THURSDAY, APRIL 15, 1886

BIRD-MURDER

A VERY urgent appeal to the public has just been issued in America by our contemporary *Science*, which journal has attached to its issue of February 26 a special "Supplement" devoted to the question of "the present wholesale destruction of bird-life in the United States." Powerful articles have been written by Messrs. J. A. Allen, W. Dutcher, and G. B. Sennett, three prominent American ornithologists, in which the facts have been plainly set forward, remedial legislation proposed, ending with an "appeal to the women of the country on behalf of the birds."

The American Ornithologists' Union has also appointed a "Committee on Bird-Protection," and from the names of the gentlemen who are serving on it, it is quite certain that practical remedies will be forced on the consideration of the American people, and that energetic efforts will be made to preserve the birds from destruction. But it is equally certain that a corresponding effort must be made by civilised nations on this side of the water, if remedial measures are to have a real effect, and we are glad to find that steps are being taken to attract public attention to the gross scandal which now exists in our midst. A "Selborne Society" has been formed, of which Mr. G. A. Musgrave, of 45, Holland Park, is the secretary, and of which H.R.H. Princess Christian is a patron, for the protection of birds. Invoking the shade of the gentle Gilbert White of Selborne, this Society may hope to prevail somewhat with the English nation, which would undoubtedly protest with the same vehemence on behalf of the small songsters of England, as it did some years ago on behalf of the sea-birds, if the facts are but put plainly forward. We are certain that if the women of this country only knew the real state of the case, the senseless and savage decorations now in vogue would be regarded with disgust and loathing. The Selborne Society has but just commenced its labours, but already many excellent well-wishers have joined it, and it numbers amongst its members many names famous in society, in art, in literature, and in science.

There is scarcely a portion of the world which is not being devastated of its birds at the present moment to minister to the fashionable wants of the women of Europe and America, and it is as well that the root of the evil should be recognised at once. This has been done in America, and the point must be insisted on again and again in this country, that the vanity of womankind is in this enlightened age the cause of the "wholesale destruction of bird-life" on this side of the Atlantic as much as in America. Nor is it confined to the higher classes. The difference between the factory-girl and the high-born lady as regards the question of bird-feather decoration is only one of degree, the former paying as many halfpence for the starling's wing in its natural state as the latter does in shillings for the same article dyed or gilt out of recognition as it may be. New Guinea and the Papuan Islands are being despoiled of the birds of paradise, India and Africa of their sun-birds and rollers, Southern Europe of its bee-eaters, until every one of these countries is being exhausted of its feathered denizens. It is no longer the brightly-plumaged species which are being laid under contribution, for, as exhaustion has begun to limit the supply, the soberly-clad birds are now being shot down in thousands to minister to "fashion" in this country. Thus any one with a knowledge of birds has only to walk down any fashionable thoroughfare in London, and note the materials with which the bulk of the hats in the milliners' shops are decorated, to see that robins, sparrows, larks, and starlings are a staple commodity with the trade in this country. Dyed they are in most cases, and occasionally relieved by the wings of some Indian "jay" (*i.e.* roller), or African "merle" (glossy starling) or sun-bird, or it may be with a few "osprey" feathers. These last are the long breeding-plumes of the egrets, which are developed only during the nesting season, and the slaughter amongst these birds at that time of the year must be something incredible. No wonder that Mr. Allen complains that the "swamps and marshes of Florida have been depopulated of their egrets and herons." It is not as if the birds thus slaughtered were harmful, the killing of them beneficial. On the contrary the majority of the species now massacred are distinctly beneficial to the countries they inhabit, and surely no one could wish that this country should be deprived of its birds and reduced to the generally unaviferous aspect of France and Italy.

It is said that legislation in the direction of the further protection of birds would be an interference with the legitimate industry of the "plume" trade. This is by no means the case. There are many birds which are used as articles of food, the plumage of which could be utilised for decorative purposes; and that this is well known by the trade is evidenced by the large number of dyed fowls' wings which figure largely in the composition of hat and bonnet ornament. Just as before, when the outcry against the slaughter of gulls and sea-birds rendered the wearing of their feathers unfashionable, the milliners adapted their wares to the wants of their customers, so would they once more find substitutes for the larks, robins, and other small birds which they now use by the thousand.

Our American brethren have put forward some practical suggestions with regard to a stoppage of the traffic. Mr. Allen shows that in the natural order of things birds have already sufficient enemies to contend against without having the hand of man turned against them too. Vast numbers perish in the eggs, which are the food of many predatory animals, and numbers perish while yet too young to defend themselves against their enemies. To stress of weather also and the trials of migration large quantities of birds succumb, and a severe winter like the last one causes the death of birds of all classes alike. On the top of all these ills which ornithological flesh is heir to, comes a bloodthirsty demand from the women of civilised nations for their small bodies to adorn hats or ball-dresses—in order that our belles may not leave the monopoly of feather ornamentation to savages. Statistics have not been published giving an exact account of the number of birds annually sold in London by auction for the plume trade, but it is well known that the numbers are enormous. Thirty thousand ruby-and-topaz humming-

birds are said to have been sold some years ago in the course of an afternoon, and the number of West Indian and Brazilian birds sold by one auction-room in London during the four months ending April 1885, was 404,464, besides 356,389 Indian birds, without counting thousands of Impeyan pheasants, birds of paradise, &c. In Mr. Dutcher's article on the "Destruction of Birds for Millinery Purposes," he quotes from an article in *Forest and Stream*, wherein one dealer, during a three months' trip to South Carolina, prepared no less than 11,000 skins. "A considerable number of the birds were, of course, too much mutilated for preparation, so that the total number of the slain would be much greater than the number given. The person referred to states that he handles, on an average, 30,000 skins per annum, of which the greater part are cut up for millinery purposes." During four months 70,000 birds were supplied to New York dealers from a single village on Long Island, and an enterprising woman from New York contracted with a Paris millinery firm to deliver during this summer 40,000 or more skins of birds at 40 cents apiece. From Cape Cod, one of the haunts of the terns and gulls, 40,000 of the former birds were killed in a single season, so that "at points where, a few years since, these beautiful birds filled the air with their graceful forms and snowy plumage, only a few pairs now remain." The above extracts out of many interesting facts which could be quoted from the articles in *Science*, give some idea of the slaughter which is going on at the present time, and it is to be hoped that some *immediate* steps may be taken to call public attention to this wholesale bird-murder, before the nesting season begins, when most of the mischief is done among the sea-birds, which congregate in large numbers at that time of year.

Space does not permit us to traverse the whole of the ground taken up by our contemporary, whose articles occupy fifteen pages, but we trust that they will be perused by our readers for themselves. Mr. Sennett's essay on the "Destruction of the Eggs of Birds for Food" proves the wanton waste which accompanies the ways of the professional "egger," to say nothing of the cruelty which accompanies the taking of the eggs. The "Relation of Birds to Agriculture" is a well-written article, as is also an essay on "Bird-Laws," the latter containing resolutions which, if adopted by the Legislature, would undoubtedly prove of great service in protecting bird-life on both sides of the water, but no legislation will avail unless the women of America and Europe can be made to understand that they are absolutely responsible for the wholesale destruction of birds which is now going on, to the great benefit of the plume trade and the milliners, but to the everlasting detriment of the world on which we live. We should like to see some authorised body, such as the British Ornithologists' Union, the Selborne Society, or a Committee of the British Association, taking this matter in hand and organising public meetings to bring the true facts of bird-slaughter before the public; and we have every faith in the good sense of English women to secure a stoppage of the trade which exists by their patronage alone, and which is thoroughly antagonistic to the instincts of humanity.

R. Bowdler Sharpe

MR. GEIKIE'S "CLASS-BOOK OF GEOLOGY"

Class-Book of Geology. By Archibald Geikie, LL.D., F.R.S. (London: Macmillan and Co., 1886.)

"GEOLOGY is essentially a science of observation. The facts with which it deals should, as far as possible, be verified by our own personal examination. We should lose no opportunity of seeing with our own eyes the actual progress of the changes which it investigates, and the proofs which it adduces of similar changes in the far past. To do this will lead us to fields and hills, to the banks of rivers and lakes, and to the shores of the sea. We can hardly take any country walk, indeed, in which with duly observant eye we may not detect either some geological operation in actual progress, or the evidence of one which has now been completed. Having learnt what to look for and how to interpret it when seen, we are as it were gifted with a new sense. Every landscape comes to possess a fresh interest and charm, for we carry about with us everywhere an added power of enjoyment, whether the scenery has been long familiar or presents itself for the first time. I would therefore seek at the outset to impress upon those who propose to read the following pages, that one of the main objects with which this book is written is to foster a habit of observation, and to serve as a guide to what they are themselves to look for, rather than merely to relate what has been seen and determined by others."

In these words, which form the concluding paragraph of the introduction to Mr. Geikie's "Class-Book on Geology," we have the key-note to the whole work, and the promise which they contain is amply redeemed in the pages which follow. Our author has wandered over many lands; he has always carried with him eyes to see, and the habit of using them which he strives so earnestly and so successfully, in this his latest book as in those which have preceded it, to develop in his readers; and out of the stores of his ripe and varied experience he brings, to throw light on his subject, a wealth of illustration which excites the envy, while it commands the admiration, of those who have not enjoyed all the opportunities for varied observation which have fallen to his lot. But even if passing feelings of envy will obtrude themselves as one happy illustration after another, new from this quarter and new from that, finds a fitting place in the narrative, they soon give way to the pleasanter feeling of satisfaction that these opportunities have been placed within the reach of one who knows so well how to use them; not for the advancement of his own knowledge merely, but whose chief pleasure is to distribute with open hand his treasures to all who care to share them, who has the seeing eye to note, the ready pencil to depict, and the facile pen to paint in words all those manifold workings of nature by the study of which geology was snatched from the shadowy realms of guess-work, and based on a firm scientific foundation.

At the very outset geology is looked at in its proper light, not as an amusement for the collector and a means of learning where he will get pretty and curious objects for his cabinet, not as a field where the ingenuity or perversity of the classifying mind may delight itself with grouping natural products as reason or fancy prompts, not in any other of these limited aspects,

beyond which it is to be feared the vision of some geologists never reaches; but as a history, the history of the earth during ages long gone by. And as the historian is careful to inform his readers of the sources from which he has drawn his information, what manuscripts he has collated, what monuments he has inspected, what inscriptions he has deciphered, so the book opens with a description of the materials which are available for constructing a history of the earth. First of all we are reminded that "that history is in progress now as really as it has ever been, and that its events are being recorded in the same way and by the same agents as in the far past;" so that "if we would explore its records in the dark backward and abysm of time, we must first make ourselves familiar with the manner in which these records are being written from day to day before our eyes." We are introduced to this study by an account of the manner in which atmospheric agents are bringing about ceaseless decay over the whole of the surface of the globe. The important part played by the freezing of water receives due notice, but it would seem that sufficient stress is not laid on the magnitude of the force generated during this process. That ice "pushes aside the particles between which it is entangled" would hardly prepare one who does not know it for the fact that ice can burst asunder a cast-iron shell. The figure on p. 72, it may be noticed in passing, does not strike us as very happy. We must also take exception to the reasoning on p. 105: so very little is known about the formation of the manganese nodules and coatings of the abysmal depths of the ocean, that it is somewhat risky to assume that it was an exceedingly slow process. Perhaps, too, a little over-confidence is shown in treating of "fissure eruptions"; doubtless some otherwise puzzling facts do receive easy explanation on the hypothesis that such eruptions have taken place, but this is not enough to convert the hypothesis into a certainty.

We next pass to a description of the more important elements, minerals, rocks, and rock-structures of the earth's crust. It is extremely difficult to decide how much or how little chemistry and mineralogy is desirable in an elementary treatise on geology. It is not safe to refer to special works on these subjects, because the majority of readers would not take the trouble to make the reference, and yet the descriptions which the limits of space will allow of are necessarily so curt and meagre as to be of little practical use; if therefore we criticise any portions of Chapters X. and XI. it is not because we are not fully alive to the difficulties of dealing in an elementary fashion with the subjects of which they treat. In the definition of a mineral it should certainly have been stated that minerals, besides having definite chemical composition and definite geometrical form, have also definite physical properties, such as hardness, which are most valuable as means of recognition.

Again, in the description of a crystal, one of the first points to impress on a beginner is that the dimensions of the faces and edges are of no importance, and that the one thing to note is the constancy of the interfacial angles, and this is a simple truth which any one may be got to understand; we wish this had been brought out more clearly. The author has followed the time-honoured custom of giving a brief summary of the six crystallographic systems. We are sadly afraid that the descriptions, though perfectly accurate as far as they go, and the excellent figures by which they are illustrated, take up room which might be more usefully employed, for these few paragraphs will never enable a student to read a crystal unless it be of the simplest character, and they are not full enough to be an introduction to a more detailed study of crystallography. It has always seemed to us that the best plan for an elementary work would be to take one actual crystal—say of orthoclase, with basal and prismatic faces, clinopinacoids, and orthodomes—and, without using any of these technical terms, to explain how the crystallographer arrives at this crystal by grafting, so to speak, certain additional faces on an ideal simple prism; how the shape of that prism can be defined by reference to certain lines and their inclination to one another, which are called axes; how the position of the additional faces are related to these axes—all of which are geometrical truths of the simplest character; and then to say how all crystals, however complicated, can in like manner be referred to certain simple forms of which there are six; and if you want to know how, you must go to a work on crystallography.

The student will then get a real knowledge of one actual crystal, instead of learning by rote descriptions of ideal forms, not one of which he will meet with in nature. We may next note one or two statements which might be usefully amended in a second edition. It is not universally the case that the least fusible mineral crystallises first in a molten rock, as stated on p. 169; it would be well to mention that the rhombohedral crystals of hæmatite (p. 172) are usually so very flat that they look like plates or laminæ: some zeolites (p. 176) contain calcium and barium as well as alkalies; whether alumina replaces the bases or the silica in hornblende (p. 177) is a question on which chemists do not seem to be agreed; under the head of calcite (p. 179) the wording would imply that the difference between nailhead and dogtooth spar consists only in a difference in the length of the chief axis, which is not the case. When it is said that gypsum is not "affected by acids" (p. 206), it is probably meant that it does not effervesce with acids. The evidence for looking upon heat as a pseudomorph after chalk, so to speak, is so strong that it might have been alluded to on p. 212. Under the head of quartzite it would have been desirable to notice that the conversion of sandstone into quartzite has in many cases been mainly brought about by the deposition of silica between the original quartz grains. And while we are on the subject of metamorphism it will be well to call attention to a slight inaccuracy of language into which our author, in common with many other geologists, has fallen. The important part played by pressure in developing schistose structure in rocks is now very generally recognised, and has been nowhere better illustrated than by the labours of Mr. Geikie and his colleagues on the Geological Survey among the crystalline schists of the Highlands, and a fashion has arisen of speaking of the action as "shearing." Now, that shearing has taken place there can be no doubt, but shearing is not all that has happened: the particles have not only been slid over one another, but they have been rolled out and flattened

in the process. Shearing does not necessarily involve flattening, though in a large number of cases the two would doubtless go together. For this reason tt is not correct to speak of cleavage as due to "shearing" (p. 255): shearing alone will not produce all the phenomena of cleavage; there must be flattening of the particles as well. Under the head of "Joints," instead of vaguely stating that some joints may be due to compression or torsion, would it not have been better to introduce a few lines about Daubrée's experiments, which almost bring a conviction that the majority of joints in subaqueous rocks are due to torsional strain?

In Part III., to which some of the above criticisms apply, we have a clear account of the way in which the crust of the earth is built up out of the materials described in Part II. Then follows Part IV., "The Geological Record of the History of the Earth." This must necessarily be presented in an abridged form, and if any fault is to be found with the way in which the subject is handled, it might perhaps be said that an attempt has been made to be rather too encyclopædic. Graphic pictures, such as the author can so well pen, of the physical geography of our own countay, and, where necessary, of the adjoining parts of Europe, during the different geological periods, would perhaps have been more acceptable and instructive to most of those who will read this book than palæontological details and accounts of the range of formations through other lands. For instance, the sketch of the physical geography of Europe during the Triassic period on p. 380, strikes us as singularly happy, and we should like to have seen more of the same kind of thing in the book. We all know how the pigeon-hole geologist deals with this question; how he produces his parallel ruler and divides his sheet of paper nearly into squares; how he puts the names of countries into the squares on the top line and the names of formations into the squares down one side, and then proceeds to fill in his puzzle. Under the column "England," line "Muschelkalk,' he inserts "Wanting." Ha! says he, a whole formation missing! great unrepresented interval! there must be a corresponding unconformity. Primed with this idea he now takes to the field, finds that the evenly-bedded New Red Marl does lie irregularly on the false-bedded sand-banks of the New Red Sandstone, and is overjoyed to see the unconformity which his chess-board told him must be there. Had he used, in trying to realise the meaning of the geological facts, half the ingenuity he showed in distorting them in order to fit them on to his Procrustean bed, he would have seen that what is called the Muschelkalk is not the only marine intercalation in the Trias of Central Europe, but that minor muschelkalks occur both in the Keuper and Bunter; that each of these marks an advance of the Triassic sea over the district where they are found; and that the reason why neither the great nor the little muschelkalks are found in England is that the sea did not succeed in pushing its way as far west as our country during any of its incursions. But there is no pigeon-holing in the book before us, and where the author has tried to bring before us a picture of the physical geography of bygone time, he has been so successful that we wish he had given us more of them.

A. H. G.

OSCAR SCHMIDT'S "MAMMALIA"

The Mammalia in their Relation to Primæval Times. By Oscar Schmidt. International Scientific Series. (London: Kegan Paul, Trench, and Co., 1885).

THE numerous and important discoveries that have been made in the last few years in extinct forms of mammalian life, and the light that has been thus thrown upon the relations of the surviving species, render a popular summary of our present knowledge of the class a very desirable undertaking. Moreover any work which, by showing the intimate relation of the present with the past, aids in breaking down the custom, which has descended to us from an antiquated condition of scientific culture, of treating separately of the existing and the extinct forms of life, of speaking of zoology and palæontology as if they were distinct subjects, must be welcomed by the philosophical naturalist.

