science, but in the present state of the university funds the money to

be allotted to any one laboratory is of necessity small. The Cavendish Laboratory in the past has done most excellent work in somewhat difficult circumstances, but at the present time there is a crying necessity for both increase of space and equipment to carry on the work of the laboratory under the best conditions. Splendidly equipped laboratories are now springing up in all parts of the world, and it is a matter of regret that funds should not be available for the extension and further equipment of the Cavendish Laboratory to keep pace with the times. Under Prof. Thomson, the laboratory has done splendid work in the past, and will continue to do splendid work in the future, but more and better work would be done if greater space and more apparatus were available. An additional sum of 20,000*l.* spent on the laboratory would greatly increase its efficiency, and it would be difficult to find an investment for such a sum which would be productive of such great returns to the cause of science and indirectly to the welfare of the race.

FIG. 1.—Engraved brass bottle, Height 16 in. British Museum. From "Great Benin," by H. Ling Roth.

GREAT BENIN.[1]

THOSE who are acquainted with Mr. Roth's earlier meritorious books, "The Tasmanians" and "The Natives of Sarawak and British North Borneo," will know what to expect in a new work by that enthusiastic and indefatigable student. One is impressed with Mr. Roth's evident intention to be quite fair, and to present to his readers all the available data, but the literal quotations from various authors lead to inevitable repetition and occasional contradiction. As in his book on Borneo, Mr. Roth has been at great pains in collecting from scattered sources very numerous interesting illustrations, which materially enhance the value of the book. Mr. Roth appears to have a predilection for issuing limited editions of his books, and we are informed that "the number of copies of this work is limited to 320, and no other or cheaper edition will be issued."

The permanent fame of Benin will rest not on the butcheries of slaves and other unfortunates which shocked the civilised world, but on the skill displayed by the native artists in wood and ivory carving, and more especially by the artificers in bronze and brass. The first castings that came to Europe revealed an unsuspected mastery of technique, and despite the publication of several papers and a couple of memoirs by various students, there is yet more to learn concerning the significance of the very varied subjects represented. Mr. Roth takes a view that differs from that supported by most previous writers; he believes that the art existed in Benin prior to the advent of the Portuguese at the end of the fifteenth century, and that it was just emerging from the stage of realistic representations and beginning to make an attempt in the direction of decoration. As was the case with many other things with which the Portuguese came in contact, these remarkable explorers left their mark strongly impressed on this art work, and thus the natives began that series of borrowed forms which is so mixed up with native motives; perhaps Mr. Roth is somewhat too prone to see exotic designs in Benin art work.

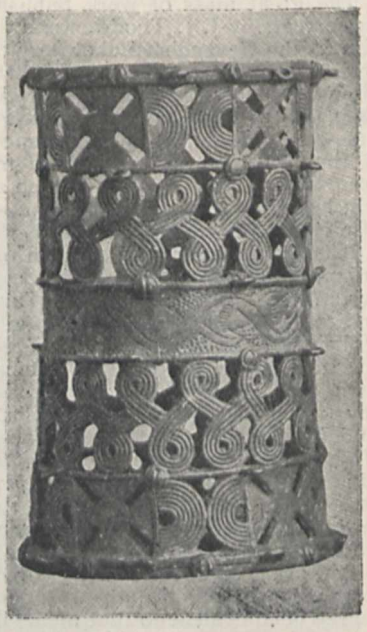

FIG. 2.—Brass armlet, 5¾ in. high. In Mr. R. K. Granville's collection. From "Great Benin," by H. Ling Roth.

We reproduce in the first figure a brass bottle with very characteristic interlaced patterns, which are evidently derived from leather-work. The brass armlet or leglet in the second figure has some typical ornamentation; it is said these long armlets or leglets are put on when the individual is quite young, and not taken off until death, if then; in the event of removal, the foot or hand has frequently to be chopped off first.

With so much to choose from, it is difficult to indicate what the book contains; the sociologist will find what is known concerning domestic life, court life, government, trade and industries; the ethnographer is informed about weapons, games, buildings, and what the people do and make.

Mr. Roth's object has been to gather together all he could discover about Benin, and, besides earlier publications, he has drawn largely upon Mr. Cyril Punch, an excellent observer who in addition has furnished Mr. Roth with sketches and interesting photographs. Fresh information has also been given by the author's brother, Dr. Felix N. Roth.

Owing to the number of authors cited, added to the fact that none of them made anything like a study of the people, the information garnered by Mr. Roth is very fragmentary, but the author is not to blame for this, and the book will have further increased its usefulness if it indicates how imperfect our knowledge is, and leads to a more detailed and thorough study of the people. It will, however, always remain a valuable work for students, as references are given with fulness, and it is embellished with a large number of excellent illustrations

[1] "Great Benin, its Customs, Art and Horrors." By H. Ling Roth. Pp. xxxii+234 with 275 illustrations. (Halifax: F. King and Sons, Ltd., 1903.)

THE SURVEY FORMATION-MONOGRAPHS.[1]

BESIDES the descriptions of districts and the explanations of the published maps and sections, the Geological Survey has of late years issued treatises upon separate formations. In these a full description is given of certain geological horizons the survey of which has been completed or so nearly finished that there is no probability of any important change of classification being called for. The subject is exhaustively treated, the palæontological and petrological characteristics of the group are described, and its relation to the equivalent geological deposits on the Continent discussed. The work before us is the second of three volumes on the Cretaceous rocks. The first volume dealt with the Lower Cretaceous, the second, which has just been published, being devoted to the Lower and Middle Chalk, and the third, which it is hoped will be published this year, completing the monograph with a description of the Upper Chalk, the discussion of some postponed economical and geographical questions, and the full list of Chalk fossils.

The authors are of opinion that none of the lithological names hitherto applied to portions of the Lower Chalk can be used without confusion or inconsistency, and find themselves compelled to seek a more satisfactory method of subdivision in the limitation of the range of certain species of fossils. Nor do they seem to regard with much more favour the use of names derived from localities. We must be careful, however, in the advance towards fuller knowledge of details not to sacrifice precision to consistency. A locality can always be found, and when we get there we can generally see what an author meant. Fossils are not always forthcoming, and from the nature of the case frequently turn up where not found before. Moreover, the names of fossils are being too often changed. Palæontology, in its present phase, is a very useful handmaid in geological classification, but a very exacting mistress in nomenclature. The zone of *Terebratulina gracilis*, for instance, is so called after a form of doubtful determination, unsettled name, and inconstant occurrence.

It is interesting to follow the authors when they point out and explain the changes in the Cretaceous rocks as they trace them from one area to another. In the south-west, coarse sand and grit take the place of chalk, and suggest that we are getting near the shore of the Cretaceous sea, and that newer beds crept over the older deposits which are seen at the base further east, where the land went down first. So Barrois has observed that certain beds in the north-east of France thin out as they approach the Palæozoic ridge, while the Lower Chalk in the south-west is represented, as in the Sarthe, by sands and sandstones. Chemical and mineralogical examination tells the same tale. The fine mud, which in Wilts furnishes 16 per cent. of the material, increases in the deposits of the same horizon as we trace them to the N. and N.E. to 28 or 41 per cent. Minerals which are well known constituents of the granitic rocks of the south-western counties occur in the Lower Chalk of the far south-west, but have not been found in the corresponding beds of the midlands.

Many interesting subjects for investigation are suggested by an examination of the Cretaceous series. The replacement of portions of the chalk by flint might at first seem to require only depression to such a depth that the temperature of the included water would be sufficiently raised to carry silica in solution, while the pressure was so great that the chalk-dissolving acids would be retained in it. But there are other factors of which we must take account. The arresting or retarding of the percolating water had something to do with it, as may be inferred from the manner of occurrence of tuberous and tabular flint along the bedding and joints, and the limitation of flint over large areas to certain horizons so constantly that their abundance or absence was long taken as a sufficient indication of the horizon. So also the supply of silica from spicules in the upper part, or the presence of much siliceous sand in the lower part, must be taken into consideration.

Phosphatic nodules, which occur at widely separated horizons from the Bala Limestone to the Crag, are peculiarly variable in character and mode of occurrence in the Cretaceous series, and from their economic value and scientific interest call for discussion. Some of them are derivative from older beds, and the area from which they have drifted has been pretty clearly made out, but that only pushes the question into other associations; the difficulties remain. There is generally evidence of a change in conditions of deposit where they occur, but it does not often point to a stationary period when animal life was abundant and sedimentation slow, which appear to be the conditions required in explanation.

The name clunch is applied to any chalk which is used as a building stone, whether it is obtained from the firmer beds in the marl, or from the Totternhoe stone or even from higher horizons. Where the Totternhoe stone is accessible it is preferred. It has been largely used at Ely, Burwell, and elsewhere for internal decorative work, and if cared for has often lasted wonderfully, even where exposed to the action of the weather. Near Reach it has been quarried from Roman times, as proved by its having been used in the basement of the Roman villa found near the railway east of the village.

The Red Rock of Hunstanton, &c., does not find a place in this volume, because it was not considered to be part of the Lower Chalk, but was regarded as the representative of the gault, and was accordingly described in the previous volume. Other red beds, however, occurring at higher horizons in the chalk are duly noticed. The Lower Greensand, which is green in borings, is foxy-red or yellow at the outcrop. This is clearly due to the percolation of water from the escarpment. There is much to suggest that the Red Chalk of Hunstanton may have sucked up the colour by capillary attraction from the underlying Car-stone. The red colour does not, however, always coincide with bedding planes, and the irregular occurrence of red beds in the chalk described in this volume is not so easily explained.

The memoir is an able exposition of the results which have been arrived at by long and careful work concentrated upon certain definite geological horizons, but illustrated by wide observation and study. It well supports the prestige of these formation-monographs, from which a large and ever increasing public derives so much benefit.

[1] Memoirs of the Geological Survey of the United Kingdom. The Cretaceous Rocks of Britain. Vol. ii.—The Lower and Middle Chalk of England. By A. J. Jukes-Browne, with contributions by Wm. Hill. Pp. xiii+568+plates. (London: H.M. Stationery Office, 1903.)

NOTES.

WE regret to announce that Mr. Herbert Spencer died on Tuesday morning, at eighty-three years of age.

THE death is announced of Prof. Proust, the French Inspector-General of Sanitary Services.

THE ships *Morning* and *Terra Nova* left Hobart on December 6 to go to the relief of the *Discovery*, now in the Antarctic regions.

THE Rev. T. R. R. Stebbing, F.R.S., has been elected zoological secretary, and a member of the council, of the Linnean Society in succession to Prof. G. B. Howes, F.R.S., who has had to retire on account of ill-health.