In undertaking such a work the late Prof. Oscar Schmidt, of Strasburg (whose death we regret to say has been recently announced), acknowledges that he was departing from the specialty in which he had so highly distinguished himself, and was deriving his materials entirely from the researches of others. But the subject evidently had strong attractions for him, and he has most industriously and impartially compiled from the best authorities a work which, if it had been written in any one of the languages of the series of which it forms a part would have well served the purpose intended. The attempt, however, to give it a truly "international" character, by bringing it out in a combination of two languages, is unfortunately anything but successful. Words are continually occurring, which, though perhaps literal translations of German pseudo-vernacular expressions of modern manufacture, can convey no meaning to the English reader, whatever assistance he may get from the dictionary, as for instance, "spoon-dog" (for the African large-eared fox, *Otocyon lalandii*), "fingered-animal" (for Chiromys), "forked-animals" (for the Monotremata), "dog-fish" (for seal); and such expressions as "mid-jawbone," "root of the hand," "middle hand," "skiff-bone," and "spoke" are far less intelligible to the student of ordinary education than their generally-accepted scientific equivalents "premaxilla," "carpus," "metacarpus," "navicular," and "radius." Misprints and inaccuracies abound everywhere, such as the habitat of the small species of hippopotamus being transferred from Liberia to Siberia, the reference to "African armadilloes" and to Prof. Huxley's discovery of fibrous epipubic structures "in several hundred different species of dogs"! As a specimen of style we may quote the following sentence:—"When it is said that the Marsupials 'vicariate' in Australia for the other groups distributed on the other continents, this expression denotes nothing but the bare fact, nothing but the mere statement, that in America we do not meet with the camel but with the llama, which in a few main characteristics shows some affinity with it" (p. 13). With the general argument against the idea that the expression "vicarious," or, as English authors generally say, "representative," species offers no explanation of the facts of distribution we entirely agree, and we can even see what was floating through the author's mind when this extraordinary sen-

tence was penned. The following description of the horn of the rhinoceros is however quite beyond our comprehension:—"The head weapons are solid horny projections of the nasal bone, which rise into a flat hump within equalities of the bone substance. From this characteristic feature it can in most cases be determined whether the fossil animals of the rhinoceros species possessed horns" (p. 194).

There is so much solid and useful information in the work, brought down to the most recently-published researches, as, for instance, those of Nehring, Branco, and Piétrement on extinct horses, that, if it had been subjected to careful revision by any one conversant both with the subject and the English language, it would have made a popular and readable manual of great educational value.

W. H. F.

OUR BOOK SHELF

Chemistry of the Non-Metallics. By E. B. Aveling, D.Sc. (London: Joseph Hughes, 1886.)

DR. AVELING tells us in the preface that "few people have as hearty a dislike for the whole system of examinations as himself. Theoretically, the object of the acquisition of knowledge is the bettering of human conditions. Practically, to-day the end and sole object is the passing of some examination"; after which the subject is shelved indefinitely in perhaps most cases. This seems to be the author's opinion, and it is doubtless correct in the main. But people who have even learned enough "*to pass*" one of the examinations the author names—the Matriculation (London) or the Elementary Stage (South Kensington)—must surely be in a better condition than before, spite of the inane questions the author speaks of as being set.

The extent of the book is to the so-called non-metallic elements only, their preparation, reactions, &c., and questions, including arithmetical problems, follow each element treated of.

The plan is very complete, perhaps too complete, for very young students such as we have nowaday. For instance, under the heading of each element is given—(A) Symbol, (B) weight number (atomic weight), (C) preparation, with several methods *in extenso*, (D) properties, with further numerated subsections 1 to 6, &c. Even Greek letters are used for "planning out" a property of a substance, &c.

Although the author starts by telling us how he dislikes examinations, his little book is eminently meant to cram students up for them. It is evidently intended to be used as a class-book, so that the beginner will have the assistance of a teacher to make a beginning.

There are a few misprints, and the descriptions are obscure in places.

Why do people who write little books always begin with hydrogen? In this book we begin with hydrogen, valency, ice, water, steam, latent heat, ammonia, and then come to oxygen, which has been spoken of as if we knew all about it. We certainly think, with most German teachers, that it is most logical to commence with oxygen and nitrogen and the atmosphere. There is much less knowledge of other substances to be assumed.

Hand-book of Mosses, with an Account of their Structure, Classification, Geographical Distribution, and Habitats. By James E. Bagnall, A.L.S. (Swan Sonnenschein and Co., 1886.)

THIS little book is a popular, but on the whole accurate, account of the best-known British mosses. The chapter on development, usually the weakest part of hand-books of this kind, is better than usual. We must however call attention to the confusion between "cuticle" and "epidermis" on p. 19, and to the unnecessarily bewildering description of the development of the spores on the following page.

The longest and also the best chapter is that on moss habitats, containing a very clear general description of the most important species, arranged according to the localities in which they are to be found. The following chapter, that on classification, is certainly not up to date, but perhaps the arrangement adopted is not intended for a natural one. The remaining sections, on distribution, cultivation, uses, and the preparation of specimens, are slight, but good as far as they go.

The book ought to be useful as an introduction to the systematic study of mosses.

D. H. S.

The Tourist's Guide to the Flora of the Alps. By Prof. K. W. v. Dalla-Torre. Translated and Edited by Alfred W. Bennett, M.A., B.Sc., F.L.S. (Swan Sonnenschein and Co., 1886.)

MR. BENNETT has introduced to English tourists a most convenient and useful Alpine flora. It is issued in a handy pocket-book form, and ought to be very popular with all travellers who take any interest in plants. The author had originally excluded the "commonest and most ubiquitous plants," but some even of these have been added by the translator, and all those natives of the Alpine districts which are not described in the flora proper will be found enumerated in an appendix.

Only two suggestions occur to us. Might not the often difficult work of identification be facilitated by the introduction of one or two analytical tables, such as those in Wünsche's "Schul-Flora von Deutschland?" They need not much increase the bulk of the book. And secondly, might it not be better, in a work intended for English tourists, and not for scientific men, to substitute English measures for those of the metric system? The latter ought by this time to be equally familiar with our own to educated people, but as a matter of fact we fear they are not so.

D. H. S.

Newton: His Friend: and His Niece. By the late Augustus De Morgan. Edited by his Wife and by his Pupil, Arthur Cowper Ranyard. (London: Elliot Stock, 1885.)

THE nucleus of the volume entitled as above was formed by an article written in 1858 for the *Companion to the British Almanac*. Its rejection brought to a close the remarkable series of Prof. De Morgan's contributions to that publication. The undivulged article, however, as years went on, grew by gradual accretions to the proportions of a book, now at last posthumously given to the world. Its primary object is to clear the character of Newton from the odious imputation of having countenanced immorality for the sake of personal advancement. This, in our opinion, has been satisfactorily attained. The researches here embodied afford strong grounds for the persuasion that there was no immorality to countenance. The sneer enshrined in No. 21 of Voltaire's "Lettres Philosophiques" (1765) thus at last loses its sting.

Catherine Barton, the "famous witty Miss Barton," as she was called in the *Gentleman's Magazine*, was the daughter of the Rev. Mr. Barton, by Hannah Smith, Newton's half-sister, and was born in 1680. Educated at the charge of her uncle, she came to keep house for him in London a year or two before 1700. Her beauty and brilliancy were the talk of the town, and won her the homage of men eminent for position and parts. She was amongst those whom Swift "loved best"; "j'ai conservé," Remond de Montmort wrote in 1716, "l'idée du monde la plus magnifique de son esprit et de sa beauté;" Charles Montague, Earl of Halifax, formed for her a devoted and life-long attach-

ment. There is, in fact, strong presumptive evidence that she became his wife nine years previous to his unlooked-for death in 1715. The position, it is true, was never explicitly claimed by or for her; but silence might easily have been imposed by the inferiority of her social position. At any rate, a letter written by Newton to his kinsman, Sir John Newton, May 23, 1715, admits of but one interpretation. It includes the following sentence:—"The concern I am in for the loss of my Lord Halifax, and the circumstances in which I stand related to his family, will not suffer me to go abroad until his funeral is over." No "circumstances" existed which could possibly explain this allusion save one—that of a marriage between the deceased nobleman and the writer's niece. The words are used with no purpose of disclosure; they treat the fact they bear witness to as a known and indisputable one—known, that is, to an inner circle, where Catherine Barton moved all her life with the respect due to an unblemished character. Handsomely provided for by the will of Lord Halifax, she married, in August 1717, John Conduit, M.P., Newton's subordinate, and afterwards his successor at the Mint, and died in 1739, leaving an only daughter, ancestress of the present Earl of Portsmouth.

A considerable amount of elucidatory information regarding the marriage-laws and social usages of the last century adds to the value of the little work edited by Mrs. De Morgan.

Numerical Examples in Heat. By R. E. Day, M.A. (London: Longmans, Green, and Co., 1885.)

THIS is not merely a collection of numerical examination questions with the answers attached, but a well-arranged series of problems grouped under twenty-five heads, each beginning with simple questions, which increase in complexity. At the first introduction of every kind of question the answer is worked out in full, with a sufficient explanation to show the meaning of the operations. Other questions are given with their answers, but without the process of solution.

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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Note on Sonnet to Pritchard

IN the general theory of algebraical forms there are two modes of defining an Invariant or Reciprocant. In the one mode either of them is regarded as subject to satisfy a partial differential *equation*—in the other as subject to *extinction* under the action of a partial-differential operator. Of course the difference between these two modes is one of presentation merely, and not of substance. Nevertheless it was interesting to me to observe that the very same rival concepts of *equality* and *extinction* lie at the root of the admirable investigations simultaneously carried on by Prof. Pickering at Harvard (who works by equation of light), and Prof. Pritchard at Oxford (who works by the method of extinction), which have earned for each of them the distinction of the award of the gold medal of the Royal Astronomical Society. I say *the* gold medal, because the medal to each is to be regarded in a transcendental sense as only one to both.

This reflection added to the sentiments of regard which I entertain towards my Savilian colleague caused me to write the sonnet in his praise, which you have done me the honour to insert in NATURE (April 1, p. 516), in which, owing to my own inadvertence the words *name* and *praise* have got interchanged. Being desirous that this tribute of unaffected admiration towards the subject of it should be affected with as few blemishes as are compatible with the feeble versificatory powers of its author, I request to be allowed to say that the first and last lines should read—

Pritchard! thy name is lifted to the skies,

and

Thy praise shall flourish in immortal song,

respectively. Also that the third and fourth lines should run thus—

To note each ray that gilds the hem of Night
Or eye her jewelled brow with keen surmise.

At the dinner of the Fellows of the Royal Astronomical Society on the evening of the public presentation of the Medal to Prof. Pritchard, the sonnet was recited by its author at the desire of the Astronomer-Royal, who presided on the occasion.

J. J. SYLVESTER,
Savilian Professor of Geometry in the University of Oxford; and Author of "The Laws of Verse"

Fishery Board of Scotland

YOUR leading article of the 1st instant, headed "A Fishery Board for England," contains several inaccuracies with regard to the Fishery Board of Scotland which it appears desirable to correct.

(1) "If a Fishery Board is useful and valuable, it is a surprising fact that Ireland and Scotland have long enjoyed an institution which is wanting in England."

The present Fishery Board for Scotland was constituted only in 1882. Prior to that date there was a Board of Fisheries which, from its origin in 1808 until 1820, confined its attention to the curing and branding of herrings, and to collecting statistics of the quantities of herrings landed and exported. From 1820 to 1881 statistics of the cod and ling cured were also prepared. This Board of Fisheries having charge of all the fisheries around the coast of Britain, appointed officers at the chief Scottish and English fishing ports, two of whom were stationed in London, from which in the beginning of the century large consignments of herring were sent to the Continent. In course of time the number of herrings cured at the English stations became so small that in 1850 the English Fishery officers were dismissed. In fact, the old Fishery Board existed chiefly in order to collect statistics of cured fish and to superintend the curing and branding of herrings. It will be understood how exclusively attention has been devoted to these objects when it is mentioned that even now the Fishery officers must be practical coopers.

(2) "The Commission for the Investigation of the German Seas is composed of distinguished men who are students and teachers of biology or physics. In Norway and Holland the same thing occurs."

We believe it is a fact that neither the Norwegian nor the Dutch Government has yet instituted Fish Commissions.

(3) "A large number of matters connected with the fisheries have not yet begun to receive attention even in Scotland."

It was only in 1883 that the Scottish Fishery Board obtained from the Government a sum of 300*l.* for studying the life-history, &c., of the food-fishes, and the total sum received up to the end of last month was only 2800*l.* When it is remembered that a sum of 10,000*l.* has been required to found the laboratory of the Marine Biological Association, it can scarcely be deemed a matter of surprise that many topics of interest and importance have not received from the Scottish Fishery Board that degree of attention which they deserve.

(4) "The spawn of the sprat is still entirely unknown."

Mr. Duncan Matthews, of the University of Edinburgh Zoological Laboratory, in his "Report on the Sprat Fishing during the Winter of 1883-84," published in the Report of the Fishery Board for Scotland for 1883, describes and figures the "spawn" of the sprat.

(5) "The Scottish Fishery Board is about to try an extensive experiment with regard to beam-trawling, prohibiting that method of fishing in certain defined areas. The experiment is worth trying, even at the cost of temporary inconvenience to the fishery industry. But in order to render such an experiment fruitful, it would be necessary to make a detailed and exact investigation of the areas selected. It is doubtful whether the organisation of the scientific department of the Scottish Board is yet in a position to make this investigation in a sufficiently complete manner."

Seeing that he appears to speak as one having authority, and not as the scribes, it is gratifying to note that the writer of your article deems "the experiment worth trying." We have only

to regret that he appears to view with suspicion the competency of the scientific department of the Fishery Board to try it. Perhaps it may serve to reassure him on this point to learn that these suspicions are not in any way shared by the Government, who have now furnished the means for purchasing a steam-vessel for trawling; for maintaining three laboratories (one of them with a large number of tanks); and for securing the assistance of three skilled naturalists who will work in conjunction with Profs. Ewart and McIntosh, to whom your contributor alludes.

S. F. B.

Protective Influence of Black Colour from Light and Heat

THE difficulty of explaining the black colour of races near the Equator has long been felt. Strong sunshine undoubtedly tends to darken the skin; but if black, as generally supposed, is the colour that absorbs most heat, natural selection should have developed white as the complexion best adapted to shield mankind from the intense radiation of an equatorial sun.

Without venturing to offer an opinion on the subject, I should like to mention three cases that have come under my personal observation, in which brown-skinned natives, in very different parts of the world, blacken their faces to protect them from intense light and heat.

In Morocco, and all along the north of Africa, the inhabitants blacken themselves round the eyes to avert ophthalmia from the glare off hot sand.

In Fiji the natives, who are in the habit of painting their faces with red and white stripes as an ornament, invariably blacken them when they go out fishing on the reef in the full glare of the sun.

Lastly, here in the Sikkim hills the natives blacken themselves round the eyes with charcoal to palliate the glare of a tropical sun on newly fallen snow.

This I had an opportunity of experimenting on. We were caught in a snowstorm at an elevation of 10,000 feet; when it subsided all the coolies blackened their eyes, so I had one eye blackened, the other left natural, and went out into the sun for half an hour. I cannot say that I felt much difference. Next day I tried marching for about six hours, up to 12,000 feet, with both eyes blackened. I cannot say how far this may have been palliative, but the glare was so bad, we were all very glad when the mist came up and obscured the sun. Radiation is far more intense at high altitudes than at low levels. Still it is impossible to suppose that three such different nations would have adopted the same device to mitigate sun glare if black colour did not give some palliation at least.

Here then we have one of those strange anomalies in which physiological experience contradicts the teachings of pure physics. Charcoal black, which is used in physical experiments as the best absorbent of every kind of heat radiation, is practically used by three races at least, to protect one of the most sensitive human organs from reflected light and heat. Of course I cannot offer any explanation, but bring the facts to the notice of those who have the skill and opportunity to make physiological experiments, in the hope that they may perhaps find a clue to the long-sought-for explanation of the colours of the human race.

RALPH ABERCROMBY

Darjeeling, March 15

Pumice on the Cornish Coast

ABOUT a month ago I picked up on Maenporth Beach, near Falmouth, a piece of drift pumice of the size of a large goose's egg. It was rounded, floated heavily, and was just twice the weight of a piece of Krakatão pumice of the same size which had been obtained in the Indian Ocean several months after the eruption. No Cirripedes, Serpulæ, &c., had attached themselves to it; but in one of its crevices I found a tiny dead coleopterous insect, which I unfortunately lost. From my familiarity with floating pumice in the Western Pacific I at once perceived that this fragment had been a considerable time in the water. After searching the other beaches in the neighbourhood I failed to find another piece. Mr. John Murray, to whom I sent the specimen, informs me that he has similarly picked up fragments of pumice on the west coast of Scotland.

Without speculating on the source of the fragment found on the Cornish beach, I should remark that, judging from an experiment made in the Western Pacific, pumice may float for several years on the sea before it becomes sufficiently sodden to sink to the bottom. I kept floating in sea-water for two years and nine months three pieces of pumice which I originally obtained in the tow-net whilst cruising in the Solomon Islands. Although they had evidently been a long time in the water before I got them, since they floated heavily and had in two cases the tubes of Serpulæ attached, the only apparent alteration in their buoyancy produced by my experiment was that one which floated in fresh water when I first obtained it now sank. How much longer they would have continued to float in the sea-water I cannot say. From their condition before the experiment they must have been previously floating for even a longer period.

H. B. GUPPY

95, Albert Street, Regent's Park, April 10

The Connection between Solar and Magnetic Phenomena

IN the discussion which followed the reading of Prof. Balfour Stewart's paper on magnetic declination, at the Physical Society, considerable weight was attached to Carrington's observation of a solar outburst observed on September 1, 1859, and the simultaneous occurrence of a movement of the magnetic needles at the Kew Observatory.

Nearly twenty-seven years have now elapsed since the event referred to took place, and both the sun's surface and the magnets have been under observation thousands of hours since that time.

Hundreds of magnetic movements similar to that above mentioned have been recorded since, and I should deem it a great favour if any correspondent would either inform me of the time or times of similar outbreaks to that seen by Carrington, if such have been observed, or refer me to any published accounts of the phenomena.

Carrington's paper is published in the *Monthly Notices* of the R.A.S. vol. xx. p. 13.

G. M. WHIPPLE

Kew Observatory, April 12

Aurora

A BRIGHT Polar light was observed here on March 30 from 8 to 11 o'clock p.m., how long it had lasted I cannot tell. At 8 o'clock only flashes of a pale blue were seen about the Pleiades; their brightness was changing very quickly; at 11 o'clock across the whole northern sky there lay the well-known dark segment with the bright arch above; from the latter only a few reddish beams of light were seen emerging.

Königsberg i. Preussen H. FRITSCH

Was it an Earthquake?

YESTERDAY morning (Thursday, April 8), at 5.35, the door of my room vibrated regularly for about three or four seconds. I did not perceive any motion of the room itself. I was up at the time, and quite still. Perhaps the best way of finding out whether anyone else experienced anything of the same nature, so as to determine whether it was in any way connected with an earthquake, is to write to NATURE.

Ladbroke Gardens, W., April 9 A. TREVOR CRISPIN

"Radical" or "Radicle"

MR. MADAN in his amusing letter last week (p. 533) raises a point which has doubtless often caused the comments of teachers. I think "a partical of reasoning" at least *can* be adduced in favour of "radical." In this paradoxical world it is not surprising to find that "radical" is the "conservative" and "constitutional" spelling, and that "radicle" is a radical alteration in a centenarian word. For next year will be the hundredth anniversary of what was, if I am not mistaken, the first use of the word by Guyton de Morveau. It seems to have long retained its French spelling, and I think it would be a pity to alter one which thus recalls to the memory a host of great names, and perhaps more than any other single word in chemistry suggests the international brotherhood of scientific men. Of course Mr. Madan's protest has force from the grammatical point of view; it may also be urged that "radicle" is English for the French "radical." But from the chemical standpoint surely the "radical" is as much a "stem" as a "root"? For instance toluene is either $C_6H_5(CH_3)$, or $CH_3(C_6H_5)$, and it would be arbitrary to select from a very limited number of reactions *the* "root" in prussic acid, H.CN, C.NH, or

N.CH. Many chemists prefer "grouping," a safer word often used by Prof. Odling in his lectures.

After all, the question is really a gnat amongst the camels of our present nomenclature in organic chemistry. The sooner the last straw comes the better. What would Morveau or Lavoisier say, for instance, to "dimethyldiethylhydroxytrimethylenecarboxylic acid (1, 3, 2, 3, 2, 1)," in Dr. Perkin, Junr's., paper, *Journal* Chem. Soc., 1885, p. 807? Chemists who doubt the propriety of spelling a word in two ways must have excessive sympathy with the geographers who are trying to get their brethren to select one of over forty different "spellings" of Fuchau or Foo-Chow. J. F. HEYES

12, Merton Street, Oxford, April 12

Square Bamboo

NATURE was so good as to publish (August 27, 1885), a communication from Mr. W. T. Thiselton Dyer in relation to my discovery of the square bamboo. Supplementary to the information therein given I send the following which I have just met with in a Chinese work:—"It grows wild in the north-eastern portion of Yunnan on the sequestered mountains of Takuan-ting and Chênhsing-Chou, to which in spring men, women, and children resort for cutting its shoots, which they tie in bundles and send to market. It is prized above all other bamboo shoots as an esculent." D. J. MACGOWAN

Wenchau, February 8

Ferocity of Animals

ALTHOUGH the animals in question are not rats, it may interest Mr. Romanes to hear that some years since a friend was on a railway journey in the north, having with him two large dogs. These were confined together in the brake-van. During the journey one of these dogs (a bull-dog) attacked and seriously injured the other (a retriever, if I remember rightly), although ordinarily they were very much attached to one another. My friend's idea was that the bull-dog became frightened at the motion of the train, which oscillated considerably, and imagined that the other dog was the malefactor. This may be merely theory, but the case perhaps is worth noting. UNUS

Birkbeck Institute, April 6

MR. VERBEEK ON KRAKATÃO

MR. Verbeek's work on the Krakatão eruption has now been completed. The first part, which deals principally with the history of the great eruption, came out more than a year ago, and has been made accessible to English readers in a French translation. It was desirable, says Mr. Verbeek, in his introduction to the second part, of which an abstract is given here, that that portion of the work should appear as soon as possible, to contradict the many untrue statements that had found their way into the newspapers, and even been partially adopted in scientific magazines.

The second part, a quarto volume of some 500 pages, with additional drawings and maps, which will likewise shortly appear in French, gives an account of the phenomena observed both during and after the eruption, besides a description of the old Krakatão. Mr. Verbeek's task has been a very laborious and comprehensive one, for while the consequences of most eruptions are confined to the immediate neighbourhood of the volcano, those which followed the great Krakatão eruption have been observed all over the earth, and have as much interest for the hydrographer, the meteorologist, and the astronomer, as for the geologist.

It may be said without exaggeration that the Krakatão eruption has been the most remarkable catastrophe of the kind of which the human race has kept a record, for, though other eruptions, such as that of the Tomboro in 1815, no doubt caused important atmospheric disturbances, there were no instruments at that time to make accurate observations, and thus they were lost for science.

How invaluable the self-recording barometers and tide-gauges have been on this occasion has been conclusively shown, but the number of these instruments is comparatively small, and Mr. Verbeek hopes that his work may lead to an increase of the number of barographs which mark the atmospheric pressure as an unbroken curved line, and especially of self-registering tide-gauges at favourable points on the coasts, and on various islands in the ocean.

In spite of the assistance Mr. Verbeek gratefully acknowledges to have received from innumerable persons in obtaining accurate information, he has had much difficulty in sifting the often conflicting evidence. Even now a few data are wanting, which will probably make an appendix necessary.

As the work with which the Dutch Indian Government had intrusted him would take a considerable time, they wished him to issue a preliminary report[1] which had necessarily to be drawn up in a limited period before the close examination of the volcanic substances could have taken place. Mr. Verbeek had in consequence to modify some of the views he expressed there. For instance, he no longer considers the balls of marl to have been produced by a rapid revolving motion of marl, mud, or sand, because at a later period similar balls were found in claystones, and thus were shown to have already existed before the eruption. He was also obliged to give up the notion that the dust found in snow and rain in various parts of Europe was derived from Krakatão. A slight modification had to be made in the time when the four greatest explosions occurred, and a more considerable one in the time of the rising of the greatest wave. Hence also the figures given for the medium depths of the sea had to undergo an alteration. Finally, the composition of some of the volcanic products was accurately determined by a later and more elaborate chemical analysis, and it was proved that the percentage of silica given in the short report is generally too large. Those are the only modifications of any importance which Mr. Verbeek says he had to make in the preliminary report.

The book—which he has spared no pains to make as complete as possible, and which is indeed the most complete work of the kind ever written—will, he hopes, serve as a standard guide for any future eruption of the same magnitude that might still occur in this century. In such an undesirable but not improbable contingency a great deal of trouble will be saved by referring to its pages, where information laboriously collected from innumerable sources may be found, as well as elaborate calculations which will not require to be repeated.

No hypotheses are offered for explaining the unusual number of volcanic phenomena in 1883, because every certain foundation is wanting. If the cause of eruptions is to be found in the first place in the water penetrating from the surface into the interior of the earth, and if their multiplicity must therefore be traced to the formation or opening up of lines of dislocation, or to subterranean subsidences, which both facilitate the access of water and increase the pressure in the subterranean regions, there still remains the question what specially produced these altered conditions in 1883.

A connection has been supposed to exist between the volcanic phenomena on the earth and the intense activity of the sun in that year. The maximum of the sunspot period seems to fall on 1884·0, thus a few months only after the eruption. The interesting researches of Prof. R. Wolf at Zürich have shown a connection between the number of sunspots and the daily variation of the magnetic declination. At a maximum of the spots, therefore, strong terrestrial magnetic currents might arise which might produce chemical disturbances in the interior of the earth that would be favourable to earthquakes or eruptions; but it must not be forgotten that at the periods 1829·9, 1837 2, 1848·1, 1860·1, and 1870·6 maxima

[1] This report appeared in NATURE, vol. xxx. p. 10.

of sunspots likewise occurred, of which those of 1837 and 1870 were almost twice as great as the maximum of 1884, whereas those years were not marked by any special volcanic activity. Mr. Verbeek cannot, therefore, see any connection between the activity of the sun and that of the earth in 1883, nor does he believe the position of the earth with respect to the moon and sun had any relation to the great eruption of August. The following is Mr. Verbeek's summary of what the eruption has specially taught us :—

(1) The extraordinary loudness of the sounds deserves, in the first place, our attention. The substances were shot out of the crater with great velocity up to a very considerable height, and this was accompanied with detonations which far surpassed in power all the sounds with which we are acquainted. Never were sounds heard over such a large area of the earth's surface during any previous catastrophe. Some time ago, in the French Academy (*Comptes rendus* du 9 Mars, 1885), the possibility even of the transmission of these sounds through the earth's centre, straight to the antipodes of Krakatão, was suggested. According to a communication from M. F. A. Forel, reports were heard on August 26 on the Island of Caïman-Brac in the Caribbean Sea (south of Cuba, 80° W. long. from Greenwich, and 20° N. lat.). The exact hour is not given ; but from the account it appears clearly that the reports were heard in the *daytime*. (The sky was clear. People ran to the shore to see whether a ship was approaching, &c.) For several reasons it does not seem to me very probable that these sounds proceeded from Krakatão. In the first place, at the time of the great eruption in the Straits of Sunda, there appear to have been eruptions near the antipodes, though the details are wanting. In the second place, it is probable, for other reasons, that an earthquake or eruption occurred in or near the Caribbean Sea. Thirdly, the time does not agree ; for if, according to M. Forel, an hour be allowed for the transmission of the sound through the earth's centre, which is probably too little, the great detonations of Krakatão could not have been heard at the antipodes in the daytime, but only late in the evening of August 26.

(2) These stupendous detonations caused such violent disturbances in the atmosphere that many objects at long distances from the volcano underwent a corresponding vibration of such intensity as to suggest the idea of an earthquake.

(3) The formation also of an atmospheric disturbance which propagated itself in very long air-waves round the earth's surface is a phenomenon which had not yet been observed in connection with eruptions, though other atmospheric disturbances had been previously understood to have regular wave-motions.

(4) The phenomena of the green and blue sun and moon, and of the beautiful red glow, had been already observed after eruptions, but not with such intensity as after August 1883.

(5) Though the truncated cones of many volcanoes had been previously recognised as the remains of conical mountains which had had their summits flattened by a subsidence of the central part, we have here for the first time witnessed a subsidence which agrees in dimensions with the Tengger in East Java, known to be one of the largest subsided crater areas in the world. The explanation, which was hitherto considered a doubtful one by some on account of the enormous dimensions ascribed to the subsided part, has been entirely confirmed by the catastrophe at Krakatão in 1883.

(6) The almost vertical section of the peak Rakata,[1] accidentally formed by the eruption, has given us a very valuable insight into the internal structure of a volcano. Of course this formation is by no means the same in all volcanic conical mountains; thus for instance in many volcanoes the existence of a hollow space or a compact kernel may be considered probable, though the Rakata section does not exhibit this.

(7) By the subsidence into the sea of part of the peak, waves arose which far surpassed in elevation the biggest ever formed in a storm. To this additional catastrophe, which caused the inundation of the coasts in the Straits of Sunda, the large number of victims of the Krakatão eruption must be attributed.

(8) The propagation of this wave-motion is very remarkable. Not only in the whole of the Indian Ocean, but even in the Atlantic and the Pacific Oceans, disturbances were observed which were caused by the Krakatão wave. Part of the disturbances, however, observed in the state of the water on the coasts of America and Europe, which were originally also attributed to Krakatão, must have had another cause.

(9) It is known that, from the velocity with which the wave-motion is propelled, the medium depth of the sea may be calculated along its path. Upon the route from Krakatão to South Georgia it is found that the rate of velocity is equal to the extraordinary depth of 6340 metres. Over that track there lies to all appearance a deep basin, the probable existence of which will, I hope, be shortly confirmed by deep-sea soundings.

(10) Finally, a very remarkable result of the analysis of the Krakatão ashes deserves mention. These ashes, namely, are the first rocks in which a very great number of plagioclase species of felspar have been found together. While in many rocks of volcanic origin various triclinic felspar species (usually two) had been previously supposed or shown to exist, it was proved for the first time by the analysis of the Krakatão ashes that one rock may contain *all* the plagioclases, from the most basic to the most acid. There appears, besides, a little sanidine. All these felspars are, in this instance, products of the first crystallisation, as the second crystallisation was prevented by the sudden cooling and consolidation of the melted rock magma. Tschermak's theory of felspar finds a fresh support in this simultaneous presence of plagioclases whose specific gravity diminishes gradually from that of pure anorthite to that of pure albite.

That which has been easily proved in this case by the isolated condition of the crystals, we may take as highly probable for many compact andesites, and even for a large number of other eruptive rocks, namely, that among the porphyritic felspars there are a variety of species, which differ in specific gravity, and therefore also in chemical composition.

If on two corresponding rectangular axes, with the specific weights as abscissæ, the analogous quantities of plagioclase which a rock contains are put as ordinates, a number of points are the result, of which the junction gives a curve which may be called the "felspar curve" of the rock. This curve must necessarily take a very different course for the different acid and basic stones. It is a new and interesting task for petrographers to determine the "felspar curve" of the principal eruptive rocks.

[1] The old name, of which Krakatão is a corruption, and which is still given to the peak itself.

THE PLEIADES

IT is a singular circumstance that the oldest-known mode of determining the seasons and directing the recurrent operations of human industry, should also have been the most widely diffused. Nor was this an obvious one. It regarded directly neither of the two great luminaries, which, as they move, might almost be said visibly to pay out a golden cable of time ; but turned, instead, to a comparatively inconspicuous, though beautiful and eminently interesting, group of stars. The periodical shiftings in the sky of the sun and moon force themselves upon the dullest apprehension ; one must, however, be already something of an astronomer to take any close

heed of stellar configurations. Yet all over the world, in the northern and southern hemispheres, amongst Polynesian and Australian savages, as well as under the sway of Egyptian, Peruvian, Mexican, early Hellenic, and Indian civilisations, traces are found of a primitive calendar regulated by the risings and settings of the so-called "Seven Stars."[1]

Only 6 Pleiades, indeed, are usually visible, although 12, 14, even perhaps 16, have been made out without optical aid by exceptionally keen and vigilant observers. Hipparchus is probably the only astronomer of antiquity who mentions the possibility of discerning a seventh member of the family; and he admits that it could be seen only under a transparent sky and in the absence of the moon. Thus Ovid's well-known line in reference to the group,—

"Quæ septem dici, sex tamen esse solent,"—

quite correctly describes its ordinary visual aspect. Nevertheless, it figures as septuple in the folk-lore of well-nigh all the peoples of the globe, from the Baltic to the Tropic of Capricorn; and the aborigines of Victoria, no less than Greek poets, have sought, by appropriate inventions, to reconcile what was apparent with what was assumed. It is altogether uncertain whether the story of the "lost Pleiad" is a tradition or a myth,—whether it commemorated an actual prehistoric occurrence, or merely supplied by fable the unit wanting to complete a consecrated number. There is no manner of doubt, however, that it is cosmopolitan and immemorially antique. Before dismissing it as an idle fancy, it may be worth while to inquire into the probability of a real loss of lustre in an originally manifest companion of Alcyone.

The spectroscope affords some grounds for a *primâ facie* presumption *against* marked variability in these associated stars. With one or two quite insignificant exceptions, they all shine with the bluish-white radiance, and display the brilliant spectrum obscured only by hydrogen-absorption, of which steadfast emission is usually the concomitant. Usually, but not invariably. There are noted instances to the contrary, which further experience may perhaps multiply. It is, at any rate, certain that perplexing anomalies have hitherto been found to affect photometric estimates of the Pleiades.

Very little reliance can in general be placed upon early accounts of relative stellar brightness; yet it is startling to find that Ptolemy enumerates four individuals of the group, none of which can be identified with its now pre-eminent member. Either, then, his description is strangely misleading, or Alcyone was not, 1750 years ago, the *lucida* of the collection. Francis Baily, who well knew how to make allowance for ancient inaccuracy, considered that this star, if observed at all by the Alexandrian astronomer, must then have been of far less magnitude than now (*Memoirs R. Astr. Soc.*, vol. xiii. p. 9). Further, Abdurrahman Sûfi, who professed, in the tenth century, to have corrected, from personal observations, the catalogue of his predecessor, expressly states that Ptolemy's quartette were re-specified by him as being the most conspicuous of the Pleiades (Flammarion, "Les Étoiles," p. 294). But Alcyone, as we have seen, was certainly not amongst them. The leading position it still occupies was first, some six centuries later, assigned to it by Tycho Brahe. That there have been fluctuations of lustre among its attendant stars has, by the recent inquiries of Wolf and Lindemann, been rendered certain in a few cases, and highly probable in many more. Room for doubt on the point will presumably ere long be narrowly limited. By means of his "wedge photometer," invented for the special purpose of introducing harmony into the light-measurements of the Pleiades, Prof. Pritchard has accumulated materials for future comparisons, vouched for as trustworthy by the satisfactory agreement between his estimates of magnitude and those arrived at by Profs. Lindemann and Pickering. In the meantime there is sufficient authentic evidence of variability in the group to render the literal explanation of the disappearance of the seventh daughter of Atlas a plausible one.

The oldest existing map of the Pleiades was constructed by Maestlin in 1579. It deserves attention as a curiosity of archæological astronomy, and as exhibiting eleven stars, discerned, of course, with the naked eye.[1] Galileo made the first telescopic survey of the group, of which he detected, with his feeble instrument, nearly 50, and graphically recorded the positions of 36 components. De la Hire, Cassini, and Jeaurat followed, the last mapping and cataloguing at the École Militaire, in 1782, 64 leading Atlantids (*Mémoires de l'Ac. des Sciences*, 1779, pub. 1782, p. 505). In publishing, in 1841, differential measures, with the Königsberg heliometer, of 52 of these stars (*Astr. Nach.*, No. 430)—besides Alcyone, the place of which was fixed by observations in the meridian—Bessel had another end in view than mere enumeration. He designed to establish a term of comparison from which their mutual displacements might hereafter be determined. And, in fact, the prospect of gaining some real knowledge of such displacements would be still remote, were it not for this anticipatory labour. Dr. Gould was the first to turn it to account. He obtained, it is true, only a negative result, but one memorable as the earliest in sidereal science derived from the use of a method then in its infancy, but now, within a score of years, grown to be of overwhelming importance.