PROF. W. D. HALLIBURTON, F.R.S., has been selected to give the Herter lectures in connection with the University of New York in the coming year, and he has chosen as his subject the biochemistry of muscle and nerve. The lectures will commence on January 4, 1904.

A SERVICE in memory of the late Sir Frederick Bramwell, Bart., F.R.S., was held at St. Margaret's Church, Westminster, on Friday last, December 4. The service was attended by a large congregation, which included representatives of the Royal Society, British Association, Institution of Civil Engineers, and many other scientific and technical bodies.

A DALZIEL message states that, having successfully exchanged messages regularly between Berlin and Munich, a distance of about 500 miles, the German Wireless Telegraphy Company is about to endeavour to establish communication between Berlin and the Swedish coast near Stockholm, a distance of more than 650 miles. The company uses a combination of the Slaby-Arco and Siemens systems.

MR. F. F. FRANCIS, Queen's Road, Wimbledon, writes to record an instance of a snake being killed by a mouse. An ordinary grass snake which he had in confinement was given a mouse for food. The snake made several attempts to catch the mouse, but in every case missed. The next day the snake was found to be dead, and there was evidence that it had been attacked and killed by the mouse, which was alive and had eaten a part of the snake's body.

AN open competitive examination for not fewer than twenty-four situations as assistant examiner in the Patent Office will be held by the Civil Service Commissioners in January next. The examination will commence on January 5, and forms of application for admission to it will probably be ready for issue in the course of a few days; they will be obtainable on request addressed by letter to the secretary, Civil Service Commission, Burlington Gardens, London, W.

THE Aberdeen Line steamer *Sophocles* arrived at Plymouth on December 3 from Sydney after experiencing exceptional weather in the Bay of Biscay. It is reported that during a severe thunderstorm the ship was struck by lightning, and the mainmast was scorched and blackened. A few minutes later, it is said, a brilliant meteor burst in the vicinity of the liner. "The attention of the passengers was attracted by a rushing sound, and immediately afterwards they saw an object plunge into the sea, apparently a few yards distant, on the starboard side of the liner, throwing up the water with a great splash."

PROF. L. C. MIALL, F.R.S., has been elected Fullerian professor of physiology at the Royal Institution. The following are among the lecture arrangements at the Institution before Easter:—A Christmas course of lectures (adapted to a juvenile auditory) on extinct animals, by Prof. Ray Lankester; Prof. L. C. Miall, six lectures on the development and transformations of animals; Dr. E. A. Wallis Budge, two lectures on the doctrine of heaven and hell in ancient Egypt, and the books of the underworld; Mr. G. R. M. Murray, three lectures on the flora of the ocean; Mr. A. D. Hall, three lectures on recent research in agriculture; Prof. H. L. Callendar, three lectures on electrical methods of measuring temperature; and six lectures by Lord Rayleigh on the life and works of Stokes. The Friday evening meetings will begin on January 15, when a discourse will be delivered by Lord Rayleigh on shadows; succeeding discourses will probably be given by the Rev. Walter Sidgreaves, Mr. D. G. Hogarth, Mr. H. Brereton Baker, Mr. Alexander Siemens, Prof. W. Stirling, Prof. F. T. Trouton, Prof. Dewar, and other gentlemen.

MR. W. T. GIBSON has been appointed curator of the station of the Marine Biological Association of the West of Scotland, and Mr. J. M'Kenzie has been appointed assistant curator. Mr. Gibson is an associate of the Royal College of Science in London, and received his scientific education there, and also at the University of Edinburgh. He has done marine field work at the Gatty Laboratory, St Andrews, and also at the laboratory of the Northumberland Sea Fisheries Committee at Cullercoats. Mr. M'Kenzie has for the last eight years been laboratory assistant in the zoology and geology departments of Marischal College, Aberdeen.

THE International Sanitary Conference, which has been sitting in Paris since October 10, has just closed its proceedings. A modification has been introduced in the period of surveillance in cases of contact with plague; this is reduced from ten to five days. The new convention provides for the manner in which outbreaks of cholera or plague are to be intimated, and, generally speaking, provides for greater facilities for international commerce, while giving additional guarantees for public health. It is proposed that an international sanitary office shall be established in Paris.

IN a lecture upon intra-cellular bacterial toxins, delivered at the Lister Institute by Dr. Allan Macfadyen, the method of mechanically grinding bacteria with the aid of liquid air was demonstrated. The lecturer pointed out that there were two classes of bacteria, one, of which diphtheria and tetanus were examples, excreting, as it were, soluble poisons or toxins into the culture medium, the other producing no extra-cellular poisons, and in which the toxins seem to be associated with the bacterial cells, as is the case with tubercle, typhoid, cholera, plague, and a number of others. By disintegrating the cells of the last-named class, the intracellular toxins are set free, and on injection into animals produce toxic effects. By cautious injection with these intra-cellular toxins, the blood of the treated animal acquires antitoxic properties, and it is hoped that it may be possible by this means to obtain antitoxic sera for such diseases as typhoid fever and plague, similar to those now employed for diphtheria and tetanus.

SIR PATRICK MANSON, F.R.S., delivered an address on Monday afternoon at the London School of Tropical Medicine on the work of the school, the occasion being the departure of Sir Francis Lovell, the dean, for the East on behalf of the school. Sir Patrick Manson, having traced the history of the foundation of the school, paid a tribute to the late Colonial Secretary, who has done so much to forward the study of tropical medicine. With regard to the work of the school, it naturally came under two headings—education and research. Since the school was opened in October, 1899, no less than 354 students had passed through its portals. Research had been prosecuted so far as the limited means at their disposal had permitted. Dr. Low had shown that the filaria was introduced into the body by a mosquito, Drs. Low and Sambon had carried out an important experiment to prove the mosquito-malaria theory, Dr. Forde, a pupil of the school, had discovered a trypanosome in man, and Dr. Castellani had observed a trypanosome in sleeping sickness. Through the generosity

of Sir John Craggs a travelling scholarship of 300*l.* a year had been bestowed for three years, and the same donor now gave a valuable prize annually for the best piece of research work carried out by a pupil of the school. The need for further funds was emphasised if the work of the school was to be successful in the future. Sir F. Lovell in a previous mission to the East had collected a considerable sum of money, 100,000 rupees being contributed by the Hon. B. Petit, of Bombay.

THE suggestions made by Sir Oliver Lodge at the Physical Society on November 13 (see p. 94) as to the possibility of dissipating fog by discharge of electricity into the air have attracted much attention. Experiments proving how a smoke-filled chamber could be cleared by the discharge were shown by Sir Oliver Lodge twenty years ago, and have been repeated by many lecturers since then, but no installation on a large scale was established. In reply to a correspondent who has asked whether street arc lamps could be utilised for the purpose, Sir Oliver Lodge says, "Your suggestion seems a practical one, and it would be a very good thing if something of that kind could be done. The difficulty is the insulation. If that could be guaranteed, the matter would be comparatively easy; but the potential is extremely high—say 100,000 volts. The quantity is next to nothing, and very little power is sufficient if only one could avoid leakage. I can tell you the kind of insulators that we employed for the single mast that I used in Liverpool, but it is a very different thing to try to distribute it over a number of street lamps. It is a matter very well worth consideration, however, and I am glad to find that your attention is called to the matter. In the Liverpool experiment I was using a potential higher than 100,000 volts; one could take sparks 4 inches long. But a good deal smaller voltage would do if there are walls or other earthed surfaces in the neighbourhood. For a lofty isolated mast the potential must be higher in order to secure adequate discharge."

AT the meeting of the Institution of Civil Engineers on November 24, Dr. H. R. Mill read an interesting paper on the distribution of mean and extreme annual rainfall over the British Isles. The results, which were exhibited by isohyetal lines, or lines of equal rainfall, were based on the means of thirty years, 1870 to 1899, and showed that a mean annual fall under 25 inches occurs in three places:—(1) a very narrow strip round the Moray Firth; (2) a triangular area about the Thames estuary; and (3) a large portion of east central England south of the Humber; and that the amount increases in various districts, in which altitude and configuration of the land form important features, to 40 inches and upwards. Falls of more than 100 inches are found:—(1) in the lake district, around Seathwaite; (2) in the western Highlands; and (3) in the Snowdon district. The average rainfall, to the nearest half-inch, for each country is given as follows:—England 31·5, Wales 49·5, Scotland 47·0, Ireland 42·0 inches, and for the whole of the British Isles 39·5 inches. The extremes of annual rainfall were discussed by taking out the figures for the driest and wettest year of the thirty years' period. The excess of rainfall in 1872 was stated to be 34 per cent., and the deficiency in 1887 23 per cent. of the average fall for the British Isles as a whole. The average rainfall over the whole of the British Isles for these two years was:—in 1872 53 inches, and in 1887 30·5 inches.

WE have received a prospectus of a new fortnightly meteorological bulletin, entitled *La Previsione del Tempo*, to be published in Rome on the 1st and 16th of each month, under the superintendence of Father A. Rodriguez. The bulletin will consist of eight large octavo pages, four of which will be occupied by diagrams exhibiting the principal meteorological data, and will form the basis for the calculation of the proposed predictions. These data will refer to some of the chief places in Europe (including Ireland), Algeria, and Tunis, for each of which forecasts are to be drawn. The remaining four pages will consist of text, and will contain a brief summary of the atmospheric changes of the preceding period, forecasts for the succeeding period, meteorological notes, and the fundamental principles of the system of prediction employed. The author has set himself a difficult, and we fear an impracticable, task, but as he apparently proposes to proceed upon strictly scientific lines, we shall be interested to learn what amount of success he may obtain. For this country at least, the changes from one type of weather to another appear to be too sudden to allow of a tolerably safe forecast for more than a day or two in advance, nor has more been yet attempted by any of the European central meteorological offices. The author, however, appears to be sanguine of obtaining a success of 65 to 75 per cent.

IN the Meteorological Office pilot chart for December the attention of mariners is directed, in a lengthy description of the Aurora Borealis, to the question of more careful and systematic observations of the various phases of auroræ. They are asked to supply details as to the following points, to which scientific inquiry might be directed:—The angle which the apex of the arch makes with the horizon; the orientation of the arch or arches; the lateral motion of the streamers, whether from right to left or left to right; does the individual streamer move sideways, or do fresh streamers arise to one side of the former? As a rule, streamers are parallel to the dipping needle—it should be noted if any streamers are curved. Can stars be seen immediately under the base of streamers? It should be noticed if the arches always move from north (magnetic) to south, and, if so, whether it is by a motion southward of the individual streamers or by new streamers appearing to the south of the old ones; the formation of coronæ by streamers should be carefully watched and noted, and special notice should be taken of the behaviour of the compass when an aurora presents the appearance of a luminous curtain.