With an object-glass 11 inches in diameter, corrected for the ultra-violet rays, Lewis M. Rutherfurd, of New York, took, in 1865, some admirable photographs of the Pleiades (*Observatory*, vol. ii. p. 16). One of them, now in the possession of the Royal Astronomical Society, remarkably exemplifies the capabilities of the old collodion-process. The time of exposure is not known, but was probably short, since there is scarcely a trace of irradiation, and the stellar impressions are minute and beautifully distinct. They are thus peculiarly susceptible of exact measurement. The right ascensions and declinations of nearly fifty Pleiades, hence deduced by Gould, showed so close an agreement with Bessel's, as to make it fairly certain that no appreciable change in their relations had taken place within a quarter of a century.

This conclusion was somewhat modified by the results of M. C. Wolf's laborious investigation at Paris ten years later (*Annales de l'Observatoire*, t. xiv. 1877)—probably the last aiming at exhaustiveness for which merely visual data will furnish the materials. His chart includes all stars down to the 14th magnitude, to the number of 625, contained in a rectangle 135′ by 90′, in which Alcyone occupies a nearly central position. Of these, 571 are catalogued, while the places of 79 are determined with the utmost nicety, and compared with those assigned at Königsberg. The upshot went to show unmistakably a community of backward drift, reflected from our own advance through space. Alcyone has a well-marked, though small, proper motion, in a direction exactly opposite to that of the solar translation. The invariability of relative situation in its crowd of companions, inferred by Gould in 1866, hence really amounted to a demonstration of the existence of a physical tie between them. For it proved that the whole cluster was pursuing an identical line of march in the sky. Even though that march be purely a parallactic effect, the force of the argument remains untouched. Unanimity in apparent movement implies a real aggregation equally with unanimity in rapid actual progress.

Other, and if possible more cogent, proofs of the close relationship of these clustered stars are now, however,

[1] See R. G. Haliburton's "Festival of the Dead," and Bunsen's "Die Plejaden und der Thierkreis."

[1] For a map by Miss Airy of 12 Pleiades from ocular view see *Monthly Notices*, vol. xxiii. p. 175.

gradually becoming available. The presence of minute displacements connected with the internal economy of the system, emerged pretty clearly from Wolf's inquiries; although their direction and amount remained little more than conjectural. The main fact indicated is that of an extraordinary complexity in the governing plan of the assemblage. It appears to embrace a great number of binaries, and at least one triple star, which pursue their separate revolutions independently of the higher systemic relations which no doubt bind and sway them. Each of the pairs, for instance, numbered 9, 10, and 31, 32, on Bessel's list, gives signs of orbital movement; while the beautiful little triangle of 8th-magnitude stars close by Alcyone is (seemingly) in slow process of deformation.

Fresh evidence was deduced from a set of elaborate measurements of forty stars in the Pleiades, completed by Prof. Pritchard in 1884. To fourteen amongst the number, two independent processes were found applicable. Meridian observations extending over 130 years afforded, when reduced, the means of ascertaining their absolute co-ordinates and proper motions; and these were compared with the results of micrometrical determinations of relative position at Königsberg, Paris, and Oxford, 1838 to 1880. Both methods agreed in pointing to certain shiftings *inter se*, just, as it were, nascent, and demanding a further lapse of time for the development of the scheme they are conducted upon. Enough, however, was made out to show plainly that no mere incongruities of proper motion, or perspective displacements consequent on change in our own point of view, were concerned, but real effects of gravitative action amongst a group of mutually connected bodies.

Thus at last we seem to be on the verge of learning something of the interior mechanism of a star-cluster, the extraordinary difficulty of the problems presented by which has hitherto almost silenced speculation. The facilities for collecting the necessary data offered by the recent enormous improvements in stellar photography, will doubtless help to stimulate the inquiry, as well as to assure its conclusions.

Our readers are already familiar with the first results in photographic star-charting secured by means of an apparatus constructed (as to its optical part) by MM. Paul and Prosper Henry, and mounted in the garden of the Paris Observatory in April 1885. These have been followed by four photographs of the Pleiades, taken respectively on November 16, December 8 and 9, and January 8, of surpassing beauty and interest. The exposure was in each case of three hours, during which long period the following of the diurnal movement appears to have been absolutely perfect. No mechanism is adequate to effect this with the requisite nicety; the eye and hand of the operator are an indispensable adjunct. An 11½-inch telescope, adapted for visual use, inclosed in the same metallic tube with a photographic object-glass 13½ inches in diameter, serves accordingly as a channel of communication with the sky, through which the progress of the operation is surveyed, and timely notice derived of the need for controlling incipient inequalities.

On the plates thus exposed, above a thousand stars—all presumably belonging to the same magnificent cluster—are clearly imprinted. They range down to the 17th magnitude, many of them being beyond the power of any telescope hitherto constructed to disclose to the eye. But the retentive "photographic retina" has time on its side. Such extraordinary success in registering the faintest objects necessarily implies considerable over-exposure in regard to bright ones. It is indeed found that the time of *pose* for a star of the sixteenth is no less than *one million times* than for one of the first order of lustre (MM. Henry, *La Nature*, December 5, 1885). This disparity constitutes perhaps the most serious drawback to the photographic method of charting. It has, however, the counterbalancing advantage of supplying tolerably accurate indications of magnitude in the varying size of the stellar disks.

The importance of these remarkable pictures is one which the lapse of centuries must tend to heighten. They will place future astronomers in possession of documentary evidence of ever-growing value. Their historical function, however, does not stand alone. They have also unexpectedly served the purpose of present discovery. A small nebula of a spiral form, encircling the 5th-magnitude star Maia, of which no visual trace had ever been perceived, comes out with surprising intensity on all four plates. It consists of a single whorl resembling a strongly-curved cometary train, and extends on one side so as to involve a minute adjacent star, which might be thought to play the part of a secondary nucleus. The configuration recalls the tendency to a duplicate structure visible in the great spiral in Canes Venatici, as well as in other similar formations. The photographic strength, in proportion to the curious optical weakness of the new nebula, suggests that its rays are situated mainly in the upper part of the spectrum, and that it is of a gaseous constitution. Spiral nebulæ conform to no fixed rule in this respect. The first recognised and most striking member of the class (that in Canes, 51 Messier) emits continuous light, while several others show bright lines. Amongst these would most probably be found the specimen just discovered, were it possible to submit its feeble light to analysis. This probability is greatly strengthened by Mr. Lockyer's recent detection in the spectrum of Maia of bright lines, as yet, however, undetermined in regard to position.

Photographic discovery led the way to, and was quickly followed by, visual detection. On February 8 Admiral Mouchez communicated to the Paris Academy of Sciences a telegram from M. Struve announcing that the Maia nebula had just been successfully observed with the 30-inch Clark achromatic recently mounted at Pulkova. This promising *début* by the largest refractor yet constructed, encourages the hope that the limit of useful size has not yet been reached.

The singular vortex round Maia is not the only nebula in the Pleiades. At Venice, on October 19, 1859, M. Tempel, who had then lately exchanged his profession of an engraver for that of an astronomer, discovered an extensive nebulosity of an elliptical form, encompassing, and stretching southward from, the star Merope. The history of its subsequent observation is not a little curious. Unaccountable discrepancies have perplexed the evidence of its existence. Some of the finest instruments in the world have persistently refused to disclose it, while at times it has been plainly visible with glasses too insignificant to serve as their finders. Messrs. Hough and Burnham have uniformly failed to perceive it with the great Chicago refractor. Prof. Pritchard, during the whole course of his assiduous study of the group, has never detected a nebulous indication connected with any of the stars composing it. D'Arrest only succeeded in seeing it in 1862 after two years of fruitless searching, and considered it the faintest object he had ever viewed with the 11-inch Copenhagen refractor (*Astr. Nach.*, No. 1393). Nevertheless Schiaparelli, February 25, 1875, found it to extend past the star Electra as far as Celæno, and gave it as his opinion that it was a striking object in a clear sky (*Astr. Nach.*, No. 2045). The late Dr. Schmidt, of Athens, had no doubt at all of its variability. Mr. Lewis Swift, of Rochester (N.Y.), on the other hand, who, unaware that it existed, "ran upon it" accidentally in 1874, watched it carefully during seven years without perceiving a sign of change (*Monthly Notices*, vol. xlii. p. 107). Its presence is to him palpable. A 2-inch aperture with a power of 25 suffices to reveal it. M. Tempel himself has always seen it in its original form. Mr. Maxwell Hall, in Jamaica, has never looked for it in vain with his 4-inch achromatic. Schönfeld described it

as "very distinct and immediately conspicuous" (Tempel, *Monthly Notices*, vol. xl. p. 622).

The truth seems to be that, whether variable or not, it is one of the most sensitive objects in the sky. The slightest haze suffices to obliterate it. Air so translucent as to allow 13th or 14th magnitude stars to shine clearly may still contain mist enough to shroud the Merope nebula. Nor will it endure high magnification. Its scanty rays need to be condensed into a small image to become sensible, while, in the restricted field of a great telescope, they are apt to leave the eye unaffected for want of a contrasted black background. Even the enormous light-grasp of the Rosse reflector was unavailing to show this delicate object until the lowest possible powers were applied. Idiosyncracies both of instruments and observers have besides tended to widen divergences of opinion. Some eyes appear to be incapable of discerning an illumination so faint and diffused. Nay, telescopes of equal apertures are not perhaps devoid of "personality" regarding it.

Still more difficult to explain than its anomalous invisibility, are the differences in its aspect when seen. Goldschmidt made the supposed discovery in 1863 (*Les Mondes*, t. iii. p. 529) that it was no isolated formation, but a spur or projection inwards from a vast nebulosity 5° in diameter, in which a blank central space similar to that left clear for the trapezium in the Orion nebula, was occupied by the entire group of the Pleiades. And Wolf, after careful consideration, adopted this view in 1876. Other observers have seen several distinct patches in lieu of the large misty ellipse, about 35′ by 20′, in which M. Tempel could just distinguish the beginnings of two nuclear condensations. Engelmann's map of the Pleiades, published in 1876 (in Bd. ii. of Bessel's *Abhandlungen*), shows a mere nebulous wisp to the south of, and apparently unconnected with, Merope. Two such were observed by MM. Baillaud and André, at Paris, March 7, 1874, and form the regular aspect of the nebula as viewed with Mr. Pratt's 8-inch mirror. Mr. Common's great speculum disclosed to him, February 3, 1880, a triple and considerably scattered group, with unmistakable symptoms of an extension north-west towards Electra. Now at last the camera steps in as arbiter between conflicting observations. The Paris photographs decide at once the Merope nebula to be no such illusory object as has sometimes been supposed. It really exists; but in a shape *at present* strangely varied from that of its earlier appearances. Only its position on either side of the star Merope identifies the irregularly striated formation visible on the plates, with the uniform train of almost evanescent luminosity recorded in M. Tempel's skilful drawings.

Comparison with future autographic pictures will quickly and easily settle the question of its variability. As yet there is little positive, though some presumptive, evidence for the affirmative. Hind's and Chacornac's admittedly variable nebulæ are situated not far off, one in the head, the other near the tip of the right horn, of Taurus. And it is unquestionable that some kinds of sidereal phenomena tend to localise themselves in certain quarters of the sky. There is, moreover, reason to believe that a nebula has vanished from the heart of the cluster itself. Such an object is marked on Jeaurat's chart of the Pleiades (published in 1782) in connection with a pair of small stars nnmbered by Bessel 31 and 32. These lie about half a lunar diameter north of Pleione, in a quarter where no vestige of nebulosity can now be distinguished; so that the possibility is excluded of Jeaurat's having merely anticipated subsequent discoveries. The stars 31 and 32 form a binary system already giving signs of mutual revolution; and one of them (No. 32) is considered by Lindemann as variable. If any weight attached to Jeaurat's estimates of brightness, there could be no doubt about the matter, since he stated them to be respectively of 7th and 4th magnitudes, while Bessel found them both of the 8th. Jeaurat's authority in photometry, it is true, is of the lowest; yet it is hard to believe that his eye can have represented to him a difference of three whole orders between two equal stars, visible side by side in one field of his telescope.

Stellar fluctuations have so frequently been observed to be associated with nebulous surroundings, that it is worth noting, as at least a coincidence, that neither Merope nor Maia is exempt from a strong suspicion of variability. The latter, according to M. Wolf, is slowly gaining lustre; the former oscillates through a range of one magnitude.

The stars of the Pleiades are immeasurably far off. None of them has any sensible parallax; and we are thus uninformed as to their intrinsic lustre, mutual distance, or gravitating mass. It is, however, easy to compute the dimensions of the group relatively to its remoteness from ourselves.[1] A circle described from Alcyone with a radius of 48′ includes all its principal stars. Only one of Bessel's 53 falls outside it. We may then take the globular mass of the cluster to be of this apparent size, disregarding the stellar streams external to it as being, more or less, outliers. Now, since the sine of an angle of 48′ is to radius as (in round numbers) 1 : 71, it follows that the furthest of the suns congregated into the nuclear group under consideration, are just 71 times as distant from us as from the centre of their own system. Consequently, Alcyone blazes upon them with 5000 times the lustre it displays to us, or as a star about 86 times the brilliancy of Sirius. It would still, however, seem a star rather than a sun. Even from the distance of Neptune, our own central luminary must outshine Alcyone, as viewed, say, from Atlas or Taygeta, fully 77,000 times.

The glimpse afforded by recent investigations of the structure of the Pleiades group is a very surprising one. We find in it a miniature sidereal system, the richness and variety of which bewilder theoretical conceptions, and recall, as analogous, the accumulated wonders of the Magellanic clouds. Nebulæ are discovered in most intimate connection with lucid stars, and in suspicious relations to their luminous vicissitudes, while themselves possibly subject to strange alternations of visibility. Stars of all orders are included in one vast assemblage, some doubtless magnificent orbs, of many times the radiance of our sun; others as inferior to them perhaps as the moons of Mars to Jupiter. The distribution of these bodies appears to be no less varied than their size. Groups are collected within the main group, systems revolve apart, the subordination of which to the laws of a general federative union leaves their internal liberty of movement unshackled. It is not, indeed, certain that a dynamical equilibrium of the whole subsists. Hints of a centrifugal tendency have been caught by M. Wolf, suggesting that an impulse of separation may at present be the predominating one. Possibly, then, Mr. Stone's curious observations on the slowly divergent proper motions of some southern stars, apparently the remnants of broken-up systems, may exemplify the inscrutable destinies in store for the unnumbered stars of the Pleiades.

A. M. CLERKE

NOTES

SCIENCE was *en fête* at the Mansion House on Tuesday night, when the Lord Mayor and Lady Mayoress received the Presidents and Members of Council of the Royal and other principal Learned Societies. Everything passed off in the most admirable way, and the presence of about 100 ladies, as well as of 200 of our representative men of science, made the gathering a very brilliant as well as a very remarkable one. The present

[1] As was done by the Rev. J. Michell in 1767 (*Phil. Trans.*, vol. lvii. p. 257).

Lord Mayor is entirely to be congratulated on this new departure.

On Monday last the galleries in the west wing of the British Museum, hitherto occupied by natural history objects which have been removed to South Kensington, were thrown open to the public. Besides a rare collection of objects of Oriental art, sacred and profane, the galleries are now the home of the ethnographical collections belonging to the British Museum, including the famous Christy Collection presented by the trustees to the nation. When Mr. Christy died in 1865 he left his prehistoric and ethnographical collections, together with a sum of money, to four trustees, with power to dispose of them to any existing institution, or to create an institution for them if this course should prove desirable. One portion of the collections had been arranged prior to Mr. Christy's death by Mr. Steinhauer of Copenhagen, and the trustees decided on offering this to the British Museum, together with a selection of objects of the same kind made from the remainder of the collections. This offer was accepted in 1866, but, owing to the crowded state of the National Collection, a temporary place of deposit was taken at 103, Victoria Street, formerly occupied by Mr. Christy. Here the scattered collections were brought together and incorporated with that arranged by Mr. Steinhauer; various additions were made from time to time during the past twenty years, either by presentation, or by purchase from the income arising from the sum left by Mr. Christy for the purpose of maintaining the collection. The ethnographical portion has now been removed to the British Museum, and is incorporated with the collections previously in the Museum. One provision of the gift by the trustees to the nation was that the collection should be actually placed in the British Museum, and exhibited there, and as this condition was not fulfilled until Monday last, it follows that it was only on and from that day that the Christy Ethnographical Collection became the national property. The prehistoric collection will, in like manner, be incorporated with the prehistoric collections already in the British Museum, and will shortly be arranged in the room between the top of the staircase and the ethnographical collection.

Of the new galleries and their contents it would be impossible to speak adequately here. They do not yield their secret in the course of a few cursory visits; each one of the many sections is a study in itself, and will engage the attention of the ethnologist and of the student of *Culturgeschichten*. The first room contains, on the left, the arms and armour of the civilised nations of Asia, from the Burgess, Meyrick, and Henderson collections, while the other side is occupied by the weapons and implements of the less civilised or barbarous Asiatic peoples; these come from Borneo, the Nicobars, Ceylon, the Khonds of Orissa, tribes inhabiting parts of Burmah and Northern Siam, the Nagas of Assam, the Ainos, and the tribes of Northern Asia. The second room is occupied by the utensils, weapons, implements, dress, &c., of Java, Sumatra, Australia, and New Guinea on the left; and on the right by those of Borneo, the Asiatic islands, Micronesia, and New Zealand. The last is an excellent collection, and one which it would be now very difficult, if not impossible, to collect again. The third room is devoted to the Pacific islands, to New Ireland, New Britain, the Solomon Islands, Fiji, the Harvey, Society, Friendly, Samoan, and Savage Islands. The centre of this room is occupied by two magnificent specimens of the canoes of the Solomon islanders. This room also contains the Sandwich Islands collection, which is now absolutely priceless, for it could never again be obtained. The fourth room is nearly wholly devoted to Africa, but the American collection (which appears to be greatly cramped for space) overflows into it. On the left we have South and West Africa represented, and North America; on the right we have the Marquesas and Easter Island, Madagascar, Eastern Central Africa, Abyssinia, North Africa, and Arctic America. The fifth and last room is possibly the most interesting and valuable of all. It is devoted to America. We commence on the left with the Ancient West Indies, which are mainly represented by stone implements; this is succeeded by a wonderful collection representing Ancient Mexico. Here also stone implements and pottery (especially the latter) abound; then come Central America and New Granada, and finally an invaluable collection representing the Inca civilisation of Ancient Peru. On the right of this room the collections from Modern Mexico, North-Western and Arctic America are placed. In this abounding wealth of ethnological objects it is difficult to specify one section which attracts the eye more than another. Each visitor, according to his tastes and course of study, will select for himself, but, as we have already suggested, the New Zealand, Sandwich Island, Ancient West Indian, Ancient Peruvian, and Ancient Mexican collections are probably unrivalled elsewhere in the world. When the prehistoric collections shall have been arranged, the British Museum will have at last materials for the illustration of the history of mankind worthy of the British nation.