A SHORT account of the meeting of the Deutsche Gesellschaft für Mechanik und Optik which took place at Ilmenau on August 14 and 15 is given by Prof. L. Ambronn in the *Physikalische Zeitschrift* for November 15.

THE *Verhandlungen* of the Deutschen zoologischen Gesellschaft for the present year contains the papers read at the session held in Würzburg on June 2–4. In the obituary notices reference is made to the loss sustained by zoological science in the death of Prof. G. Radde, of Tiflis. The papers, which are for the most part short, cover a wide range of subjects, but there are none among them which call for special notice.

WE have received a copy of Prof. W. B. Benham's presidential address to the biological section of the Australian Association. The subject is the geographical distribution of earth-worms and the palæography of the Antarctic region. In the first place, from their invariable association with angiospermous plants, the author is of opinion that earth-worms form a comparatively modern group, which did not attain any important development before the Cretaceous. The ancestral type would appear to have been more or less nearly related to the existing Notiodrilus, of which the headquarters, if not the birthplace, was the "Melanesian plateau." New Zealand and the neighbour-

ing islands, which possess the most ancient worm-fauna, were separated at an early date from this plateau. From this area the primitive worms travelled in one direction into the Austro-Malayan countries, while in another, by way of Antarctica, they reached South America and Africa. Other theories as to former land-connections in the southern hemisphere are propounded.

IN the *Transactions* of the South African Philosophical Society Dr. Bolas and Major Wolley-Dod have published a list of the flowering plants and ferns of the Cape Peninsula, and have thereby brought to notice a flora which presents a number of unique features. In the first place, from an area of rather less than 200 square miles, they report more than 2000 flowering plants, and amongst these there are a number of representatives of such uncommon orders as Selaginaceæ, Restiaceæ, and Proteaceæ. Another striking character is the richness in species of several genera; thus Erica possesses no fewer than 92 species, Mesembryanthemum shows 61, while the very rare genus Restio has as many as 29 representatives.

MUCH uncertainty has existed as to whether or no the bacterial cell possesses a nucleus. Some have considered that it does not, others that it contains a fragmented one, or one of the ordinary type, or that the whole cell is a naked nucleus. Profs. Raýman and Kruis (*Bulletin* Acad. des Sciences de l'Empereur François Joseph I., June 5) claim to have shown by a special staining method that a nucleus is present in the form of a small round body situated at about the centre of the cell. In order to demonstrate this structure, films are prepared on perfectly clean cover glasses, dried in a desiccator, treated with a mordant of iron-alum, and stained with a dye known as alizarine PS, or its constituents. The paper is illustrated with some excellent reproductions of photographs.

WE have received the *Transactions* of the Leicester Literary and Philosophical Society for the session 1902–3. The volume also contains the report of the council and the annual reports of the sections into which the Society is divided for working purposes. Numerous papers are reprinted, and some of them are well illustrated. The volume is published at sixpence by Messrs. Thornley and Waddington, of Leicester.

A THIRD edition of Prof. James Walker's "Introduction to Physical Chemistry" has been published by Messrs. Macmillan and Co., Ltd. A new chapter on electromotive force has been added, and the chapter on thermodynamical proofs has been extended. In cases where recent researches have made it possible, more accurate numerical values and better illustrative examples have been substituted in the text.

THE current number of the *Quarterly Journal* of the Royal Meteorological Society is an interesting one. Dr. W. N. Shaw, F.R.S., in a paper containing several instructive figures, gives a detailed analysis of the meteorological aspects of the storm of February 26–27. Mr. C. P. Hooker discusses the relation of the rainfall to the depth of water in a well; Mr. W. Marriott examines the available observations in connection with the frost of April, and Mr. J. Baxendell gives illustrated descriptions of the Dines-Baxendell anemograph and the dial-pattern non-oscillating pressure-plate anemometer.

IT is now the common practice to illustrate lectures and demonstrations in most schools and colleges by means of the lantern and lantern-slides. Those teachers and lecturers who have not mastered the art of making their own slides would do well to study the lists of slides which are to be purchased from Messrs. Newton and Co., of Fleet Street, London. We have received from this firm a supplementary list of slides to illustrate scientific and other subjects, and among them we notice sets dealing with the growth, structure, and defects of timber; the evolution of a frog; the bacteriology of tropical diseases; and the open-air cure for consumption.

A NEW illustrated catalogue of chemical apparatus recently published by Messrs. F. E. Becker and Co., of Hatton Wall, London, is one of the most complete and conveniently arranged that we have examined. Every item in the list is illustrated by a figure immediately adjoining it, and the unusually full index makes reference very easy. The catalogue gives information concerning all forms of chemical apparatus in general use in laboratories, and an exhaustive list of chemicals, reagents, and standard solutions is also included. Teachers of chemistry, and those who are engaged in chemical research, should obtain a copy of the catalogue to keep in their laboratories for reference.

A TRANSLATION of a long thesis on radio-active substances, presented to the Faculté des Sciences de Paris by Mdme. S. Curie, is concluded in the current number of the *Chemical News* (December 4). The conclusions read as follows:—"I will define, in conclusion, the part I have personally taken in the researches upon radio-active bodies. I have investigated the radio-activity of uranium compounds. I have examined other bodies for the existence of radio-activity, and found the property to be possessed by thorium compounds. I have made clear the atomic character of the radio-activity of the compounds of uranium and thorium. I have conducted a research upon radio-active substances other than uranium and thorium. To this end I investigated a large number of substances by an accurate electrometric method, and I discovered that certain minerals possess activity which is not to be accounted for by their content of uranium and thorium. From this I concluded that these minerals must contain a radio-active body different from uranium and thorium, and more strongly radio-active than the latter metals. In conjunction with M. Curie, and subsequently with MM. Curie and Bémont, I was able to extract from pitch-blende two strongly radio-active bodies—polonium and radium. I have been continuously engaged upon the chemical examination and preparation of these substances. I effected the fractionations necessary to the concentration of radium, and I succeeded in isolating pure radium chloride. Concurrently with this work, I made several atomic weight determinations with a very small quantity of material, and was finally able to determine the atomic weight of radium with a very fair degree of accuracy. The work has proved *that radium is a new chemical element*. Thus the new method of investigating new chemical elements, established by M. Curie and myself, based upon radio-activity, is fully justified. I have investigated the law of absorption of polonium rays, and of the absorbable rays of radium, and have demonstrated that this law of absorption is peculiar and different from the known laws of other radiations. I have investigated the variation of activity of radium salts, the effect of solution and of heating, and the renewal of activity with time, after solution or after heating. In conjunction with M. Curie, I have examined different effects produced by the new radio-active substances (electric, photographic, fluorescent, luminous, colorations, &c.). In conjunction with M. Curie, I have established the

fact that radium gives rise to rays charged with negative electricity. Our researches upon the new radio-active bodies have given rise to a scientific movement, and have been the starting point of numerous researches in connection with new radio-active substances, and with the investigation of the radiation of the known radio-active bodies."

THE additions to the Zoological Society's Gardens during the past week include two Black-eared Marmosets (*Hapale penicillata*) from South-east Brazil, presented by Mr. J. Arthur Turner; a Short-toed Eagle (*Circaëtus gallicus*) captured at sea, presented by Lieut. W. H. Colegrave, R.N.R.; four Chameleons (*Chamaeleon vulgaris*) from North Africa, presented by Mr. Thomas Yates; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, two Slender Loris (*Loris gracilis*) from Ceylon, a Blue-fronted Amazon (*Chrysotis aestiva*), a Rough-eyed Cayman (*Caiman sclerops*), five Black-pointed Teguexins (*Tupinambis nigropunctatus*) from South America, a Red-billed Toucan (*Ramphastos erythrorhynchus*) from Cayenne, two Red-handed Tamarins (*Midas rufimanus*) from Surinam, a One-bearded Greaved Tortoise (*Podicnemis unifilis*) from the Upper Amazons, deposited.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF SOLAR PHENOMENA.—In a paper presented to the Paris Académie des Sciences, M. Deslandres discusses the various theories concerning the inter-relation of solar and magnetic phenomena which have been brought into prominence by the exceptional magnetic storm of October 31. He points out that, whereas the magnetic phenomena are recorded continuously at many widely separated observatories, the solar observations, which constitute the other side of the problem under discussion, are only made during short intervals each day and at fewer stations; therefore he strongly urges that solar observatories should be more widely disseminated in order that a *continuous* record may be obtained. Again, he points out that, at present, at least ninety-nine out of every hundred observers of the sun only record the *forms*, and not the *movements*, or velocities, of the solar disturbances, whereas in his opinion the records of the latter would prove much more effective in bringing us to a solution of the vexed questions.

M. Deslandres suggested in 1893, and in the present paper he strongly emphasises the fact, that it is essential, in order that our knowledge of solar disturbances may be rendered less defective, to obtain a *continuous* record of:—(1) The surface of the photosphere as photographed by the ordinary process; (2) the *forms* of the disturbances in the lower, mean, and higher chromosphere as obtained with the spectroheliograph; and (3) the radial velocities of these chromospheric disturbances as shown on photographs obtained with the spectroheliograph especially arranged to register these velocities. He states that the present instruments are perfect enough to ensure success, and estimates the annual expense of such observations (at Meudon) as twenty thousand francs (about 800*l*.) (*Comptes rendus*, No. 21, November 23).

THE SPECTRUM OF LIGHTNING.—Mr. Phillip Fox, of the Yerkes Observatory, has recently succeeded in obtaining several spectra of lightning flashes which were taken with an objective-prism spectroscope consisting of a 30° flint glass prism mounted in front of a camera of 35 mm. aperture and 274 mm. focal length. Proceeding on the lines suggested by the visual observations of Vogel, Lohse, and Schuster, he compared his spectra with a spark spectrum of air obtained with the same instrument, and found that a striking agreement existed between the two.

Similar results were arrived at by Dr. W. J. S. Lockyer, who, in a recent number of the *Illustrated Scientific News* (No. 15, vol. ii.), described an extremely simple method whereby photographs of lightning flashes and their spectra can be obtained by using an ordinary camera having one of Thorpe's transmission gratings fixed in front of the lens. The spectra thus obtained by Dr. Lockyer in May of this year are shown to differ from those obtained by Prof. Pickering at Harvard in 1901, and a spectrum recently obtained by the latter is again different from either of the other two; all, however, bear a striking resemblance, in general appearance, to the air spark spectrum, the chief nitrogen lines being especially prominent.