We understand that Mr. John Smith, Curator of the Royal Gardens, Kew, has, in consequence of ill-health, resigned his appointment, which he has held for a period of twenty-two years.

A strongly supported memorial has been presented to the Lord President of the Council, urging the desirability of establishing a Medical Faculty and an Engineering School at Cardiff, in connection with the University College of South Wales. Forcible reasons are given for the establishment of the former in so thickly populated a region; and as several of the subjects required for medical students are already taught at Cardiff, it need not be difficult to supplement them, so as at least to carry medical studies to all but the final stage for the medical degree. As to an Engineering School, it is pointed out—that the engineering and colliery interests in the district are second to none in the world, while the rapidity of their growth has been unparalleled in our national history; that the urgent need for the establishment of a Faculty of Engineering in connection with the University College of South Wales and Monmouthshire is shown by the fact that no less than 90,000 skilled workmen are employed in the vast collieries, and in the iron, steel, tin, copper, chemical, and general engineering works of the district; that those who direct and manage the operations of these large industries (at a low estimate in number more than 4000 persons) must at present, in order to obtain a technical training, proceed to distant parts of the United Kingdom or to the Continent; so that for the great bulk of the people there are insuperable difficulties in the way of that higher education which is becoming more and more necessary in the face of the growing competition with Continental nations, and the greater advantages in the way of technical education offered by Germany, France, and other countries. It is to be hoped that Government will grant the prayer of the petition, and provide the funds necessary to establish the necessary Chairs.

It is intended to hold a Photographic Exhibition in Glasgow, in the Corporation Galleries of Art, during July, August, and September, 1886. The Exhibition will comprise:—(I.) Illustrations of the history of photography, early daguerreotypes, calotypes, &c.; (II.) photographic instruments, materials and appliances, lenses, cameras, chemicals, &c.; (III.) illustrations of modern processes in photography; (IV.) applications of photography: portraiture, landscape photographs, architecture, reproductions of pictures, drawings, etchings, and engravings, photolithographs, photogravures, copying plans, maps, mechanical drawings, illustration of books, decoration of glass, pottery, &c., astronomy, meteorology, microscopy, &c. The object of the Exhi-

bition is to illustrate the history and development of photography, and to show the numerous and important applications of the art to science, art, and industry. All objects selected for exhibition will be chosen with the view of promoting the educational value of the collection. The elements of competition and trade will not enter into the Exhibition, nor will there be any prize offered to exhibitors. Portraits will be shown only in so far as they may serve to illustrate the various methods of portrait photography, or special features of size, treatment, &c. Landscapes may be accepted on account of the interest of the subject, as well as for technical excellence. Reproductions of art objects will be received both as illustrations of processes and for the artistic interest and importance they possess. Communications respecting the business of the Exhibition should be addressed to the Secretary of the Museum and Galleries Committee, Town Council, Glasgow.

MR. GEORGE R. ROGERSON, an old pupil of the College, has presented his valuable astronomical observatory to the Council of Liverpool College. The instruments include an equatorially-mounted refracting telescope, a spectroscope with ten prisms, a micrometer, and also an astronomical library.

AN important essay on micro-chemical reactions has just been published in Brussels by MM. Klement and Renard. Availing themselves of the published researches of Boricky, Behrens, Streng, Lehmann, Haushofer, and others, combined with the results of their own extensive researches, the authors have produced the most complete account of the subject which has yet appeared. They describe the methods of research and the reactions, simple and characteristic, by which compounds of more than fifty elementary bodies may be identified in minute crystals recognisable under the microscope. They also give a brief description of the processes of isolation and identification applicable to such compounds as the mineral constituents of rocks. The value of the treatise is much enhanced by the accompanying plates, eight in number, comprising nearly 100 figures of the forms of crystals obtained by the various reactions described in the text.

AN International Congress of Climatologists and Hydrologists is appointed to meet at Biarritz during the first week in October. The co-operation of the various medical, hydrological, and meteorological societies of France has been received; the Minister of Commerce will open the first meeting on October 1, and Dr. Durand-Fardel of Paris will be the President. The object of the Congress will be to assemble specialists from every country to discuss questions connected with hydrology and climatology. Excursions are to be made to various watering-places in the Pyrenees.

THE sale of a considerable portion of the celebrated Godeffroy Ethnological Collection from the South Sea Islands, at Hamburg, to the Leipzig Museum, has already been recorded. The portion thus sold appears to have been mortgaged by the owner, and the sale was made by the mortgagees. The remaining part, which was not mortgaged, and which included very valuable zoological and palæontological collections, as well as a comprehensive collection of woods from the South Seas, has just been purchased by the city of Hamburg for 85,000 marks.

MRS. OGILVIE, of Sizewell House, has presented 1300*l.* to the Ipswich Museum, to clear off the debt attaching to the building.

THE Municipal Council of Paris at its sitting of the 29th ult. resolved to vote a sum of 5000 francs to M. Georges Poucher, to enable him to continue his investigations into the course of the Gulf Stream.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mrs. Carter; a Black-eared Marmoset (*Hapale penicillata*) from South-East Brazil, presented by Mr. A. Evershed; two Three-toed Sloths (*Bradypus tridactylus*) from British Guiana, presented by Capt. Hicks; a Crested Porcupine (*Hystrix cristata*) from Ceylon, presented by Miss C. S. Simpson; a Crested Porcupine (*Hystrix cristata*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Mr. John Hewat; an Indian Antelope (*Antilope cervicapra*) from India, presented by Capt. J. C. Robinson; a Herring Gull (*Larus argentatus*), British, presented by Capt. H. G. Alexander; a Ceylonese Hanging Parrakeet (*Loriculus asiaticus*) from Ceylon, presented by Mr. C. W. Rosset; a Clouded Tiger (*Felis macrocelis*) from Assam, a Burchell's Zebra (*Equus burchelli* ♂) from South Africa, two Globose Curassows (*Crax globicera* ♀ ♀) from Central America, deposited; two Black-footed Penguins (*Spheniscus demersus*) from South Africa, purchased; a Lesser Koodoo (*Strepsiceros imberbis* ♂) from Somali Land, a Ruddy Sheldrake (*Tadorna casarca*), European, received in exchange; two Black-backed Jackals (*Canis mesomelas*), an Eland (*Oreas canna* ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN

PARALLAX OF NOVA ANDROMEDÆ.—Prof. Asaph Hall, writing under date February 12, in the *American Journal of Science*, states that this star was then very near the limit of visibility in the great refractor of the Washington Observatory. It had thus in five months faded down from "the limit of visibility to the naked eye to that in a 26-inch telescope." Led by the suggestion of Prof. Peters that it would be interesting to test the parallax of such a star, Prof. Hall began on September 29 a series of measures of the Nova, referring it by means of polar co-ordinates to a known star of the eleventh magnitude, distant from it a little less than 2′. The measures do not, in Prof. Hall's opinion, show any proof of a parallax, though they indicate perhaps a diminution of the apparent distance from the comparison star. The variation in the brightness of the star would, however, be likely to affect the measures. The star was too faint for the measures to be continued after February 7.

Prof. Hall mentions favourably Mr. W. H. Monck's suggestion (*Observatory*, vol. viii. p. 335) that the Nova may have been a swiftly-moving star "that in rushing through the nebula had been set on fire like a meteor in our atmosphere."

M. LŒWY'S METHOD OF DETERMINING THE ELEMENTS OF REFRACTION.—Mr. Gill, writing on the subject of M. Lœwy's proposal to determine the elements of refraction by means of a reflecting prism placed in front of the object-glass of an equatorial (NATURE, vol. xxxiii. p. 303), whilst expressing his appreciation of the merits of the French *savant's* scheme, suggests that, in place of having the tube of the telescope fixed and the prism movable with respect to it, it would be better to have the prism rigidly attached to the objective, the micrometer threads being parallel to the line of intersection of the reflecting surfaces of the prism, and the whole tube capable of rotation round its axis. By this arrangement a sufficiently firm connection would be established between the prism and the micrometer, and the necessity of calculating the direction of the line of measurement by the latter would be entirely obviated. It is also pointed out by Mr. Gill that the carrying out of M. Lœwy's plan necessitates the construction of a complete special apparatus, but that it would be comparatively easy to adapt the modern heliometer to this kind of observation. It would only be necessary to mount the prism symmetrically in front of the object-glass, so that the line of intersection of the reflecting surfaces should be at right angles to the line of section of the object-glass, and to the axis of the heliometer. The observations would then be made by bringing the images of the two stars into coincidence near the centre of the field by symmetrical movements of the segments of the objective, as in the ordinary process of measurement with this instrument. This method of observation is, in Mr. Gill's opinion, the most convenient and the most accurate of all those known at the present time, and

the advantage of precisely simultaneous measures is a point of considerable importance when one of the stars is at a low altitude which is rapidly varying.

DISCOVERY OF MINOR PLANETS.—Four new minor planets were discovered in less than a week by Herr Palisa at the Vienna Observatory—Nos. 254 and 255 on March 31, No. 256 on April 3, and No. 257 on April 5. All are about the thirteenth magnitude.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 *APRIL* 18-24

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on April 18

Sun rises, 5h. 0m.; souths, 11h. 59m. 16·8s.; sets, 18h. 59m.; decl. on meridian, 10° 54′ N.: Sidereal Time at Sunset, 8h. 46m.

Moon (Full) rises, 18h. 58m.; souths, 0h. 24m.*; sets, 5h. 42m.*; decl. on meridian, 9° 13′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	4 34 ...	11 4 ...	17 34 ...	5 11 N.
Venus	3 36 ...	9 9 ...	14 42 ...	6 5 S.
Mars	13 43 ...	20 47 ...	3 51* ...	11 42 N.
Jupiter... ...	15 51 ...	22 7 ...	4 23* ...	2 19 N.
Saturn... ...	8 16 ...	16 28 ...	0 40* ...	22 51 N.

* Indicates that the southing or setting is that of the following morning.

Occultation of Star by the Moon (visible at Greenwich)

April	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
18 ...	κ Virginis... ...	4½ ...	21 5 ...	21 48 ...	349 273

April	h.	
18 ...	6 ...	Mars stationary.
21 ...	14 ...	Mercury stationary.

Places of Comet Fabry.

1886	R.A. h. m. s.	Decl. ° ′	Log Δ	Brightness.
April 18 ...	0 13 47 ...	37 53 N. ...	9·628 ...	145
22 ...	0 58 58 ...	33 58 ...	9·504 ...	230

Places of Comet Barnard.

1886	R.A. h. m. s.	Decl. ° ′	Log Δ	Brightness.
April 18 ...	1 43 58 ...	37 41 N. ...	0·109 ...	37
22 ...	1 41 36 ...	39 2 ...	0·075 ...	54

The comet places are for Berlin midnight.

Variable-Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
S Cancri	8 37·4 ...	19 27 N. ...	Apr. 23,	23 41	*m*
R Leonis	9 41·4 ...	11 57 N. ...	,, 23,		*m*
U Virginis	12 45·3 ...	6 10 N. ...	,, 24,		*M*
W Virginis	13 20·2 ...	2 47 S. ...	,, 18,	0 0	*M*
δ Libræ	14 54·9 ...	8 4 S. ...	,, 18,	3 52	*m*
U Coronæ	15 13·6 ...	32 4 N. ...	,, 23,	4 10	*m*
S Libræ	15 14·9 ...	19 59 S. ...	,, 22,		*m*
S Ophiuchi... ...	16 27·7 ...	16 55 S. ...	,, 19,		*M*
U Ophiuchi... ...	17 10·8 ...	1 20 N. ...	,, 18,	8 30	*m*
		and at intervals of		20 8	
X Sagittarii... ...	17 40·4 ...	27 47 S. ...	Apr. 21,	2 20	*m*
			,, 24,	0 0	*M*
δ Cephei	22 24·9 ...	57 50 N. ...	,, 24,	0 0	*m*

M signifies maximum; *m* minimum.

Meteor Showers

The present week is one usually rich in meteors, but moonlight will interfere with observation this year. The most interesting shower, the *Lyrids*, radiant R.A. 274°, Decl. 34° N., April 18–20, has been poorly represented of late years. Several radiants from Cygnus and Draco are usually active from April 19 to April 23.

GEOGRAPHICAL NOTES

THE greater part of the contents of the current number of *Petermann's Mittheilungen* is devoted to the geography of the African continent. In the first paper (which is accompanied by an excellent map) Dr. Chavanne describes his journey from the Lower Congo to San Salvador and the Arthington Falls, as well as other explorations in Portuguese West Africa. The position of many hitherto unsettled points is now defined. The traveller states that he paid particular attention to the question of the population and its density. He counted the huts in the places through which he passed, and endeavoured to obtain from the natives details of the houses within 5 kilometres on each side of his route, and he comes to the conclusion that the estimates of some previous travellers are greatly exaggerated. Dr. Lenz communicates some observations on the Congo, and Prof. Kirchhoff writes a short but important article on the hydrography of the Muta Nsige. Dr. Karl Lechner gives the history and present condition of what he styles a "language island" in Moravia, a kind of oasis in this province of Slavs, in which the German, or a kind of German, language has been preserved by the people for centuries. The place is Wischau, not far off the high road between Brün and Olmütz. The people call themselves Schwoben, and in the struggle for the maintenance of their nationality they have been assisted by the Tyrol and Bavaria. Dr. Müller defends his edition of the Arabian geography of Hamdânî against the strictures of Herr Glaser in his recent account of his Arabian journeys.

THE *Verhandlungen* (Bd. xiii. No. 3) of the Geographical Society of Berlin contains an account by Lieut. François, of his journeys in the southern basin of the Congo. He accompanied the Wissmann Expedition to Kassai, and also Mr. Grenfell on his journey on the Lulongo and Chuapa, and he describes some of the incidents and observations of these journeys. Dr. Moritz, who proceeded to Syria in 1884, on behalf of the Archæological Institute of Berlin, read a paper on the geographical experiences of his journey. A brief communication from Dr. Sievers recounting his work in Columbia is also published.

THE Foreign Department of the Würtemberg Government has invited the Governments of Austria, Bavaria, Baden, and Switzerland to join in a common and simultaneous investigation of the depths of Lake Constance, and the preparation of a chart of it. The proposition is that a commission of specialists from all these States should meet at Friedrichshafen to settle the extent, methods, and time for the investigation. The Swiss Assembly has welcomed the proposal, more especially as the Swiss have already carried out a considerable part of the work as far as their portion of the trade is concerned.

SOME time since we noticed the success of two officers of the French navy, Capt. Réveillère and Lieut. Fesigny in a daring attempt to ascend the rapids of the Meikong when the river was in full flood. The Colonial Council of Cochin China has now passed a resolution affirming the necessity for organising a mission of engineers or naval officers to enter into a complete and minute study of the Meikong rapids at low water. These rapids are all that prevent access from the sea by the Meikong to Hung-Tseng, Luang-Prabang, and beyond even to Kiang-hung and the Shan States up to the Chinese border.

FURTHER details of Mr. Charles Winnecke's plan of that part of South Australia crossed by the overland telegraph, to which we have already referred, are supplied in a late issue of the *Colonies and India*. The survey shows that the distance from Tennant's Creek eastwards over the rivers Buchanan, Rankine, James, Herbert, and Milne, is 1626 miles. The country continually rises from Port Augustus till Burt Plain on the MacDonnell ranges—a distance of 1000 miles—is reached, after which it falls gradually to the boundary. Mr. Winnecke has included in his plan every camping-place along the telegraph line. He asserts that Lake Eyre is a considerable depth below the sea-level, a statement which he made in 1877, but which has been disputed. The highest point along the route was the Burt Plains in the MacDonnell ranges, which are 2532 feet above the sea-level, but the ranges themselves are several thousand feet higher. The telegraph station of Central Australia,

Alice Springs, is 2000 feet above the level of the sea. The Finke River is described as the largest and most important in Central Australia; its southern part is now being re-explored by Mr. Lindsay. On the whole it appears that Mr. Winnecke's map and the details accompanying it add considerably to our knowledge of the geography of Central Australia.

THE last census of the Hawaiian Archipelago, as compared with that of 1878, gives some curious results. In these six years the pure natives have decreased from 44,088 to 40,014, while the half-castes have increased from 3420 to 4218. The Chinese immigrants in 1878 numbered only 5916; in 1884 they had increased threefold, their number being 17,931. In every other respect the population increased. The Portuguese labourers number 9377 against 436; immigrants from the United States were 2066 against 1276; British subjects 1282 against 883; Germans 1600 against 272, and so on. The children born in the archipelago of foreign parents increased from 947 in 1878 to 2040 in 1884. On the whole the population was 80,578 in the latter year, against 57,985 in the former, although the natives had diminished about 10 per cent. in the six years. We thus havd passing under our eyes the peaceful extinction of a race by the operation apparently of natural laws. The Hawaiians govern themselves under a sovereign of their own race, and under their native conditions; yet they are rapidly disappearing, simply through the presence of other races, without war or any other of the direct causes to which the decay of native races is generally attributed. The social conditions of the archipelago are an interesting study just now from many points of view.

M. VAN GEÛNS, Chief Engineer and Inspector of Public Works in Java, has lately been on a journey through that and the neighbouring islands, of which he has published an account. He speaks of the various Javan volcanoes, of which much has been heard lately, and says that since the eruption of Krakatão in 1883 the people live in comparative quiet. But this calm is only apparent, for volcanic eruptions, always numerous, are incessant. The volcanoes on the Island of Java itself manifest everywhere great activity, but not so as to produce a serious cataclysm. Smeroc, which is the highest mountain in the island, and its neighbours Brômo and Lamonyon, are active from time to time. In 1885, for example, Smeroc overwhelmed plantations and villages on its side with eruptive matter. Merapi, in the centre of the island, shows constant signs of life; lava is constantly flowing from it, smoke and steam are almost always visible at its summit, so that it is one of the active volcanes of the world. M. van Geûns reports another curious phenomenon. After a period of extreme drought continued rains have inundated one part of the country, while there is an absolute want of water in other places which should have it in abundance. This anomaly is attributed to the monsoons which blow irregularly, and which cause more anxiety to the Javanese than their volcanoes.