In Mr. Fox's spectra it is seen that the various lines differ in intensity from one part of the flash to another, and, as this apparently indicates a variation of the spectrum with the atmospheric conditions, it seems probable that the differences existing between the several spectra may be thus explained.

Mr. Fox's article is illustrated by reproductions of the spectra obtained by him, and a comparison of the air and lightning spectra, and is published in No. 4, vol. xviii., of the *Astrophysical Journal*.

THE LINE SPECTRA OF THE ALKALINE METALS.—In No. 27 of the *Physikalische Zeitschrift* Herren H. Konen and A. Hagenbach record the results of some observations made by them with the object of discovering additional lines in the secondary series of the spectra of lithium, potassium, cæsium, and rubidium.

In the spectrum of lithium four new lines were observed, but their diffuse character renders the determined wavelengths (6240·8, 4636·14, 4149·1, and 3934) rather untrustworthy, and for this reason it is difficult to determine finally whether they belong to a definite series or not, although it seems likely, from their character and their analogy to the lines in the sodium series, that they are really pairs, and belong to the first secondary series. No new lines were discovered in the potassium spectrum. In the spectrum of rubidium three new lines were discovered, and fourteen of the fifteen lines observed by Mr. Hugh Ramage in the flame spectrum were seen, although these observers were unable to find, either in the arc or the flame, the line at λ 5037 recorded by Mr. Ramage. These new lines fill up gaps in the first secondary series as calculated from Kayser and Runge's formula.

All the lines recorded by Mr. Ramage below λ 5750 in the cæsium spectrum were observed, together with an additional line at λ 5209.

PATAGONIAN "DIPROTODONT" MAMMALS.[1]

SEÑOR AMEGHINO appears to be firmly convinced that the ancestors of a large number of groups of mammals are to be met with among the remains from the Santa Cruz and associated beds of Patagonia. Last year, in the journal quoted below, he attempted to prove the descent of the modern elephant, through Pyrotherium and certain other forms, from a primitive opossum (Proteodidelphys). Now he essays to demonstrate that the rodents have originated from another type of Patagonian "diprotodonts," namely, the Garzoniidæ, which is itself traced back to a still earlier group, the Microbiotheriidæ. Apart from zoological considerations, the possibility of such phylogenies depends entirely on the age assigned to the Santa Cruz and subjacent strata. If, with Dr. Ameghino, we regard them as of early Eocene, Cretaceous, and possibly Upper Jurassic age, then, from this point of view, there is nothing impossible in such pedigrees. If, on the other hand, we accept the view of the great majority of palæontologists that these strata are of Miocene age, the very foundations of Dr. Ameghino's elaborate phylogenies are at once destroyed.

Putting, however, this consideration on one side, we may refer briefly to some of the zoological features in the paper before us. Briefly stated, Dr. Ameghino's views, so far as we can follow them, appear to be as follows. In the Upper Jurassic of Patagonia there existed a primitive group of "diprotodonts" (that is to say, mammals furnished with a single pair of chisel-like incisors in the lower jaw), the Microbiotheriidæ. On the one hand, as we learn from the earlier paper, these gave rise to the Proboscidea, while on the other they culminated in the modern rodents, the diprotodont marsupials of Australia, and certain extinct forms,

[1] F. Ameghino, "Los Diprotodontes del ordren des los Plagiaulacoideos y el Origen de los Roedores y de los Polymastodontes" (*An. Mus. Nac. Buenos Aires*, vol. ix., pp. 81–192)

such as Plagiaulax of the Purbeck and Microlestes of the Trias (!). The author appears, indeed, to consider that, with the exception of Pyrotherium (which, despite its remarkable resemblance to Diprotodon, he places in the proboscidean line), all mammals with a diprotodont type of dentition are related to one another. And he endeavours to show that the dentition of one type passes by imperceptible degrees into that of another. But such gradations may be traced between the dentition of almost any groups, and no allowance whatever is made for parallelism in development, which has undoubtedly been an important factor in evolution. Moreover, no account whatever is taken of the undoubted resemblance existing between the cheek-teeth of the polymastodonts and the reptilian Tritylodon.

Then, again, according to the author's scheme, the true diprotodonts of Australia have no relationship with the polyprotodont marsupials of the same region, which is, on the face of it, an absurdity. It may also be pointed out that Dr. Ameghino takes no account of the work of other palæontologists. It is very generally accepted, for instance, that an intimate relationship exists between marsupials (as a whole) with the extinct creodonts, and so with the modern Carnivora (see Wortman, *Amer. J. Sci.*, vol. xiv., 144, 1902), while Prof. Osborn (*Bull. Amer. Mus.*, xvi. p. 203, 1902) has indicated the probability of the descent of the rodents from the Holarctic Eocene Mixodectidæ. Obviously both these phylogenies must be demonstrated false before there is even a *primâ facie* possibility for Dr. Ameghino's scheme. It will be interesting to learn what the United States palæontologists have to say on the subject when the groups in question come to be treated in the working out of the Hatcher collection. R. L.

GEOLOGICAL NOTES.

OBSERVATIONS have been made by Mr. R. D. Oldham on the growth of sandhills, which threaten to cut off communication between the town of Karachi and the suburb of Clifton, two or three miles distant (*Mem.* Geol. Surv. India, xxxiv., part iii.). He traces out the growth of dunes from small oval patches of sand which begin to accumulate on irregular tracts of the stony surface, pointing out that even a slight accumulation may cause an upward bend of the air currents whereby a space of comparative calm is produced, and sand more readily comes to rest. In course of time the oval patches of sand are heaped up with a sharper slope to leeward, down which the sand grains fall. Here a hollow is produced by an eddy of the wind, and this eddy serves to maintain and increase a crescentic form with a crater-like opening. The principal winds at Clifton blow from W.S.W., and form the main features in the sandhills; but winds from the E.N.E. blow during the winter months, causing a reverse slope and a bank of sand to be formed near the summit of the long gentle slope which faces the W.S.W. winds. There is a good deal of scour of the original steep leeward slope, but no complete reversal of the shape of the sandhill.

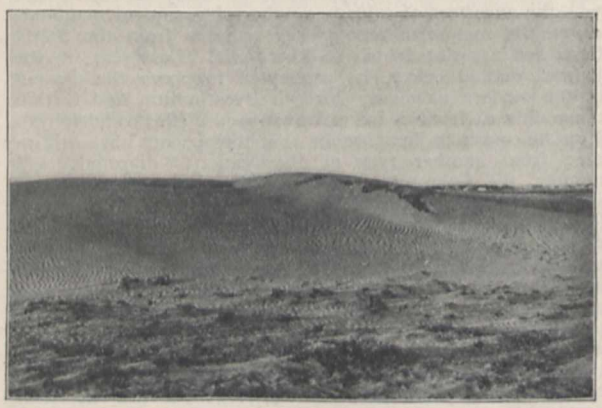

FIG. 1.—Sandhill near Clifton, Karachi, showing change of form and scour by wind.

Mr. Oldham points out that the original hollow is well shown in the accompanying view. The sandhill was first shaped by W.S.W. winds, then a period of E.N.E. winds caused a partial modification of form, heaping up the sand from that side and producing the steep slope facing to left of the picture. The sandhill was afterwards attacked by a S.W. wind, which commenced to reshape it, and this alteration at first led to the formation of notches in the crest, in which the wind became concentrated, leading to a violent scour and to the excavation of deep pits to leeward. The furthest of the notches has been cut down nearly to the foot of the steep slope. Eventually it and the other notches will be widened, and the intervening pinnacles will be lowered until the crest is reduced to a smoothly rounded outline. Mr. Oldham discusses the means which may be taken to arrest the progress of the sandhills, and concludes that much may be done by encouraging the growth of local grasses.

In an essay on the deformation of rocks, Mr. E. H. L. Schwarz (*Trans.* S. African Phil. Soc., xiv., part iv.) discusses their crushing strength, and remarks that this is less when the specimen tested is soaked in water. In natural circumstances in the earth's crust the crushing value of a column of rock, which would crush the layer at its foot, must be estimated by the weight of the material in water, and the author calculates that a column of sandstone must be from about two-thirds of a mile to five miles in height, one of granite from four to seven and a half miles, and one of felsite from seven to nine miles. The actual zone of mass deformation seems to be much nearer the surface, judging by the "creep" in mine-levels, and by the fact, in the case of deep bore-holes, that a cylinder of rock gradually rises from the bottom. The author alludes to the effect that crushing would produce along the bases of deep gorges, and he points out that the line of inquiry indicates that there must be a limit to the height of mountains and to the thickness of ice-sheets. He further discusses the deformation of rocks at great depths by the action of water.

In the *Proceedings* of the Royal Society of Victoria (n.s. vol. xvi. part i.), Mr. F. Chapman describes some new species of Silurian Polyzoa and Brachiopoda. Prof. J. W. Gregory discusses the formation of the Henty peneplain in N.W. Tasmania. In places it is 1300 feet or more above the sea, but is lower towards the north, west, and south. It appears to have been due to river-action in pre-Glacial times, when western Tasmania stood a few hundred feet lower than it does now. Its comparatively recent uplift is shown by the King River, which, east of Mount Lyell, flows through a very ancient flat-floored valley, and then traverses the peneplain in a sinuous narrow canyon.

An elaborate memoir on the Jurassic Trigoniæ of Cutch has been contributed by Dr. F. L. Kitchin to the *Memoirs* of the Geological Survey of India (Pal. Ind., ser. ix., vol. iii., part ii., No. 1). Most of the species of Trigonia have been obtained from the Putchum-Charee series, which, on the evidence of Cephalopoda, has been grouped with the European Bathonian, Callovian, and Oxfordian strata. In no case has Dr. Kitchin been able to identify any of the Cutch Trigoniæ with European species, but while they afford no definite evidence of the correlation above mentioned, they present no obstacles to its acceptance. They flourished in a different zoological province, but the Lower Charee (Callovian) forms bear the imprint of a facies which characterised a slightly earlier age in Europe, a fact suggestive of migration into the Cutch area. No Trigoniæ have been obtained from the Katrol (Kimeridgian) strata, but in the overlying Oomia beds, which appear to be transitional between Jurassic and Cretaceous, there are Trigoniæ that approximate in adult characters to forms found in the Uitenhage strata of South Africa. There is other evidence which suggests community between the Jura-Cretaceous faunas of the two areas, but as the forms in question differ widely in their youthful characters, Dr. Kitchin regards them as indicating homœomorphous derivation from separate stocks. Evolution of this character may have taken place under similar conditions, but it does not imply contemporaneity. The subject is of great im-

portance in the comparison of forms, in the naming of species, and in the correlation of strata by their aid. As the author points out, it demonstrates the necessity for abundant material in palæontological studies.

Mr. W. H. Dall has published a summary of the geological results of the study of the Tertiary fauna of Florida, 1886–1903 (*Trans.* Wagner Inst. Sci., Philad., iii., part vi.). He points out the objections to the method of grouping which was based by Lyell and Deshayes on the percentage of species that survive to the present day, as the conditions may be more favourable for the survival of species in one region than in another. The presence or absence of identical species in the Tertiary beds on either side of the Atlantic may be an important factor in correlation, but while this is partially true of older geological horizons, yet after the Mesozoic epoch the faunal characteristics of the shallow-water Mollusca of different regions became rapidly distinctive. Even in the Eocene but two or three species can be claimed as identical on both shores of the Atlantic, and in later periods it would be unreasonable to expect to find a series of identical species in subtropical marine invertebrate faunas in widely separated regions. In order to establish correlation, we should look for equivalent stages of evolution in relation to preceding and subsequent faunas, and not expect a greater number of identical species than are found in the contemporaneous faunas of distant areas at the present day. Mr. Dall adopts the grouping of Eogene to include Eocene and Oligocene, and Neogene to include Miocene and Pliocene, and he gives detailed lists of fossils. He discusses the physical changes that have taken place, and agrees that no discontinuity of the link between N. and S. America from the Miocene to the present time is probable, and certainly none amounting to a free communication between the two oceans.

A pamphlet on "Rock Phosphates and Other Mineral Fertilisers" has been issued by Dr. Charles Chewings (C. E. Bristow, Adelaide, S. Australia). The object is to give descriptions of the deposits from which mineral fertilisers originate, with notes on the preparation of the phosphate for the market, as an aid to the prospector and to others engaged in the practical applications of the manures. Particulars are given of phosphate deposits in all parts of the world, but special reference is made to those of Clinton, on Yorke's Peninsula, in South Australia. Here a range of hills, formed mainly of Cambrian rocks, rises to an elevation of nearly 400 feet, and beneath the crest, in a N.E. and S.W. direction, the rock phosphate occurs. It extends for more than 104 chains, varies in width from 8 to 20 chains, and is covered to a considerable extent by alluvial deposits. No fossils have been found in the deposit, and the author gives reasons for believing it to have been derived from guano. Selected samples can hardly be distinguished from the phosphate rock of Christmas Island.

According to Mr. E. O. Hovey (*Science*, November 13) the ascending obelisk of Mont Pelée, of which we reproduced an illustration from a photograph taken on June 13 (NATURE, October 1), has since disappeared. Meanwhile, the dome of the cone surmounting the crater has been greatly altered, and a small spine issued from it early in September. This was pushed up 20 metres within a week, and then destroyed by an eruption. Eruptions giving rise to great dust clouds led to the expectation that further serious disturbances might take place. The latest bulletins (October 1 to 19), however, indicate only feeble activity of the volcano.

We have received the subject list of works on the mineral industries and allied sciences in the Library of the Patent Office. This is a helpful guide to the literature of various subjects, and these are arranged under headings of which assaying, clay and clay industries, coal and coal mining, geology descriptive and applied, lead, limestone, peat, uranium and zinc may be taken as examples. The list is, of course, confined to the works in the Patent Office, and it contains titles of a few books and pamphlets that are worthless from a practical point of view, such as "King Coal's Levee" (1820). Institutions should have authority to part with works of this kind, so that they might be placed in appropriate libraries. The practical utility of the list is, however, great, and the price is only 6*d*.

Some Jurassic fossils from Borneo have been described by Mr. R. Bullen Newton (*Proc.* Malacol. Soc., v., October). These include a new species of Trigonia (*T. Molengraaffi*), the genus being recorded for the first time from the rocks of Borneo. The characters of the fossils indicate that the strata belong to the Lower Oolites.

In some notes on the origin of coral reefs (*Amer. Journ. Sci.*, September) Mr. J. Stanley Gardiner remarks that while some reefs may possibly owe their existence to the subsidence of the land round which they originally formed only a fringe, yet the facts collected during recent years prove that such a method of formation was rare and exceptional. Referring to the Maldive group, he shows that a study of the reefs indicates the following stages:—(1) a basis of primitive rock cut down by the action of currents, &c., and lying at a depth of about 200 fathoms in a sea of more than 2000 fathoms; (2) upgrowth of a shoal by means of deep-sea corals assisted by other organisms; (3) outward extension of the reef by means of detritus; (4) surface reef formed by corals, &c.; (5) land, formed by piling up of sand and rubble on the reef; and (6) lagoon, formed partially by the more rapid growth of the organisms on the edge of the original bank, building up an encircling reef, and partially by the solution and erosion of the central parts.

BIOLOGICAL TREATMENT OF SEWAGE.

FOR some years a very interesting series of experiments in connection with the biological method of sewage treatment has been carried on by Dr. Dunbar, director of the Hygienisches Institut at Hamburg, and by his colleagues. Special attention has been directed to the elucidation of the sequence of changes which underlies the purification process in contact beds and percolating filters.

The most recent conclusions are given in a paper read by Dr. Dunbar at the International Congress of Hygiene and Demography at Brussels, and in several papers in the *Gesundheits-Ingenieur*, more especially in one by Messrs. Kattein and Lübbert in No. 25 of that journal. Great importance is attached by the Hamburg workers to the *rôle* played by the process of so-called "absorption" which takes place when the liquid is in contact with the purifying medium. It has been found that sterile clinkers have the power of withdrawing from solution not only colouring matters, but also the highly complex nitrogenous bodies found in sewage.

The exact meaning to be given to the term absorption is carefully discussed by Kattein and Lübbert in their paper, with copious references to the literature of the subject. It is defined as a purely surface action independent of chemical attraction, analogous, in fact, to the condensation of carbonic acid on glass threads observed by Bunsen.

The purification of the sewage by the ordinary biological methods is considered, in the first place, to be due to the "absorption" by the medium of the putrefactive matters in solution, which are afterwards oxidised through the intervention of micro-organisms. Without the activity of the organisms in presence of oxygen, absorption soon ceases.

The absorptive effect increases with the surface exposed, *i.e.* with the fineness of the material. Very considerable reduction of impurities can be effected by a contact of a few minutes, and the effect practically attains its maximum in from four to six hours.

Besides the destruction of the absorbed organic matter, which is due to micro-organisms, some oxidation is effected directly by the atmospheric oxygen, which is also absorbed, and which is shown to be in a specially active condition, as it is capable of instantly oxidising hypochlorites to chlorates, and, more remarkable still, of converting dimethyl-aniline into methyl-violet. The last change can only be brought about in the ordinary way by heating with chlorate, or other powerful oxidising agent.

An interesting example of absorption is seen in the case of the percolating filter adopted by Dr. Dunbar. This filter is provided with a layer of fine material on the surface, about six inches deep. According to Dr. Dunbar, 50 per cent. of the purification, apart from nitrification, takes place in this six inches.

THE ORIENTATION OF THE ANCIENT CHURCHES OF IRELAND.[1]

PROF. J. P. O'REILLY'S paper, although mainly antiquarian, presents certain points of scientific interest worth attention for their novelty and possible application elsewhere. The two churches in question are easily accessible from Dublin, but they have not been fully and sufficiently examined. The author examines what is known of the saint to whom both the churches are said to be dedicated, giving citations from the public records relative to the saint's name and its various forms. He shows that there are at least four different saints of the name of Begga mentioned having different festival days, and points out the admitted uncertainty existing as to the dedicatory saint in question. As a solution, he takes into account the orientation of Dalkey Town Church, assuming that the church was oriented to the rising sun of the saint's festival day. The older or western part of the church is oriented E. 8° 10′ N., while the newer or eastern part or chancel has that of E. 9° 30′ N. He finds the sun to present a northing corresponding to these figures between April 11 and 15 on his passage northward, and between August 29 and *September* 2 on his passage southwards. "As regards," he says, "the festivals of saints mentioned as occurring between August 29 and September 2, the nearest in date would be that of St. Bega (September 3) (the saint venerated at Dunbar)." Hence he draws the conclusion that she was the particular St. Bega to whom the church was dedicated.

Prof. O'Reilly then considers the church on Dalkey Island, points out its remarkable position, gives the details of its structure, and argues that the belfry (so called) was most probably used as an observatory for the determination of the equinox in particular, and for the observation of the stars so as to fix the hours of service. This argument he supports by several citations and a description of the meridian line, with inscriptions, existing in St. Sulpice Church, Paris. He then compares the south-east window now existing in the Dalkey Island church with that of Dalkey Town Church, and shows their close relation in certain respects. This leads to a detailed examination of the south-east opening of Dalkey Town Church, its dimensions and probable use, for the determination of the saints' festival day by the stoppage of the sunlight rays through it at certain times of the year. He shows that this would happen for one of the compartments of the window on April 9 and *September* 4, so that here again the festival day of St. Bega of Dunbar is pointed out. As regards the orientation of Dalkey Island church, he shows that it is about E. 3° south, not due east. He explains this error from the nature of the ground as previously described, and further points out how the true east and west line is given, and was apparently fixed, by a line passing through a Greek cross carved on a rock opposite the western door, and the north-west angle of the church. Lastly, his measures having been made metrically, he finds that the unit of measurement used in the building was the Spanish "Vara"=0·835m., and gives proofs of this. He thus raises the broad and interesting question of the unit or units of measurement having been in use in Ireland previous to the adoption of the British standard of feet and inches, and invites further investigation in this respect.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. H. Young, Peterhouse, has been approved for the degree of Doctor of Science.

A vacancy for a university lecturer in histology has been caused by the election of Dr. Langley to the chair of physiology. The appointment will be made in the Lent term, 1904.

Dr. Dickinson, Dr. Rolleston, and Dr. Kellock have been appointed additional examiners for medical degrees on account of the large number of candidates in the present term.

The Walsingham medal for biology has not been awarded this year.

The Sheepshanks astronomical exhibition is awarded to Mr. P. E. Marrack, one of the senior wranglers of the year.

The observatory syndicate proposes that the office of assistant director of the observatory should be conferred on Mr. H. F. Newall, who has been observer since 1890, without stipend.