THE MINES COMMISSION REPORT

THE final report of the Accidents in Mines Commission has been issued as a Blue Book. The report, which occupies 120 pages, is accompanied by minutes of the evidence taken and numerous appendixes and diagrams. The report concludes with the following paragraphs, in which the Commissioners give a summary of the most important subjects dealt with and of the chief conclusions and recommendations based upon them:—

Volumes of air sufficient for the ventilation of even the most extensive collieries are capable of being passed through the workings by means of properly constructed furnaces, or by mechanical contrivances, such as are already in action at most of the collieries. At a large number of collieries the sectional area of the intake and return-air courses may be increased with advantage. Where furnaces are used they should by preference be in connection with dry and deep shafts, and should be provided with dumb drifts. Where mechanical contrivances are employed they should be in such positions and placed under such conditions as will tend to insure their being uninjured by an explosion, and, if they are not provided altogether in duplicate, there should be at least an engine in reserve. The improved system of ventilation by "splits" and the shortening of the air-courses, as practised in the larger collieries, is a subject of great importance, and we recommend that more general attention should be given to it. It would conduce greatly to safety if the system of carrying the intake air through two parallel drifts, of which one may be used as the travelling road, were introduced into workings likely to become extensive, and where mechanical haulage is intended to be employed.

That the casualties due to falls of the roof and sides are much more numerous than those due to any other causes is demonstrated by the tabular statement given at the commencement of this report. It is essential that all the officials and workmen in mines should pay special attention to the careful propping of the working places and travelling roads. In the north of England the system of trusting mainly to officials (deputies) for the timbering is found to answer well; in South Wales and other districts, where the roof, face, and sides are more liable to falls, the system of the men timbering their own working places has been found to be best.

We are of opinion, however, that in all cases the security of the working places should be examined into by over-lookers once at least in the course of each shift. Supervision has been greatly enlarged in the last thirty-five years, and we find that there is generally one official so employed to about twenty men, sometimes one even to eleven or twelve men. In order to reduce the number of casualties from falls, we recommend the observance of the following:—(*a*) The maintenance of ample supplies of timber in localities convenient to the workmen; (*b*) the proper training of each miner to the best modes of timbering and of otherwise protecting his working place; (*c*) the exercise of increased care on the part of the workmen in watching the roof, sides, and face, and protecting themselves in time; (*d*) the introduction, as far as possible, of arrangements with the workmen which will make it their interest not to avoid the labour of putting up the necessary timber, cog-walls, buildings, or nogs for their proper protection; (*e*) the employment of special timbermen or deputies for the timbering of main ways and also for the repairing as well as drawing of timber; (*f*) preventing timber being left in the goaf of long wall workings, which would have the effect of breaking the roof; (*g*) driving the working places as rapidly as possible by shifts of an ample number of workmen in each face, and so reducing the risk of falls and exposing the least number of men to danger at any one time.

We are of opinion that by improved discipline and the exercise of greater care by those employed in or travelling through engine planes and other roadways the number of casualties comprised under the head of "miscellaneous accidents" would be considerably diminished. The practice in some collieries in South Wales of boys running in front of the horses and trams should be prohibited. The very numerous casualties under the heads of "falls of roof and sides" and "miscellaneous accidents" are due in great part either to carelessness or want of early training. Looking to the importance of practical training, and of encouraging boys to enter the mines at the ages specified by the Mines Regulation Acts, we are of opinion that careful consideration should be given to this point in connection with the administration of the Elementary Education Act.

We think that the experiments we have made on the pressure of fire-damp in plugged bore holes in coal, a pressure sometimes amounting to upwards of 400 lbs. on the square inch, have thrown much light upon the occurrence of sudden outbursts of gas. The boring of holes upward or downward has been successfully tried as a means of avoiding such outbursts, and we have little doubt that the closer attention which is now paid to thorough stowing and packing or building in the workings will contribute greatly to the same end. It is almost impossible to account for many of the accidents which have occurred in well-managed mines, some of which have originated in the main-intake airways, except upon the supposition that gas has suddenly invaded the workings from the adjacent strata. Sudden outbursts of large quantities of gas, accompanied by violent disruption of the floor, roof, or coal, are fortunately rare, but smaller incursions of gas, accompanied by falls of roof, or even without any apparent displacement of ground, are comparatively frequent. We are of opinion that in working fiery seams at great depth such abnormal discharges of gas must occasionally occur, yet that they may be successfully met by ample ventilation, good discipline, and efficient lamps. While we recognise that variations of atmospheric pressure exert an influence on the escape of gases which have accumulated in cavities, and possibly to a slight extent on that of gases emitted directly from the coal, we entertain great doubt as to the wisdom of placing reliance on the issue of meteorological warnings. These can at best only convey very imperfect information, which, moreover, may be sometimes dangerously misleading. We are of opinion that safety would be much more likely to be insured by unceasing vigilance on the part of the

officials and workmen in the mine than by any attention to such warnings.

The action and effects of coal-dust in connection with mine explosions have been made the subject of careful study and comprehensive experiment by numerous workers since attention was first drawn, about forty-two years ago, by Faraday and Lyell to the functions exercised by coal-dust in "aggravating and extending the injurious effects of fire-damp explosions." The results and conclusions which have been arrived at in this direction, and to which the labours of your Commissioners have contributed, are sufficiently complete and definite to warrant the following authoritative statements:—The disastrous effects of fire-damp explosions in coal-mines are almost always aggravated and extended by the existence of coal-dust in dry mine-workings and roadways. A gas explosion in a dry mine, even if only of comparatively trifling nature, will raise and inflame coal-dust existing at the seat of the explosion or in the vicinity; the flame attending the explosion will be thereby increased and carried to more or less considerable distances, and may thus become communicated to any accumulations of explosive gas-mixture which may exist in goaves or other lurking places at a distance from the seat of the original gas explosion.

The firing of an explosive in shot-hole of a strength which is in excess of the power applied, or which has not been sufficiently tamped, will result in the almost complete projection of the highly-heated products of explosion and of a more or less considerable body of flame from the mouth of the hole, as from the bore of a gun; it thus produces what is known as a blown-out shot. And further, if the charge of explosive is decidedly greater than that necessary to perform the desired work in the coal or stone where it is applied, a more or less considerable projection of highly-heated products of explosion will also take place, and effects similar to those of a blown-out shot will be produced. The production of a blown-out powder shot in a mine-working, in the entire absence of coal-dust, or in a wet mine, is not attended by the projection of flame to a very considerable distance, but the flame thus projected is much increased in volume if, as is frequently the practice, dry or slightly damp small coal has been used as stemming for the shot. If a blown-out powder-shot be produced in a dry locality where coal-dust exists in more or less abundance, the flame projected by the shot is sure to be considerably increased and extended by the ignition of portions of the dust-cloud which is raised by the rush of air occasioned by the firing of the shot. A result of this nature will be produced even if the air in the vicinity of the blown-out shot is entirely free from fire-damp. Unless the coal-dust which exists in the immediate vicinity of a blown-out powder-shot is dry, very finely-divided, and of a very highly inflammable character, the propagation of flame from the shot by the raised dust will only take place to a comparatively limited extent if the atmosphere in which the dust is raised be entirely free from fire-damp. It is, however, well established that, even when the air is quite free from fire-damp, an exceptionally inflammable coal-dust, in a very finely divided and dry condition and existing in abundance in the immediate vicinity of a blown-out shot, may, when raised by the shot, be ignited so readily, and carry on the flame so rapidly, that it may produce explosive effects of a similar character to those caused by a gas explosion. The flame, as it rushes along, if fed by freshly raised dust, may extend under these circumstances to very considerable distances, with results resembling, in their disastrous nature, those of explosions originating with, and mainly due to, fire-damp. If a blown-out powder-shot occurs in a locality where the atmosphere contains a small proportion of fire-damp (even not above two parts in 100 of the air), the presence of dry, fine, and porous dust, even if it be only comparatively slightly inflammable, may give rise to the explosive propagation of flame to distant localities, where either accumulations of inflammable or explosive gas-mixture (as in goaves or old working places), or deposits of very inflammable dust, may take up the explosion and still further extend its disastrous effects. Wherever a coal is worked which contains inflammable gas, the atmosphere in the vicinity of the workings, however efficient the ventilating arrangements, will at one time or another, and, it may even be said, generally, contain some small proportion of fire-damp. Mines have hitherto been considered free from fire-damp when the search for gas by means of a lamp flame has been unattended by the appearance of a cap upon the flame or by an elongation of the flame. This test, however, fails to indicate the presence of fire-damp, if the atmosphere contains less than from 2 to 2·5 per cent. of its volume of marsh gas. Such a slight contamination of the atmosphere by fire-damp is not only sufficient to greatly enhance the dangers due to the existence of dust in any abundance in a dry mine-working, as already described, but is also sufficient actually to give rise to the production of an explosive mixture with dust raised in it by a blown-out shot. Small proportions of gas, such as are referred to, when existing in the atmosphere of a mine, can now be detected by more delicate gas-indicators than a lamp flame; but, while a knowledge is thus afforded of the presence of gas, it remains impracticable to prevent such slight contamination by fire-damp of the air of a mine near the working places.

It will be seen from the foregoing that such contamination, although quite insufficient to constitute in itself a source of danger, does become dangerous if dust co-exists with it, in abundance, in dry mine-workings, if powder-shots are fired in such workings. No means are at present known by which security can be attained against blown-out shots during blasting in hard coal or in stone, and the use of powder in coal is sometimes attended by the emission of flame, even when blown-out shots are not produced. It follows from the foregoing that the firing of powder-shots in a dry mine-working where dust exists in abundance must always be liable to be attended with disastrous results if the air in such a locality is contaminated by fire-damp, even to so small an extent as in the proportion of two volumes in 100 volumes of the air of the mine. The constant removal of accumulating dust from the workings in dry mines, to such an extent as to guard against the raising of any considerable quantity of dust where shots are fired, could scarcely be so thoroughly carried out, in any but very exceptional cases, as to constitute by itself an effectual precaution. The application of water to the laying of dust in roadways has been applied here and there with some amount of success, but the effective adoption of such a measure in or near the working places is in some instances attended with practical difficulties. Unless very copious watering be resorted to, it would be ineffectual in guarding against the dangers arising from the firing of powder-shots in dry and dusty workings where the air may contain some small proportion of fire-damp. The employment of hygroscopic or deliquescent salts in conjunction with water has not been found a trustworthy means of maintaining dust in a safely moist condition. The dangers which attend the firing of powder-shots in dry mine workings where dust exists in abundance, and where the air may contain even only a small proportion of fire-damp, can therefore not, with our existing knowledge, be effectually guarded against, except by combining the removal of dust as far as practicable with very copious watering. The obvious inference to be drawn from the foregoing is that a due regard for the safety of those employed in mines, where the conditions above indicated prevail, precludes the use of powder, unless the precautions just specified are effectually applied. The results of extensive practical experiments, carried out by ourselves and by others, have demonstrated that the abolition of the use of powder, where the conditions above indicated prevail, will not generally involve any formidable inconvenience, because the work which is accomplished by its employment, both in coal and in stone, can now be performed with equal efficiency and at very little, if any, greater outlay, by one or other of the following available alternative means:—(*a*) In some coal-seams the lime-cartridge will perform work quite equal to that accomplished with powder, at no greater cost, and with absolute immunity from risk of explosions; (*b*) mechanical appliances exist which will do efficient work, not only in some kinds of coal, but also in some stone or shale over or underlying coal; (*c*) the so-called "high" or violent explosive agents, which are represented by dynamite or gelatine-dynamite, and by gun-cotton or tonite, can now be applied, not only for working economically in stone or shale, but also for coal-getting, by using them in conjunction with water, according to one or other of the methods described in this report.

The "high" explosives may be used, as indicated in (*c*), with security against the ignition of coal-dust thickly suspended in air, by a blown-out shot or by the effects of an over-charged hole, even when the air contains some small proportion of fire-damp. One very simple method of using the "high" explosives in conjunction with water, included in (*c*), which may be supplemented by the use of ordinary tamping for securing the best working results, has, so far as several severe tests have shown, afforded a complete safeguard even against the ignition of an explosive mixture of fire-damp and air by a blown-out shot.

Therefore, in dry mine-workings, where the removal of dust, combined with copious watering cannot be carried out, and where neither of the alternative methods (*a*) and (*b*) of working in coal or stone can be advantageously substituted for blasting by means of powder, in localities where fire-damp is liable to have access to the mine-workings, shot-firing may be safely carried on, provided that any one of the "high" or violent explosives is employed, in one or other of the modes described, in substitution for powder. But the methods of operation which furnish effective safeguards when applied in conjunction with the high explosives fail to furnish such safeguard when applied in the same way together with powder. Unless, therefore, effective measures be adopted for the removal of dust as completely as practicable in the vicinity of the place where the shot is to be fired, such removal being followed by copious watering, the employment of powder, or of any explosive preparation of a similar nature to powder, should be prohibited in dry coal-mines where fire-damp may pervade the air, and where at the same time coal-dust accumulations are unavoidable.

With the view of promoting security from accidents under circumstances where blasting may be practised in coal-mines we would recommend that the following instructions be observed:—(1) That all work involving blasting in mines should be intrusted only to experienced workmen. (2) That, in order to lessen the risk from blown-out shots, particular care should be taken that each shot should be assisted by under-cutting and nicking or shearing whenever it is practicable. (3) That the tamping, stemming, or ramming should consist of very damp or non-inflammable material. (4) That where strong tamping is needed the compression of air at the bottom of the hole should be avoided by pushing in the first part of the tamping in small portions. (5) That where safety-lamps are used and powder is employed the shots should be fired only by specially-appointed shot-men, who before firing the shots shall satisfy themselves that the foregoing instructions are observed, and shall also satisfy themselves by carefully examining all accessible contiguous places within a radius of twenty yards of the shots to be fired that fire-damp does not exist to a dangerous extent.

The employment of the ordinary miner's fuse, which when burning is liable to allow fire to escape from its extremity or laterally into the atmosphere, should not be permitted in any mine-workings where the exigencies of safety dictate the exclusion of powder and the substitution for it of one or other of the "high" explosives in conjunction with water. Similarly, no description of mining fuse, however safe in itself, should be allowed to be ignited in such localities by means either of a lamp-flame or of a wire which has been made red hot by inserting it into the gauze of a safety-lamp, or by means of any other source of fire, which, when applied to the lighting of the fuse, must come into contact with the atmosphere of the mine. Electrical exploding appliances present very important advantages from the point of view of safety over any kind of fuse which has to be ignited by the application of flame to its exposed extremity, as the firing of shots by their means is not only accomplished out of contact with air, but is also under most complete control up to the moment of firing. Their simplicity and certainty of action have been much increased of late years while their cost has been greatly reduced, and but little instruction is now needed to insure their efficient employment by persons of average intelligence. For the foregoing reasons the use of electrical arrangements for firing shots in mines, where the employment of powder for blasting is inadmissible, should be encouraged as much as possible. Where the regular use of electrical exploding appliances is attended with serious difficulties, as in wet mines, a special form of miner's fuse, now procurable at a cost very slightly, if at all, greater than that of the ordinary miner's fuse, and exempt from the defect of a possible lateral escape of fire, should be employed, but it should be used only in conjunction with a special self-contained igniting arrangement. Such an appliance should be constructed to fit over the entire exposed end of the fuse in a shot-hole, and to ignite the fuse out of contact with the air, and after the lapse of a definite interval (*i.e.* five minutes) from the time when it has been set into action by the person in charge of the shot-firing. Simple, cheap, and efficient forms of "igniter" have been devised which fulfil these conditions.

It has been shown that mines which have hitherto been considered free from fire-damp may have the air which passes through them vitiated to an extent corresponding to about 2 per cent. of its volume of marsh gas. The air in many such mines may probably never be entirely free from explosive gas, at all events in the neighbourhood of freshly cut faces of coal and in the return airways. It has been demonstrated in our experiments that when the atmosphere contains 5 to 5·5 per cent. of marsh gas it becomes highly explosive. We have even obtained explosions which, though less violent, might be nevertheless destructive of life if they occurred on the large scale possible in a mine when the air contained only 4 per cent. of marsh gas. It will thus be seen that air which would appear free from gas if tested in the ordinary way may become by the addition of only about 2 per cent. of marsh gas capable of propagating flame and causing destruction, while the addition of about 3 per cent. converts it into a highly explosive mixture. As we have already pointed out, air which would appear quite free from gas if examined by a lamp flame may become explosive when laden with fine, dry coal-dust. It has been stated that appliances now exist by which very small proportions of marsh gas in air may be readily detected, and which can be used for examining the atmosphere of a mine. With Liveing's indicator present, gas in the air can be estimated with sufficient accuracy for all practical purposes, even when the proportion is as low as 0·25 per cent. Maurice's indicator is also capable of giving accurate measures of the proportion of gas, and is very portable, but the time required in taking an observation with the instrument in its present form seems to preclude its practical application.

The natural inference from the foregoing is that some mines hitherto considered safe with naked lights may at times be in peril. It may be that risks of explosion, arising out of the possibility of an unforeseen contamination of the air by fire-damp to a dangerous extent in parts of the workings of some coal-mines, can only be provided against by the invariable use of safety-lamps. We have not, however, considered it advisable to make a suggestion of this nature, because the great preponderance of casualties due to falls of stone and coal, over those arising from explosions, points to the importance of miners having the advantage of superior illumination afforded by naked lights in comparison with even the best forms of safety-lamp, when the circumstances of the mine, in regard to association of fire-damp and coal-dust, do not necessitate the use of safety-lamps.

We have therefore arrived at the following conclusions:—(1) That it is most important that all mines should be carefully examined by means of indicators capable of detecting as small a proportion as 1 per cent. of gas; such examination to be made before the commencement of each day-shift, and, in case of an interval, also before the succeeding shift. (2) That in all dry mines where the air may be laden with coal-dust, and where fire-damp is either known to be given off from the strata, or may from experience be reasonably suspected to exist, the Secretary of State may require safety-lamps to be used, unless the owners and workmen of such mines prove, to the satisfaction of a court of arbitration to be appointed by the respective parties, that less liability to accidents, generally, will be involved by the working of the mine with open lights than by the use of safety-lamps. It should be a special instruction to such court that the circumstances of each mine be taken into consideration with reference to the following points: (*a*), the mode of working; (*b*), the nature of the coal-seams and of the roofs and floors of the seams and of the adjacent strata; (*c*), the proximity of the seams to each other; (*d*), the emission of gas from the seam, and the liability to blowers or outbursts of gas from the coal, roof, or floor; (*e*), the order of working the seams of coal. For the system which prevails in some places of working with mixed lights—that is, with open lights and safety-lamps intermixed in the same set of workings—there is no justification, and this practice should be strictly prohibited. We are of opinion that in mines where safety-lamps are required, the position of lamp stations, or places where open lights are allowed, in reference to the possibility of access of vitiated air, should receive much more attention than at present. It is desirable that, at convenient places near the working faces, reserves of lighted and locked lamps be kept available for exchange with those extinguished in the workings.