The graces for the organisation of the school of geography were opposed in the Senate on December 5, but were carried by large majorities. A board of studies, a special examination for the ordinary B.A. degree, and a diploma in geography are thereby established.

SIR WILLIAM MATHER will distribute the prizes at the Merchant Venturers' Technical College, Bristol, on Thursday, December 17.

A GIFT of 50,000*l.* has been made by an anonymous donor to University College, London, through Prof. Starling, to be used by the council of the college for the promotion of higher scientific education and research at that institution.

MR. JOHN D. ROCKEFELLER has, we learn from *Science*, offered to give Vassar College 40,000*l.*, or such part of this sum as may be equalled by gifts from other sources before June, 1904. 10,000*l.* has so far been subscribed, and an appeal is made for further gifts.

THE annual meeting of the Association of Technical Institutions will be held at the Leathersellers' Hall, London, on Friday, January 29, 1904. Sir John Wolfe Barry, K.C.B., F.R.S., will occupy the chair, and an address will be given by the president-elect, the Right Hon. Sir John E. Gorst, K.C., M.P.

IT is announced from New York that the committee to control the selection for the Rhodes scholarships available for Americans has been formed. The presidents of Yale and Harvard Universities are the principal members of the committee, which also includes one representative from each State in the Union.

THE University of Ottawa was totally destroyed by fire on December 2. More than five hundred students from all parts of Canada, the United States, and Mexico were in residence. Fortunately they escaped, but several professors were injured, none, however, fatally. Everything in the building was destroyed, the total loss being estimated at 500,000 dollars.

THE first meeting of the court of the University of Liverpool was held on December 5, when Sir Edward Lawrence, Pro-Chancellor, presided. During the course of an address, proposing the adoption of the report and accounts, the chairman said the university had started its career with a property in land, buildings, and investments having a value of more than 500,000*l.* The subscriptions to the university movement in Liverpool amount to 170,000*l.*

A CONFERENCE was held on December 4 between the consultative committee of the Board of Education and representatives of various professional bodies in order to discuss the desirability and feasibility of the introduction of a system of school leaving certificates for England. Similar conferences with representatives of universities and of the teaching profession have previously been held. Lord Londonderry attended the conference for a short time in order to say a few words on behalf of the Board of Education. Sir W. Hart Dyke subsequently took the chair.

MR. R. B. HALDANE, K.C., M.P., presented the prizes and certificates at the Borough Polytechnic, Southwark, on December 4. In the course of his address, Mr. Haldane said that with regard to the movement for the creation of a great school of technology in London, there had been a certain amount of mystery as to its relation to polytechnics and its position generally. The reason that nothing had yet been disclosed was because things were moving, but with such deliberation that it was inexpedient to present pictures of the end when they had not got much beyond the beginning. They were only in the early stages at the present time. Conferences were taking place with various

[1] "Notes on the Orientations and Certain Architectural details of the Old Churches of Dalkey Town and Dalkey Island, Dublin." By Prof. Jos. P. O'Reilly. Abstract of paper read before the Royal Irish Academy, February 23.

experts, and it was hoped that the combined effort of the trustees of the Rosebery scheme, the Government, the great city companies, and the London University would produce a school which would be worthy of London. There would be no overlapping, but they would try to fill up the gaps, and the polytechnics would be linked to this higher school.

A SCHOOL NATURE-STUDY UNION has been established to utilise and make better known facilities which already exist to encourage the study of nature by pupils in primary and secondary schools, and to supplement by work in several new directions the efforts of existing associations. The prospectus of the Union states that it is proposed to promote addresses to children by supplying lantern slides and specimens to teachers desirous of giving lessons on natural objects, and by providing qualified lecturers where desired; to assist in the organisation of school rambles and journeys, in the establishment of school museums and in the arrangement of conferences and natural history field days. The inauguration of a junior department, of reading circles, of circulating libraries for teachers, is also contemplated, as well as the publication of an official organ. Sir George Kekewich, K.C.B., is the president, and the Rev. C. Hinscliff, Bobbing, Sittingbourne, is the hon. secretary of the Union.

AT the annual meeting of the governors of Yorkshire College on Monday, reference was made to the charter for the new university. Donations amounting to 36,000*l.* have been promised, provided that the sum of 100,000*l.* is raised. It is essential that their annual income should be largely increased if the new university is to take the position to which its central position among the industries of Yorkshire entitles it. Lord Allerton, who presided, remarked that they had reached the stage when they might consider the charter assured. The only point raised against the title of "The Victoria University of Yorkshire" was that it might clash with that of the Victoria University of Manchester, but Lord Allerton thought the distinction was well marked. A resolution was passed authorising the council to make any alterations in the draft charter which might appear to them desirable, and to promote a Bill for the incorporation of Yorkshire College in the university when founded, and to take such steps as would tend to secure the foundation of a university for Yorkshire.

SIR W. ANSON, M.P., Parliamentary Secretary to the Board of Education, distributed the prizes to the students at the Goldsmiths' Company's Technical Institute, New Cross, S.E., on December 2, and delivered an address on education, during which he urged the claims of a wide culture and of a broad curriculum. In the course of his remarks Sir William remarked it was no disparagement to language, to history, and to literature to say that they did not explain the wonders of the world around them. It was no disparagement to science to say that it did not reveal to us the great facts and the great thoughts of the men of the past. He believed that practical business men were beginning to find that a liberal education was a good foundation for subsequent scientific and technological study when that had to be applied to business. They were beginning to discover that a man who had had what he would call a liberal education in language, history and literature had thereby laid a good foundation for scientific study or technological study, and that he was more useful for practical purposes than the man who had devoted his whole life to the limited area of one subject of scientific or technological pursuit.

A CONFERENCE of Welsh county councils' representatives on the question of establishing a school of forestry for Wales and Monmouthshire was held recently at Haverfordwest. Mr. E. Robinson, of Boncath, who inaugurated the movement, explained that their object was to plant waste and at present unproductive woodlands in Wales. A school could be established with 100 to 200 acres of land to start with, and the option of acquiring a further 500 or 800 acres, and the total capital outlay ought not to exceed 5000*l.* to 8000*l.*, which could be contributed by the councils according to their rateable values. He believed the Government would contribute about half the amount required, and he assumed that an annual grant of 100*l.* from each of the councils would be sufficient to cover all out-of-pocket expenses, and give a good return on capital. There were about a million acres of waste land in the Principality which could grow timber. The planting would cost not more than 6*l.* an acre. Spread over thirty years, that would require a yearly grant of 100,000*l.* from the Government, the money to be repaid in that period by half-yearly instalments, and by the end of that time they should have plantations worth from 30,000,000*l.* to 40,000,000*l.* In the whole country there were 21 million acres of waste land and quite 8 millions suitable for planting, which in fifty years would be worth fully 650,000,000*l.* sterling. A resolution was adopted that it was desirable to establish a school of forestry for the whole of South Wales and Monmouthshire.

MENTION has already been made (p. 70) of the conference of teachers to be held on January 7–9 under the auspices of the Technical Education Board of the London County Council. The meetings will be held, as in previous years, at the South-western Polytechnic, Manresa Road, Chelsea, S.W. The arrangements for the first day have been made in conjunction with the Geographical Association, and those for the second day in conjunction with the Modern Language Association. The subjects to be discussed in connection with the teaching of geography were announced in our previous note on the meetings. At the sixth meeting, on Saturday, January 9, at 2 o'clock, Prof. J. Perry, F.R.S., will take the chair. Addresses will be delivered by Mr. W. Hibbert on "New Apparatus for the Teaching of Electricity and Magnetism," and by Mr. R. W. Bayliss on "Practical Work in the Teaching of Geometry." A large exhibit of maps, globes, slides and apparatus illustrative of practical methods of teaching geography has been collected by the Geographical Association. Short explanatory lectures will be given on the collection on Tuesday afternoon, January 5, and every subsequent afternoon during the week. There will also be an important art exhibition, including an interesting loan collection of fifteenth and sixteenth century herbals and finely illustrated botanical works, together with a number of plant drawings by John Ruskin and his pupils. No charge will be made for admission to the conference or exhibitions. Application for tickets of admission should be made to Dr. Kimmins, 116 St. Martin's Lane, W.C., or Mr. C. A. Buckmaster, 16 Heathfield Road, Mill Hill Park, W.

IN an address at the Municipal Technical Institute, West Ham, on Thursday last, Sir William White remarked that both elementary and higher technical education are necessary for national progress. There is the technical education which belongs to those who are trained from the first with the idea of becoming directors, managers, heads of businesses. This may be called the higher technical training for those who are intended to be captains of industry. Both kinds of training are necessary. The time has passed when the idea prevailed that technical instruction for the artisan should be limited to the workshop or the factory. Skill in handicraft and knowledge of practice and precedent no longer suffice. Every man engaged in industrial work should have the opportunity, if he so desires, of acquiring a knowledge of principles as well as of processes. For the workers themselves such knowledge is advantageous. Work done intelligently must be better done. From well-instructed workers better results are obtained than from others not so well informed. It is reasonable, also, to anticipate that from trained men should come more valuable suggestions for improvements in methods and processes that may reduce the cost of production and advance manufacture. In the stress of industrial competition, ever increasing in severity, it is absolutely necessary to the maintenance of our national position in the markets of the world that no advantage which technical training can give should be unrealised. Elementary technical instruction adapted to the working classes is by common consent a necessity of any scheme of State-aided technical instruction, and it seemed to Sir William White that to devote attention solely to higher technical instruction and to lavish our resources upon it exclusively, or even chiefly, would be a fatal mistake in the national interest. For sixty years the Admiralty has had a system of technical training for dockyard apprentices at the Royal dockyards, and there is no system of elementary technical education in existence that, in his judgment, has been so thoroughly proved. It is no exaggeration to say

that this Admiralty system of training has produced the majority of the men who are now occupying the leading positions in the shipbuilding industry of this country; that it has given to the private shipbuilders its leaders, who have risen from the working classes; and that it has produced many men holding responsible positions in other parts of the world.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 18.—Dr. W. A. Tilden, F.R.S., president, in the chair.—The union of carbon monoxide and oxygen, and the drying of gases by cooling, by Mr. A. F. **Girvan.** A series of experiments with various cooling agents was made, to determine whether aqueous vapour could be so far removed from mixtures of these two gases by cooling that they could no longer be exploded electrically. It was found that after having been cooled to a temperature of −35° the mixture exploded feebly, and that if it had been cooled to below −50° explosion did not occur; whence it appears that there must be at least one molecule of water in 24,000 molecules of the mixture in order that such mixtures may explode.—Simplification of Zeisel's method of methoxyl and ethoxyl determinations, by Dr. W. H. **Perkin**, sen., F.R.S. The vertical condenser and washing bulbs are dispensed with, it having been found that the hydriodic acid is completely retained by using a long-necked distilling flask with its side arm arranged to slope slightly upwards. —The rusting of iron, part ii., by Dr. G. T. **Moody.** The salts which inhibit the formation of "rust" on iron are divisible into two classes, viz. those which are strongly alkaline, and therefore absorb carbon dioxide, *e.g.* sodium phosphate and borate, and those which are decomposed by carbon dioxide, *e.g.* sodium nitrite, acetate, and formate. The author is of opinion that the non-formation of "rust" in presence of these salts is due, therefore, to their removal of carbon dioxide from the air, and not, as was suggested by Dunstan, to their property of destroying hydrogen peroxide.—Constitution of ethyl cyanoacetate. Condensation of ethyl cyanoacetate with its sodium derivative, by Messrs. F. G. P. **Remfry** and J. F. **Thorpe.**—The action of water and dilute caustic soda solutions on crystalline and amorphous arsenic, by Mr. W. T. **Cooke.** Amorphous arsenic is dissolved to a minute extent only, by prolonged ebullition of the element in water or aqueous solutions of sodium hydroxide even in presence of air. The crystalline form of the element, on the other hand, is also only slightly soluble in water and caustic soda solutions in presence of inert gases, but in presence of air the solubility is greatly increased.—Note on a double chloride of molybdenum and potassium, by Prof. G. G. **Henderson.** A description of the method of formation and of the properties of this salt, the composition of which is represented by the formula $3KCl,MoCl_3,2H_2O$, was given.—The action of benzamidine on olefinic-β-diketones, by Dr. S. **Ruhemann.**—Dissociation constants of trimethylenecarboxylic acids, by Messrs. W. A. **Bone** and C. H. G. **Sprankling.** A comparison of the values of these dissociation constants with those of the corresponding saturated open-chain acids shows that the formation of a closed ring increases the values of these constants.—The elimination of hydrogen bromide from bromo-*gem*-dimethylsuccinic acid and from bromotrimethylsuccinic anhydride, by Messrs. W. A. **Bone** and H. **Henstock.**

Mineralogical Society, November 17.—Dr. Hugo Müller, F.R.S., president, in the chair.—Mr. R. H. **Solly** gave a detailed description of various minerals from the Binnenthal, five of which had not been identified with existing species. These five minerals all contain lead, arsenic and sulphur, but sufficient material for complete analyses has not yet been obtained. Three of them are red transparent minerals having each one perfect cleavage and a similar vermilion streak, but differing crystallographically: one is apparently orthorhombic with (100), (110)=39° 16′, (010), (011)=52° 57′ and (001), (101)=42° 43′; another is oblique with β=78° 46′, (100), (101)=42° 22′ and (010), (111)=37° 3′; while the third has a zone at right angles to the perfect cleavage with angles of approximately 30° and 60°. The other two minerals, which could not be identified with any of the other sulpharsenites of lead previously described by the author, are black with metallic lustre. One of these is oblique with β=81° 11′, (100), (101)=40° 7′, (010), (111)=55° 26′; it has a perfect cleavage (100), and, like liveingite, exhibits no oblique striations on the planes in the zone [100, 001]. The other mineral is also oblique with β=89° 40′, (100), (101)=46° 18′, and (010), (111)=59° 56′; it has a perfect cleavage (100), and, like rathite, exhibits numerous oblique striations on the planes in the zone [100, 001]. On fine brilliant crystals of sartorite recently obtained by the author he has been able to confirm the oblique symmetry which he had previously announced, and to determine accurately the elements, β=88° 31′, (100) (101)=54° 45′, (010) (111)=69° 52½′. Amongst other specimens from the dolomite of the Lengenbach in the Binnenthal, the author exhibited and described peculiar rounded crystals of galena resembling seligmannite, hyalophane crystals twinned according to the Carlsbad law and showing three new forms, a green mica which was determined to be anorthic, albite and biotite, minerals which have not yet been hitherto recorded from the locality, and barytes in green crystals. Of specimens from the Ofenhorn, the author exhibited some remarkably fine crystals of anatase, and crystals of laumontite, a mineral new to the locality.—Mr. L. J. **Spencer** described crystals of adamite from Chili which were remarkable for their strong pleochroism.—Mr. G. F. Herbert **Smith** discussed the prismatic method of determining indices of refraction. From observations of the angles of incidence and deviation the refractive index and direction of the wave-front in the crystalline medium could be found. By using pairs of faces in the same zone and different angles of incidence a series of refractive indices is obtained which, when plotted with the direction angle as ordinate, gives in general a double curve. Three of the critical values are the principal indices, the fourth corresponding to the direction parallel to the zone-axis. The angles of polarisation with respect to the zone-axis provide a means of discriminating between the doubtful values. A description was given of an inverted goniometer whereby observations could be made in media other than air.

Linnean Society, November 19.—Prof. S. H. Vines, F.R.S., president, in the chair.—The Rev. John **Gerard**, S.J., exhibited a fasciated rose sent by the Rev. J. Dobson, of St. Ignatius's College, St. Julian, Malta, with this note:—"A freak of a white climbing rose, in which eight or nine blossoms with their stalks have grown together." —The Rev. R. Ashington **Bullen** brought for exhibition an albino mole, from a farm near Bagshot; it was wholly of a light fawn colour, and no similar specimen had been seen for at least twenty years, though many moles had been trapped on the same farm.—Dr. M. T. **Masters**, F.R.S., gave an abstract of his paper, a general view of the genus Pinus. The author stated that the object of the paper was to discuss the nature and value of the characters made use of in discriminating the various species of Pinus, and to supply additional points of distinction derived from the anatomical structure of the leaf and other sources. The author has framed an analytical table of the species, which, although mainly artificial, may be of assistance hereafter in facilitating the determination of the species, and in arranging them in more natural groups. The two main divisions adopted are the thin-scaled pines or Tenuisquamæ, and the thick-scaled pines or Crassisquamæ, according to the relative thickness of the cone-scales. Further subdivisions are founded on various points of distinction.—Contributions to the embryology of the Amentiferæ, part ii., *Carpinus Betulus*, by Dr. Margaret **Benson** and Miss Elizabeth **Sanday.** More than 500 accurately orientated, stained and mounted series of sections were obtained through ovules containing the earlier stages in the development of the numerous embryo-sacs, until the segmentation of the definitive nucleus and of the egg occurred. Former observations (see part i. in *Trans.* Linn. Soc., ser. 2, bot. iii. (1894), pp. 409–424) were confirmed and the following new facts obtained. The polar nuclei meet at the neck of the cæcum, descend together and ultimately fuse near its base. The pollen-tube enters the sac in their vicinity, and provides some means of exit for one male gamete, which seems to be emitted into the cæcum

and makes its way to the definitive nucleus. Meanwhile the other male gamete is carried up by the tube and emitted into the substance of the egg, with which it fuses after a short delay. A wall is now formed round the egg, and when a considerable amount of endosperm is present, segmentation of the egg commences.

Royal Microscopical Society, November 18.—Dr. Hy. Woodward, F.R.S., president, in the chair.—Dr. Ed. **Horder** exhibited and described a metal clinical case for blood film work, &c.—Mr. **Taverner** exhibited on the screen two photographs of the leg of a water-mite which he had taken through the separate tubes of a binocular microscope to demonstrate that the images were dissimilar and capable of producing a true stereoscopic effect; if they were alike, the apparent solidity of the object as seen through the binocular microscope would be only a mental effect. He also exhibited in a stereoscope enlarged prints of the pair of photographs, which clearly showed that a true stereoscopic effect was produced.—Prof. J. D. **Everett,** F.R.S., read a note on Lord Rayleigh's paper of 1896, one part of which he had found specially difficult, namely, that in which the transition is made from direct to oblique illumination of a grating under the microscope. He had recently found a more direct mode of deducing the results there established, and that was set forth in the present communication. Lord Rayleigh, to whom he had submitted the note, said that on a cursory examination the new method of deduction seemed to be correct. Prof. Everett then proceeded to explain his proof by diagrams and formulæ on the blackboard.—Mr. W. **Wesché** gave a *résumé* of his paper on the mouth parts of the Nemocera and their relation to the families in Diptera, illustrated by a number of drawings shown on the screen by the epidiascope, and mounted specimens exhibited under microscopes.

CAMBRIDGE.

Philosophical Society, November 23.—Dr. Hobson, vice-president, in the chair.—The horse in Iceland and the Færöes, by Mr. F. H. A. **Marshall** and Mr. Nelson **Annandale.**—Note on the proportion of the sexes in *Carcinus maenas,* by Mr. R. C. **Punnett.**—On the transmission of earthquake waves through the earth, by the Rev. O. **Fisher.**—The action of ultra-violet light on moist air, by Mr. J. H. **Vincent.**—Experiment to show that negative electricity is given off by a metal exposed to Röntgen rays, by Prof. **Thomson,** F.R.S. Dorn, as well as Curie and Sagnac, have in different ways shown that a metal exposed to Röntgen rays gives out kathode rays; this can be shown very simply by mounting a small gold-leaf electroscope on a quartz support in a vessel in which a very good vacuum can be produced; when the vessel is exhausted and the gold leaves exposed to Röntgen rays they diverge, and on testing they are found to have a charge of positive electricity. If before exposure to the rays the leaves are charged negatively, then when the rays are applied the leaves at first collapse and then diverge, while if the initial charge is positive the divergence of the leaves increases from the time of putting on the rays. In this way is obtained a very direct proof that the gold leaves when exposed to the rays acquire positive and lose negative electricity.

MANCHESTER.

Literary and Philosophical Society, November 3.—Prof. W. Boyd Dawkins, president, in the chair.—A collection of wind-worn pebbles of quartz and quartzite from an old raised beach near Waverley, North Island, New Zealand, together with photographs, was exhibited by the president. They have been cut by the sand driven by the wind into the characteristic *Dreikanter,* and might easily be mistaken for the work of the hand of man. The direction of the prevalent winds is shown by the amount of work done on each side or facet, the texture of the wind-worn being quite different from that of the wave-worn surfaces. The collection and photographs were made by Lady Constance **Knox** in 1900, and they will be given to the Manchester Museum, Owens College.—Mr. H. E. **Schmitz** gave an account of his experiments on the specific heats of metals at low temperatures. The author gave a summary of his determinations of the specific heats of various metals:—(1) between the temperature of liquid air and the ordinary temperature; (2) between the ordinary temperature and the temperature of steam. For the former temperature range two methods were used. Of these the first was the method of mixtures. The second method is similar in principle to Joly's well-known method of steam condensation, but here the weight determined is that of a deposit of ice. The final results show a variation of specific heat considerable in all cases, but more marked for metals of low than for metals of high atomic weight. This is shown by the following ratios of specific heat for lower range to specific heat for higher range for various metals:—aluminium 0·79, nickel 0·77, cobalt 0·78, copper 0·85, zinc 0·90, silver 0·92, tin 0·90, thallium 0·92, lead 0·96.