It has long been known that if the atmosphere become inflammable the Davy and Clanny lamps, and in a less degree the Stephenson lamp, are unsafe in currents having velocities much below those encountered in well ventilated mines. Our experiments fully confirm this. The ordinary Davy lamp becomes unsafe before a velocity of 400 ft. per minute is attained. The

ordinary Clanny lamp will almost certainly cause an explosion in a current having a velocity of 600 ft. per minute. A Stephenson lamp will frequently cause an explosion in a current with a velocity of 800 ft. per minute. From the information supplied to us by your Majesty's Inspectors of Mines and others, currents having velocities of more than 400 ft. per minute are now frequently found in working places. The currents sweeping long wall-faces have very often higher velocities, in main airways current-velocities approaching 2,000 ft. per minute are recorded, and considerably higher velocities are encountered at regulators and in narrow places, or when large falls occur. It is thus obvious that, in the present improved ventilation of collieries, ordinary Davy and Clanny lamps have ceased to afford protection from explosion, and that the Stephenson lamp, though more secure than the two former, cannot be relied upon. We felt it our duty at an early stage of our investigation to draw the attention of the Secretary of State to the danger attending the use of the ordinary Davy and Clanny lamps, and our subsequent experiments have made this danger still more conspicuous. We have no hesitation in stating that these lamps should be prohibited, unless they are inclosed in cases capable of effectually preventing the gauze from being exposed to the full force of the current of air. Many lamps now exist which are able to resist, in highly explosive atmospheres, current velocities up to and even exceeding 3000 ft. per minute, at all events for several minutes. Ample time is thus obtained for bringing into operation a "shut off" appliance for the extinction of flame produced both by the illuminant and by ignited gas within the lamp. We consider that all safety-lamps should be provided with such an appliance.

Four lamps seem to us deserving of special attention, as combining a high degree of security with fair illuminating power and simplicity of construction. They are Gray's lamp, Marsaut's lamp, the bonneted Mueseler lamp, and Evan Thomas's modification of the bonneted Clanny lamp, described as No. 7 in our report. In our experiments the last lamp has given upon the whole the best results. It will be seen, however, from our experiments that many other lamps exist which are simple in construction, and almost, if not quite, as safe as the above. They generally, however, yield an inferior light in consequence of the flame being surrounded by gauze, but from this method of construction they derive the advantage of not being entirely dependent on glass for their security. To make a particular lamp compulsory would be unwise, as calculated to throw difficulties in the way of introducing improvements which will no doubt arise in the future, but we think it desirable that some control should be exercised in reference to the description of lamps employed in coal-mines, and that only those lamps should be used which are authorised from time to time by the Secretary of State. A lamp may be of the safest pattern and yet small defects in the fitting of its parts may entirely deprive it of its power of affording protection. In preparing a large number of lamps for use in a mine it may happen, even with the greatest care on the part of the lamp-men, that a lamp in an imperfect condition may be allowed to pass. The detection of these imperfections by simple inspection is in many cases almost impossible, and we are convinced that the only way of avoiding the introduction into a mine of a dangerously imperfect lamp is to test every lamp in an explosive mixture of air and some inflammable gas before it is allowed to descend the shaft. Though we have good reason to believe that the practice of surreptitiously opening safety-lamps in the workings is much less prevalent than formerly, it is still necessary that such lamps should be locked. We have examined many appliances for this purpose, and we consider that the plan of fastening the oil vessel to the other part of the lamp by a riveted lead plug, impressed at each end with marks or letters varied from time to time, is the simplest, the most efficient, and the one most likely to lead to the detection of any attempt to tamper with the lock. The power and uniformity of illumination given by a lamp can be notably improved by using, as the illuminant, vegetable or animal oil mixed with about one-half of its volume of a petroleum oil of safe flashing-point. The use of petroleum spirit or benzine as the illuminant in safety-lamps instead of vegetable or animal oil, is attended with some advantages, but it is also liable to introduce new sources of danger. Special care is needed in the filling and trimming of lamps, and in the arrangement of lamp rooms, to avoid the ignition of the highly explosive mixture formed by air with the vapour arising from this spirit. The selling of petroleum spirit, or of spirit of similar character as to volatility, under designations which are calculated to mislead in regard to the nature of the illuminant, is a proceeding fraught with danger, unless all vessels containing such illuminants bear a prominent label indicating the dangerous nature of their contents. Stringent regulations as to the conditions under which illuminants of this class are to be used and stored are absolutely necessary.

The advantages in point of convenience and efficiency which attend the employment of electric glow-lamps for illuminating the pit's bottom and roadways immediately adjacent to it have already been demonstrated at several collieries where this utilisation of the electric light has been combined with illumination at the surface by arc lights. In applying electric glow-lamps to underground illumination, to the extent indicated, through the medium of conducting cables leading from the generators to the pit bottom, it is essential to safety, as well as to the permanent efficiency of the installation, that the cables should be placed in positions where they are thoroughly protected against possible accidental injury. It is also essential, in all mines where fire-damp has been known to occur, that the glow-lamps should be excluded from direct contact with the air of the mine in one or other of the ways indicated in this report. Portable, self-contained electric lamps have been devised which will furnish for several successive hours a light considerably superior to that of the best safety-lamps, and which at the expiration of eight hours and upwards will still give a light fully equal to that of a freshly lighted Davy lamp. These lamps are perfectly safe, but as they do not afford any indication of the condition of the atmosphere in a mine, their employment, even if special fire-damp detectors are used, cannot in any case entirely dispense with the necessity for the use of some safety-lamps. For exploring purposes after accidents, or in foul places, these lamps must prove very valuable even in the present condition of their development, and as auxiliary lights they cannot fail to prove very useful. The great progress which has recently been made in the construction of portable electric lamps affords promise of a speedy utilisation of such lamps to an important extent in coal-mines.

While we think that the safety-hooks at present available may have contributed to prevent fatalities from over-winding, we believe that the best appliance for the purpose is an automatic steam brake attached to the winding-gear, and we think it desirable that such brake should be introduced where practicable.

We consider that measures should be adopted to deal more systematically, and if possible more expeditiously, with casualties resulting from the various sources of accidents dealt with in this report. Collieries or mines should be required to provide an ambulance and stretchers for the purpose of conveying to their homes sufferers from injuries received while in the discharge of their duties. Arrangements should be made for the establishment of centres in mining districts, where additional appliances for succour and relief, and also special appliances for exploring purposes, should be maintained in an efficient condition, so as to be ready for use at the shortest notice. It is most desirable that facilities should be afforded for the instruction of men in the use of special auxiliary appliances for exploring purposes, and in simple measures connected with the provisional treatment of injuries. We attach great importance to the systematic inspection of each mine by the workmen, as provided for in General Rule 30 of the Coal Mines Regulation Act, 1872, and we recommend that this provision should be generally and regularly acted upon.

Concluding Observations

In submitting to your Majesty the results of our inquiries and experimental work, and the conclusions to which they have led us, we desire to express our regret at the unavoidable delay which has occurred in the presentation of our report. This delay has been due to the wide range of important and very extensive subjects included in the reference to us, and to the great difficulties we have experienced in bringing to a close the experimental work upon which we have been engaged, almost continuously, since we first entered upon the inquiry intrusted to us. These difficulties have arisen in part out of the constant succession of inventions and suggestions submitted to us in connection with the questions under investigation, many of which demanded careful consideration and necessitated the institution of fresh experiments. They have also been in part due to the circumstance that, as our investigations progressed, the results obtained opened up new fields into which it was necessary

to extend our inquiries. In bringing our labours to a termination, we feel very strongly that many of the subjects with which we have dealt need much further elucidation by perseverance in experimental research of the kind which we have pursued. We are convinced that if the work which we are relinquishing were continued, the knowledge of the conditions to be fulfilled for securing safety from preventable disasters, and the development of resources and appliances calculated to promote the fulfilment of those conditions, could still be much advanced. It is moreover certain that new subjects for inquiry connected with the safe working of coal-mines must continue to present themselves, as has been the case during our seven years' experience. These considerations have impressed upon us the need for the official establishment of some permanent arrangement by which the continuous pursuit of this highly important class of work would be secured, and by which, also, the merits of suggestions and inventions presenting themselves from time to time would be investigated properly and thoroughly, and dealt with authoritatively. We consider, moreover, that the complete investigation of coal-mine disasters would be greatly promoted if the arrangements to which we have referred were utilised systematically, in connection with the usual official inquiries, in dealing with the difficulties which frequently arise in elucidating the causes of these disasters.

WARINGTON W. SMYTH. THOS. BURT.
CRAWFORD AND BALCARRES. R. B. CLIFTON.
GEORGE ELLIOT. W. THOMAS LEWIS.
F. A. ABEL. LINDSAY WOOD.
JOHN TYNDALL.

March 15, 1886

SCIENTIFIC SERIALS

IN the *Journal of Botany* for March Mr. G. A. Holt describes and figures a species of moss, *Thamnium angustifolium*, not only new to Britain, but new to science. It was found sparingly in Derbyshire.—Mr. J. G. Baker concludes his comparison of the British and Continental forms of the difficult genus *Rubus*.

Proceedings of the Linnean Society of New South Wales, vol. x. part 3, Sydney, December 21, 1885.—This part contains the proceedings of this most energetic Society for July, August, and September, 1885, and memoirs by the following:—Dr. R. von Lendenfeld, monograph of the Australian sponges, part 5 (plates 26–35). The Auleninæ, order 3, the Ceraospongiæ, Halme, Aphrodite, Aulena, and Halmopses are established as new genera. part 6 (plates 36–38), on the genus Euspongia.—On a sponge destructive to oyster culture in the Clarence River, a new species of Chalinulæ.—Addendum to the Australian sponges.—Addendum to the Australian Hydromedusæ.—Note on the Glacial period in Australia.—W. A. Haswell, M.A., jottings from the Biological Laboratory of the Sydney University, on an Australian species of Bonellia; on a greater respiration in fresh-water turtles. From observations on the Australian *Chelodina longicollis*, thinks the phenomena described by S. H. Gage as auxiliary respiration extremely improbable and that the Chelonian can bear with impunity being deprived of oxygen for lengthened periods; but the facts recorded by Simon and Susanne Gage in the March 1886 number of the *American Naturalist* cannot thus be interpreted.—Capt. Hutton, on the supposed Glacial period in Australia.—N. de Miklouho-Maclay, plants used by the natives of the Macleay Coast, named by Baron Müller.—George Masters, catalogue of the hitherto-described Coleoptera of Australia, part 1, Cicindelidæ and Carabidos (960 species enumerated).—J. Douglas-Ogilby, three new fishes from Port Jackson; notes on the distribution of some Australian sharks and rays.—A. Sidney Olliff, new species of Australian Coleoptera belonging to the genera Lacordairia, Xanthophæa, Plagioteium, Catosiopus, and Rhysodes.—W. Macleay, on a new genus (Phalacrognathus) of the sub family Lamprimides.—Rev. Dr. Wools, on double flowers.—K. H. Bennettt, remarks on the decay of certain species of Eucalyptus. The species were almost without exception *E. mellidora* and *E. rostrata*, and the cause is ascribed to the enormous increase in the numbers of the opossums. Some idea of the number of this animal in a portion of Gipps' Land may be had from the fact that four men in a short time procured a quarter of a million of skins.

Rivista Scientifico-Industriale, February 28.—Description of a new telescope, the "plesiotelescope," by Prof. Nicodemo Jadanza. This is an astronomical instrument intended for the study of near and distant objects. It is constructed with an achromatic objective, M, to the second focus of which is attached a second lens, N, at a less focal distance than that of the lens M. These two lenses form a compound objective, which brings into view objects at short and great distances.—A new application of electrolysis, by G. F. The anonymous author describes a process for producing damascened work rapidly and economically by electrolysis.—Note on the explosion of boilers in steam-engines, by Prof. Giovanni Luvini. The author traces the bursting of boilers to their chief causes, suggests a practical remedy, and offers some remarks on a means of generating steam with a saving of fuel.—A description of Prof. E. Lommel's aërostatic scales for determining the specific weight of gases, by G. Faè.

Bulletin de l'Académie Royale de Belgique, January.—Description of some crystals of calcite, by Prof. C. Casaro. The author describes a first series of Belgian calcites, comprising the crystals found along the left bank of the Meuse and in some other localities. These are reduced to thirty-two simple forms, of which three are new.—On the difference of sea-level in winter and summer, by Gen. Commines de Marsilly. It is argued that the Polar seas must be higher in summer than in winter, when the accumulation of ice increases the salinity, consequently also the density, of the water.—Note on the display of meteors observed throughout Belgium on November 27, 1885, by F. Folie. The maximum of intensity was generally about 6 p.m., when as many as 155 meteors were observed in a single minute at Louvain.—A contribution to the study of the germ-cell in the lower animal organisms, by C. Van Bambeke.—On the coefficient of internal friction of fluids: determination of its variations according to temperature. Theoretical considerations suggested by the observation of these variations, by P. de Heen.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 11.—"On Systems of Circles and Spheres." By R. Lachlan, B.A., Fellow of Trinity College, Cambridge. Communicated by Prof. A. Cayley, F.R.S.

This memoir is an attempt to develop the ideas contained in two papers to be found in the volume of "Clifford's Mathematical Papers" (Macmillan, 1882), viz. "On Power Co-ordinates" (pp. 546–55), and "On the Powers of Spheres" (pp. 332–36). The conception of the "*power* of two circles," or spheres, as an extension of Steiner's use of the "*power* of a point with respect to a circle," is due to Darboux.

The memoir is divided into three parts: Part I. consists of the discussion of systems of circles in one plane; Part II. of systems of circles on the surface of a sphere; and Part III. of systems of spheres.

The power of two circles is defined to be the square of the distance between their centres less the sum of the squares of their radii.

Denoting the power of the circles (1, 2) by $\pi_{1,2}$ it is proved that the powers of any five circles (1, 2, 3, 4, 5) with respect to any other circles (6, 7, 8, 9, 10) are connected by the relation—

$$\begin{vmatrix} \pi_{1,6} & \pi_{1,7} & \pi_{1,8} & \pi_{1,9} & \pi_{1,10} \\ \pi_{2,6} & \pi_{2,7} & \pi_{2,8} & \pi_{2,9} & \pi_{2,10} \\ \pi_{3,6} & \pi_{3,7} & \pi_{3,8} & \pi_{3,9} & \pi_{3,10} \\ \pi_{4,6} & \pi_{4,7} & \pi_{4,8} & \pi_{4,9} & \pi_{4,10} \\ \pi_{5,6} & \pi_{5,7} & \pi_{5,8} & \pi_{5,9} & \pi_{5,10} \end{vmatrix} = 0,$$

which may be conveniently written—

$$\pi\begin{pmatrix} 1, & 2, & 3, & 4, & 5 \\ 6, & 7, & 8, & 9, & 10 \end{pmatrix} = 0.$$

This is the fundamental theorem of the paper; it is shown that, if the power of a straight line and a circle be defined as the perpendicular from the centre of the circle on the straight line, and the power of two straight lines as the cosine of the angle between them, then the theorem is true if any circles of either system be replaced by points, straight lines, or the line at infinity.

The general theorem is then applied to prove some properties of special systems of circles, and more particularly those systems

of circles which have analogous relations to three circles, as the circum-circle, the inscribed, and nine-points circle of a triangle have to the straight lines forming the triangle.

The rest of Part I. is taken up with a discussion of equations expressed in terms of power-co-ordinates. The "power-co-ordinates" of a point are defined as any multiples of its powers with respect to a system of four circles which have not got a common orthogonal circle.

The equation of the first degree represents a circle, or straight line; and the equation of the second degree a bicircular quartic, or circular cubic, and these curves are discussed in some detail.

Part II. contains merely the extension of the results of Part I. to spherical geometry; the power of two circles on a sphere is defined to be $\tan r \tan r' \cos\omega$, where r, r' are their radii, ω their angle of intersection: the power of a small circle, radius r, and a great circle is defined as $\tan r \cos\omega$, and the power of two great circles as $\cos\omega$.

The fundamental theorem is as before

$$\pi\begin{pmatrix}1, & 2, & 3, & 4, & 5\\ 6, & 7, & 8, & 9, & 10\end{pmatrix} = 0,$$

connecting the powers of the systems of circles.

Consequently the results obtained previously are extended with but slight modification.

In Part III. the method of Part I. is applied to spheres; it is proved at once that the powers of two systems of spheres must satisfy the relation

$$\pi\begin{pmatrix}1, & 2, & 3, & 4, & 5, & 6\\ 7, & 8, & 9, & 10, & 11, & 12\end{pmatrix} = 0,$$

where any of the spheres may be replaced by planes, or the plane at infinity.

The discussion of the equation of the first degree in power-co-ordinates is much the same as that in Part I. The equation of the second degree represents a cyclide of the fourth or third order, but the reduction of the equation to its simplest form is more complicated than in the case of bicircular quartics. It is shown that there are four distinct canonical forms, each of which includes several species of surfaces. The different species are then discussed in detail.

March 25.—"Remarks on the Cloaca and on the Copulatory Organs of the Amniota." By Dr. Hans Gadow. Communicated by Prof. M. Foster, Sec. R.S.

The first portion of this communication contains an account of the sphincter and copulatory muscles, the derivation of which from skeletal and from visceral muscles is followed up in the Sauropsida and Mammalia, partly aided by the study of the nerve-supply.

Then follows an extensive description of the modifications of the cloaca of the chief groups of the Amniota. Hatteria comes nearest the Amphibia. Chelonia represent a type intermediate between that of the Ostriches and Crocodiles, and that of the Monotremes, from which again a continuity of stages up to the highest Placentalia can be traced.

The anal sacs of the Chelonia are discussed with reference to experiments on their being able to take in water. The peritoneal canals of Crocodiles and Tortoises are still functional, but in Hatteria they are rudimentary. Muellerian ducts are present in the males and Wolffian ducts in the females of young Crocodiles. Space will not permit to mention more than the following of the general conclusions drawn regarding the phylogenetic development and the homologies of the various organs treated in this paper.