PARIS.

Academy of Sciences, November 30.—M. Albert Gaudry in the chair.—On the scapular and pelvic fins of fishes, by M. Armand **Sabatier.**—Observations made at the island of Réunion on the eclipse of the moon of October 6, by MM. Edmond **Bordage** and A. **Garsault.** The observations were much hindered by clouds, only two good photographs being obtained, one being at the moment of greatest shadow.—The last sun-spot minimum, and remarks on the subject of the law of zones, by M. J. **Guillaume.** It is suggested that the distribution of sun-spots in latitude has not followed the law of zones, due to Spörer.—The problem of Cauchy relating to a particular class of surfaces, by M. W. **de Tannenberg.**—On the effective representation of certain discontinuous functions, as limits of continuous functions, by M. Émile **Borel.**—On a class of functional equations, by M. S. **Lattès.**—Articulations with a flexible plate, by M. A. **Mesnager.**—On the temperature of flame, by M. Ch. **Féry.** After a critical examination of the errors involved in the use of thermocouples, an alternative method is proposed in which no solid body is introduced into the flame. The measurement is made by the production of the reversal of a metallic line, by means of rays emitted by a solid body carried to any convenient temperature. The method is accurate to about 10° C., and has been applied to the determination of the temperatures of a Bunsen flame, an acetylene flame, alcohol, hydrogen, and oxyhydrogen blowpipe flames.—On some phenomena presented by mercury arcs, by M. **de Valbreuze.** Some of the peculiarities observed in starting the arc appear to indicate the existence of a superficial membrane on the mercury which opposes the passage of the current, especially in the cold.—On the suppression of magnetic hysteresis by the action of an oscillating magnetic field, by M. Ch. **Maurain.** Some recent experiments by M. Marconi and M. Tissot on a new receiver for wireless telegraphy have directed attention to the action of a rapidly varying magnetic field upon magnetisation produced under ordinary conditions. This action is attributed by M. Marconi to the suppression of the time lag, by M. Tissot to a modification of ordinary hysteresis with respect to the field. The quantitative experiments of the author agree with the latter of these hypotheses.—On the law of regular distribution of total magnetic force of the earth in France on January 1, 1896, by M. E. **Mathias.**—The magnetic anomaly of the Paris basin, by M. Th. **Moureaux.**—On the fusibility of mixtures of the sulphides of bismuth and silver, and of the sulphides of bismuth and antimony, by M. H. **Pélabon.** The fusibility curve of mixtures of bismuth and silver sulphides is a polygonal line presenting two minima and a maximum, the latter corresponding to a definite compound of the formula $Ag_2S.4BiS$.—Stimulating or paralysing influences acting upon manganese considered as a ferment, by M. A. **Trillat.** A study of the precise conditions under which the maximum oxidising effect is obtained from small quantities of manganese salts, acting as metallic ferments.—The systematic alkylation of arsenic, by M. V. **Auger.** An extension of Meyer's reaction; sodium methylarsenate is reduced by sulphurous acid to methylarsine oxide, and this is treated with methyl alcohol, soda, and the alkyl iodide.—The separation of iodine in the state of alkaline salt from bromides and chlorides by its transformation into iodic acid, and on the preparation of pure iodine, by MM. H. **Baubigny** and P. **Rivals.** The solution is oxidised in alkaline solution with potassium permanganate, the iodine

being thus converted into iodate, and after the addition of copper sulphate the bromine is distilled off in a current of air. On acidifying with sulphuric acid the chlorine can then be distilled off. Test analyses are given.—The microscopic study of the prehistoric bronzes of the Charente, by M. G. **Chesneau.**—On the eggs of *Bombyx Mori*, by M. Jules **Gal.**—On the egg production, fecundity, and sexuality in carnivorous fowls, by M. Frédéric **Houssay.**—On the infectious exophthalmia of certain fresh-water fishes, by M. J. **Audigé.**—Contribution to the cytological study of the Ascomycetes, by M. **Guilliermond.**—On the geological synthesis of the eastern Alps, by M. Pierre **Termier.**—On a remarkable case of spontaneous crystallisation of gypsum, by M. Stanislas **Meunier.**—Luminous sensation as a function of the time for coloured light: technique and results, by MM. André **Broca** and D. **Sulzer.**—On the prediction of the yield of the sources of the Vanne, by M. Edmond **Maillet.**

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 10.

ROYAL SOCIETY, at 4.30.—On the Integrals of the Squares of Ellipsoidal Surface Harmonic Functions: Prof. G. H. Darwin, F.R.S.—Preliminary Note on the Resistance to Heat of *B. Anthracis*: A. Mallock, F.R.S., and Lieut.-Col. A. M. Davis.

MATHEMATICAL SOCIETY, at 5.30.—Proof of a Formula in Elliptic Functions: Mr. R. J. Dallas.—On Many-valued Newtonian Potentials: Prof. A. C. Dixon.—A Generalisation of Neumann's Expansion of an Arbitrary Function in a Series of Bessel's Functions: Rev. F. H. Jackson.—Modes of Convergence of Infinite Series of Functions of a Real Variable: Dr. E. W. Hobson.—On Normal and Antinormal Piling: Prof. J. D. Everett.—On the Distribution of the Points of Uniform Convergence of a Series of Functions: Mr. W. H. Young.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presentation to representatives of the Borough of Colchester of a historical picture representing Dr. Gilbert in the act of showing his electrical experiments to Queen Elizabeth and her Court.—The Slow Registration of Rapid Phenomena by Strobographic Methods: the "Ondographe" and "Puissancegraphe" (Wave Recorder and Power Recorder): M. E. Hospitalier.—The Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines: Dr. Hans Behn-Eschenburg.

SOCIETY OF ARTS, at 4.30.—India's Place in an Imperial Federation: J. M. Maclean.

FRIDAY, DECEMBER 11.

PHYSICAL SOCIETY, at 8.—A Method of Mechanically Reinforcing Sounds: Rev. T. C. Porter.—The Simmance-Abady "Flicker" Photometer: Messrs. Simmance and Abady.—Exhibition of a Conductometer: R. Appleyard.—A Model to illustrate various Properties of Wave-motion: Prof. L. R. Wilberforce.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Rotation Period of the Planet Saturn: W. F. Denning.—The Shower of Leonids in 1903: G. W. Hough.—*Probable Papers*:—Two Drawings of the Mare Serenitatis by John Russell, R.A., affording some hitherto Unpublished Evidence as to the appearance of Linné in the Year 1788: A. A. Rambaut.—On Graphical Methods of finding the Time of Sunset at any Place: H. H. Turner.—On Oscillating Satellites; Second Paper: H. C. Plummer.—An Examination of the Relative Star Density in different Parts of the Plates forming the Harvard Photographic Star Map: J. C. W. Herschel.

MALACOLOGICAL SOCIETY, at 8.—On *Pleuronautilus pulcher*, sp. nov.: G. C. Crick.—Description of a New Species of Cassis: E. A. Smith.—On the Mollusca procured during the *Porcupine* Expedition 1869-1870, Supplemental Notes, Part I.: E. R. Sykes.—Notes on the Nervous System of Pelecypoda: R. H. Burne.

MONDAY, DECEMBER 14.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Patagonian Andes: Col. Sir T. H. Holdich, K.C.M.G., K.C.I.E.

VICTORIA INSTITUTE, at 4.30.—The Genesis of Nature: Rev G. F. Whidborne.

SOCIETY OF ARTS, at 8.—The Mining of Non-Metallic Elements: Bennett H. Brough. (Cantor Lectures. IV.)

TUESDAY, DECEMBER 15.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Deposits in Pipes and other Channels conveying Potable Water: Prof. J. Campbell Brown.—The Purification of Water Highly Charged with Vegetable Matter; with Special Reference to the Effect of Aëration: Osbert Chadwick, C.M.G., and Bertram Blount.

SOCIETY OF ARTS, at 8.—The British Silk Industry: Frank Warner.

ROYAL STATISTICAL SOCIETY, at 5.—The Metrical System of Weights and Measures: Alex. Siemens.

WEDNESDAY, DECEMBER 16.

CHEMICAL SOCIETY, at 5.30.—On the Relative Strengths of the Fixed Bases and of Ammonia as Measured by their Action on Cotarnine: J. J. Dobbie, A. Lauder and C. K. Tinkler.—New Halogen Derivatives of Diphenyl and Dihydroxy-diphenyl: J. C. Cain.—(1) Constitution of Nitric Peroxide; (2) Sabatier's Nitroso-disulphonic Acid: E. Divers.—Notes on some Natural Colouring Matters: A. G. Perkin and E. Phipps.—The Estimation of Methyl Alcohol in Presence of Ethyl Alcohol: T. E. Thorpe and J. Holmes.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Some Account of the Meteorological Work of the late James Glaisher, F.R.S.: William Marriott.—On certain Relationships between the Diurnal Curves of Barometric Pressure and Vapour Tension at Kimberley, South Africa: J. R. Sutton.

ROYAL MICROSCOSICAL SOCIETY, at 8.—On the Structure and Affinities of the Genus Porosphæra: Dr. George J. Hinde, F.R.S.—Exhibition Slides illustrating the Development of an Ascidian: F. W. Watson Baker.

GEOLOGICAL SOCIETY, at 8.—The Igneous Rocks Associated with the Carboniferous Limestone of the Bristol District: Prof. C. Lloyd Morgan, F.R.S., and Prof. S. H. Reynolds.—The Rhætic Beds of England: A. Rendle Short.

SOCIETY OF ARTS, at 8.—The Science of Taxation and Business: Sir William H. Preece, K.C.B., F.R.S.

THURSDAY, DECEMBER 17.

LINNEAN SOCIETY, at 8.—On the Docoglossa; a Study in Evolution H. J. Fleure.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, DECEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—An Inquiry into the Working of various Water-Softeners: C. E. Stromeyer and W. B. Baron.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Action of the Sea upon the Foreshore: C. B. Case.—The Causes of the Loss of Beaches: F. W Cable.

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