The whole cloaca of the Amniota consists originally, either permanently or in the embryo only, of three successive chambers, which may be distinguished as follows:—

I. The Proctodæum (termed thus by Prof. Lankester). It is the outermost anal chamber of epiblastic origin. With its derivatives: (1) bursa Fabricii in birds; (2) various hedonic glands in most Amniota; (3) the copulatory organs, the at least partly epiblastic nature of which is indicated by the frequently developed horny armament of the glans, by the various sebaceous glands, and, as shown in this paper, by its development.

II. The Urodæum, from οὖρον and δαίω. Hypoblastic. This is the middle chamber or primitive cloaca, into which open the urinogenital ducts, and through which pass the fæces. With its differentiations: (1) urinary bladder, ventral; (2) anal sacs in Tortoises, dorsal.

III. The Coprodæum, from κόπρος and δαίω. This is the innermost cloacal chamber.

The Urodæum is the oldest portion of the whole cloaca, then follows the Proctodæum, and, lastly, the Coprodæum has secondarily assumed cloacal functions.

The various modifications of these three chambers, their function, and the gradual separation of fæces, urine, and genital products have been discussed in the third chapter.

We can derive the types of the intromittent organs and of the cloaca of the Amniota from conditions which are still represented by the Gymnophiona and by Hatteria, viz. from the walls of the Proctodæum in connection with a certain uro-proctodæal fold. Then Lizards and Snakes followed one line leading to the development of paired organs, whilst the other Amniota modified the same substratum into another, unpaired, ventral form. The Carinatæ show a degeneration in this respect.

The extraordinary resemblance of the organs dealt with in this paper to those of the Chelonia and young Crocodiles can hardly be explained by homoplastic coincidence, but strongly favours the phylogenetic relationship of the Mammalia with the Reptiles. This, however, is but one more link in the long chain, which, being anchored in the Triassic Theriomorpha, makes the Amniota more akin to each other than to the Amphibia.

April 1.—"Description of Fossil Remains of Two Species of a Megalanian Genus (*Meiolania*, Ow.) from Lord Howe's Island." By Sir Richard Owen, K.C.B., F.R.S.

In a scientific survey by the Department of Mines, New South Wales, of Lord Howe's Island, fossil remains were obtained which were transmitted to the British Museum of Natural History, and were confided to the author for determination and description.

These fossils, referable to the extinct family of horned Saurians described in former volumes of the *Philosophical Transactions* (vol cxlix., 1858, p. 43; *ib.* 1880, p. 1037; *ib.* 1881, p. 1037) under the generic name *Megalania*, form the subject of the present paper. They represent species smaller in size than *Megalania prisca*, Ow., and with other differential characters on which an allied genus *Meiolania* is founded. Characters of an almost entire skull with part of the lower jaw-bone, of some vertebræ and parts of the scapula and pelvic arches, are assigned to the species *Meiolania platyceps*. Portions of a cranium and mandible are referred to a *Meiolania minor*. Both species, as in *Megalania*, are edentulous with modifications of the mouth indicative of a horny beak, as in the Chelonian order. The cranial and vertebral characters are, however, sauroid. Horn-cores in three pairs are present, but shorter relatively, especially the first and third pairs, than in *Megalania prisca*. The indication of a seventh more advanced and medial horn is feeble, and the author remarks that in the small existing lizard (*Moloch*) this horn has not an osseous support. The tail of *Meiolania* is long and stiff; the vertebræ being incased by an osseous sheath, developing, as in *Megalania*, tuberous processes in two pairs, corresponding with the vertebræ within: such defensive parts are less developed, relatively, than in *Megalania prisca*.

The locality of these singular remains is an insular tract not exceeding 6 miles by 1 mile in extent, situated midway between Sydney and Norfolk Island, in lat. 31° 31′ S., long. 159° 9′ E. The island is formed of three raised basaltic masses connected by low-lying grounds of blown coral-sand formation, consisting of rounded grains and fragments of corals and shells. In the parts of this formation converted into rock were found the petrified remains which are the subject of the present paper. It is accompanied by drawings of the most instructive fossils: these form the subjects of five plates illustrative of the text.

Mathematical Society, April 8.—Mr. J. W. L. Glaisher, F.R.S., President, in the chair.—The following communications were made:—On the number of linearly independent invariants (or seminvariants), reciprocants, or in general of integrals of any assigned type of a homogeneous and isobaric linear partial differential equation, by Prof. Sylvester, F.R.S.—On some results connected with the theory of reciprocants, by C. Leudesdorf.—The President (Mr. Walker, F.R.S., in the chair) gave an account of the work he has been for some time engaged upon in connection with elliptic functions, the special points he drew attention to being the use of the twelve elliptic functions, and of twelve zeta and twelve theta functions. The two latter systems of functions depend upon the quantities E, G, I, where $G = E - k'K$ and $I = E - K$.—Mr. A. B. Kempe, F.R.S., communicated a note on an extension of ordinary algebra differing from the latter in the substitution of three arbitrary quantities z, i, and u, for the

quantities 0, 1, and ∞. Taking z, i, and u to be 0, 6, and 1 respectively, he showed that $2 + 2 = 3$, $2 \times 2 = 3\frac{1}{3}$.—Mr. Tucker read a theorem in conics, by the Rev. T. C. Simmons. Through the focus K of an ellipse chords LKL', MKM' are drawn at angles of 60° with the major axis. A new ellipse is described having K for focus, and LM', ML' for tangents at vertices. Then it will follow that (1) the new ellipse will have the same directrix as the former; (2) its eccentricity will equal half that of former; (3) an infinite number of triangles inscribed in the outer, may be circumscribed about the latter; (4) if the outer ellipse be projected orthogonally into a circle, these projected triangles will all have K for symmedian point, the inner ellipse for Brocard ellipse, and the projections of the intersections of LL', MM', with the inner minor axis for Brocard points; (5) the sine of the Brocard angle will be the ratio of the minor axes of the ellipses, the ratio of the Brocard diameter to the circum-radius will be the eccentricity of the outer ellipse, &c.

Geological Society, March 24.—Prof. J. W. Judd, F.R.S., President, in the chair.—Henry Fisher, Edwin Harman, Henry Johnson, and Edward Alloway Parkhurst were proposed as Fellows of the Society.—The following communications were read:—On the genus *Diphyphyllum*, Lonsdale, by James Thomson, F.G.S.—On additional evidence of the occurrence of glacial conditions in the Palæozoic era, and on the geological age of the beds containing plants of Mesozoic type in India and Australia, by Dr. W. T. Blanford, F.R.S., Sec.G.S. After recapitulating briefly the principal facts known as to the correlation of the Karoo formation of South Africa, the Gondwána system of India, and the coal-measures and associated beds of Eastern Australia, and especially noticing those phenomena in the different strata that had been attributed to the action of ice, the author proceeded to describe the additions recently made to previous knowledge by various members, past or present, of the Geological Survey of India, and especially by Mr. R. Oldham and Dr. Waagen. These additions had recently been published in the Records of the Geological Survey of India. Mr. R. Oldham, in a recent visit to Australia, had come to the same conclusion as all other geologists who had visited the country, and clearly showed, as the Rev. W. B. Clarke and many others had done, that beds containing *Glossopteris*, *Phyllotheca*, and *Nœggerathiopsis* were intercalated among marine beds with Carboniferous fossils. The age of these marine beds was shown by Dr. Waagen to be that of the European coal-measures. Mr. Oldham had, however, further ascertained the presence in abundance of smoothed and striated boulders, evidently transported by ice, in the marine Carboniferous beds north of Newcastle, N.S.W., and he consequently considered these beds, and not the overlying Hawkesbury, the equivalents of the Bacchus-marsh beds of Victoria, and of the Talchirs of India, a view which was in accordance with the relations of the fossil flora. Meantime Dr. Waagen had received from Dr. H. Warth some fossils from the Salt-range of the Punjab. The fossils came from the upper part of a boulder-bed, the resemblance of which to the Talchir group at the base of the Gondwána system had long been recognised, but which had hitherto been classed with a stage immediately overlying, containing Upper Cretaceous fossils. The fossils now found by Dr. Warth included two forms of *Conularia* found in the Australian Carboniferous rocks, besides some other species evidently of Carboniferous age. Dr. Waagen consequently classed the boulder-bed together with other similar formations in other parts of the Salt-range as Carboniferous. There was one difficulty, the fossils just referred to were considered by Mr. Wynne to be contained in pebbles derivative from another bed. It was, however, shown that this did not affect the age of other boulder-beds in the Salt-range, and that the latter were connected with the Talchir beds in Central India by another discovery of Mr. R. Oldham's, that a boulder-bed in the Indian deserts was also probably of Talchir age, and that the question as to whether the nodules containing the *Conulariæ*, &c., were concretions or pebbles might await further examination in the field. Another contribution to the question had been made by Mr. Griesbach, who had recently found a boulder-bed which, from its character and fossils, he considered as Talchir, in the neighbourhood of Herat. It was pointed out that the existence, over such extensive areas, of boulder-beds, all of which might, without any improbability, be of approximately the same age, rendered it highly probable that all were really contemporaneous and due to one Glacial period; that this period must have been towards the close of the Palæozoic era, which it may possibly have terminated by exterminating many of the principal forms of life. The peculiar flora of the Australian Newcastle beds and of the Indian Damudas, having nothing in common with the contemporaneous European Carboniferous flora, afforded an important proof of distinct botanical provinces in past times.

Geologists' Association, April 2.—On grasses, by J. Starkie Gardner, F.L.S. The paper was an inquiry as to the geological period at which grasses first commenced to assume a preponderating position in vegetation. Their value and importance at the present day was first sketched, and it was remarked that they occupy under cultivation one-third of the entire area of Europe, inclusive of lakes and mountains, while, exclusive of malt and spirituous drinks distilled from them, their products to the value of nearly one hundred millions sterling are imported annually into this country alone. There are over 3000 species, fitted to occupy most diverse stations and to overcome nearly every kind of competition under no matter what conditions, with the result that about 95 per cent. of the plants growing in ordinary meadow-land are grasses. The conclusion arrived at was that there was no great development of grasses until towards the close of the Eocene, no definite remains being associated with any of the older Eocene floras of temperate latitudes. A number of facts were brought forward to show that grasses could by no possibility have failed to become associated with the remains of other plants in beds deposited under such conditions as those of the Eocene had they existed in any profusion then, while further to support this argument it was stated that the very similar Oligocene and Miocene beds all over Europe are crowded with them. Further it was shown that the dentition of all the early Eocene herbivorous Mammalia was adapted for crunching fruits, snapping twigs, and grubbing up roots, rather than for browsing on such food as grass, so that the evolution of true Graminivora, as well as the specialised Carnivora that prey on them, must be post-dated to the appearance of the grass itself. The geological history of the whole class of insects was reviewed, with the object of supporting the conclusion arrived at as to the *post* mid-Eocene date of grass. Older remains of grass may, however, occur in the vast series of Tertiary deposits in Spitzbergen, but as yet their age has not been accurately correlated. Finally, it was shown that the introduction of an aggressive type in vast numbers and of different habits to pre-existing vegetation, exerted an influence on terrestrial life altogether without parallel, and for the first time rendered possible the development of a meadow and prairie vegetation, as distinct from that of marsh, scrub, and forest, with all the attendant forms of animal and vegetable life to which such vegetation is indispensable.

Physical Society, March 27.—Prof. W. G. Adams, Vice-President, in the chair.—Mr. A. R. Wright was elected a Member of the Society.—The Chairman read a letter from Dr. Alder Wright, Secretary to the "Tribe Fund" Committee, in which reference was made to the scientific work of the late Mr. Alfred Tribe, and an appeal made for funds to aid in the maintenance and education of his family, which, owing to his early death, has been left in straitened circumstances.—The following communications were read:—On an arc lamp convenient for use with the Duboscq lantern, by Prof. S. P. Thompson. The old Duboscq lamp, though working well with a series of Grove's cells, is very unsuitable for use with currents from dynamos. Prof. Thompson has employed as a substitute in the Duboscq lantern a lamp commonly known as the "Belfast arc lamp." The result is all that can be desired as regards steadiness and regularity. The focusing, that is, the adjustment of the arc so that it shall remain unchanged in position, is effected by a wheel below the lantern, which is moved by hand.—On a modified Maxwell's galvanometer, by Prof. S. P. Thompson. The galvanometer consists of a light frame of copper, upon which is a coil of wire. This is suspended between the poles of a horse-shoe magnet, and a piece of soft iron is placed within the coil, but free from it, which concentrates the magnetic force between the poles. The coil is suspended by two silver wires, by which it is in connection with two binding screws on the base of the instrument. The galvanometer is extremely simple in adjustment, and very dead beat; it has also the advantage of being affected to an inappreciable extent by neighbouring magnets and currents, with a current in its own coils; when no current is in it, it is of course quite unaffected. The reading is effected by the ordinary lamp, mirror, and scale arrangement.—On the expansion

of mercury between 0° and −39° C., by Profs. W. E. Ayrton and John Perry. On November 14, 1885, Mr. G. M. Whipple gave the Society the results of the examination of thermometers down to the melting-point of mercury. There was, however, no evidence as to whether the contraction of the mercury continued uniform, as the thermometers were only compared with mercurial ones. The authors have therefore examined this point, and have made a series of comparisons of a mercurial thermometer, lent them by Mr. Whipple, with a constant volume air-thermometer, both immersed in a bath of frozen mercury, which was allowed to gradually become warm. The result obtained was that no certain deviation from a linear law could be detected in the expansion of mercury when temperature was measured by the increase of pressure required to keep a volume of air constant. Hence temperatures down to −39° C. may be correctly measured by a mercury thermometer the stem of which is graduated for equal volumes.—On the expansion produced by amalgamation, by Profs. W. E. Ayrton and John Perry. It has been accidentally observed by the authors that the amalgamation of brass is accompanied by great expansive force. If one edge of a straight thick brass bar be amalgamated, it will be found that in a short time the bar is curved, the amalgamated edge being always convex, and the opposite concave. The authors imagine that a similar action may be the primary cause of the phenomena presented by the Japanese "magic mirrors." Japanese mirrors are made of bronze, and have a pattern cast upon the back, and although to the eye no trace of it can be discovered upon the polished reflecting surface, yet, when light is reflected by certain of these mirrors on to a screen, the pattern is distinctly visible in the luminous patch formed. In a paper before the Royal Society they have shown that this is due to the polished side opposite the thinner parts of the casting being more convex than the others, a conclusion verified by the fact that the pattern is reversed when formed by a convergent beam of light. Such a condition of things would evidently result from a uniform expansive stress taking place over the reflecting surface, the thinner, and consequently the weaker, parts becoming more convex or less concave than the others. The authors have hitherto attributed this inequality of curvature to a mechanical distortion to which the mirrors are intentionally submitted during manufacture, to produce the general convexity of the polished surface, but they now think it possible that the use of a mercury amalgam in the process of polishing may have an effect in the production of this inequality of curvature.

Victoria (Philosophical) Institute, April 5.—A paper by Mr. W. P. James, F.L.S., giving a careful *résumé* of the various records of the Creation current among nations in ancient and modern times, was read.

Institution of Civil Engineers, April 6.—Sir Frederick Bramwell, F.R.S., President, in the chair.—The paper read was on water-purification: its biological and chemical basis, by Percy F. Frankland, Ph.D.

Dublin

Royal Society, February 17.—Physical, Experimental, and Applied Science Sections.—Prof. W. F. Barrett in the chair.—Prof. E. Hull, LL.D., F.R.S., read a paper on the different varieties of Irish paving sets. The use of Irish paving materials is of comparatively recent date, North Wales having been the chief source of supply. Granite, which affords comparatively tough paving sets, capable of preserving a rough surface, is worked at Bessbrook, Goraghwood, and Castlewellan. Whinstone, similar to that of Penmaenmawr in Wales, and from rocks of the same group, is worked at Ballintoy, Co. Antrim, and Arklow, Co. Wicklow. The author expressed the opinion that sets of the granitoid class were most serviceable in those parts of a city where the traffic was of an ordinary character, but where it was excessive in quantity and weight paving-stones of the whinstone class, especially if largely crystalline, were preferable.—On a sine and tangent galvanometer, by Prof. G. F. Fitzgerald, F.R.S.—An improved method for determining the specific gravity of solids, by R. J. Moss, F.C.S. This is an application of Sprengel's specific-gravity tube to solids. The tube employed consists of two parts fitting together by an accurately-ground joint the full width of the tube. The error arising from this joint may easily be reduced to one-tenth of a milligramme. With a tube of 1 cubic centimetre capacity, about 2 grammes of most minerals can be employed. If benzene or turpentine be used instead of water, no difficulty arises with air-bubbles. Results sufficiently accurate for determinative purposes can be obtained with even 20 milligrammes of the solid body.

Natural Science Section.—Prof. J. P. O'Reilly, C.E., in the chair.—On some recent discoveries in the salt-range, Punjab, by Mr. A. B. Wynne. Certain peculiarities of the section at different parts of the range were described, and attention was called to the absence of any recognisable Devonian formation in the neighbouring parts of the country, as well as in the salt-range itself, which added interest to the recent discovery by Dr. H. Warth of fossils believed to be of Devonian age, occurring as rolled and derived or transported inclusions of some of the later Jurassic or Cretaceous conglomerates. Specimens of these fossils were exhibited; the most characteristic is Conularia. It was suggested as probable that the parent beds lay to the southward. Other cases of derivative fragments amongst the Salt-Range series having an equally obscure origin were mentioned, all pointing to a lost land, perhaps buried under the deserts and alluvial tracts stretching away into Sind.—On the relationship of the structure of rocks to the conditions of their formation, by H. J. Johnston-Lavis, M.D. Communicated by Rev. Dr. S. Haughton, F.R.S.

Edinburgh

Mathematical Society, April 9.—Dr. R. M. Ferguson, President, in the chair.—Mr. J. S. Mackay communicated a note on the divisibility of certain numbers.—Mr. R. E. Allardice discussed the projective geometry of the sphere.—Mr. John Alison gave statical proofs of several geometrical theorems.

Paris

Academy of Sciences, April 5.—M. Jurien de la Gravière, President, in the chair.—Obituary notice of M. A. Lallemand, Member of the Section for Physics, by M. Mascart.—On the constitution of the earth's crust (concluded), by M. Faye. The author concludes that the revolutions of the globe are due, not to contraction caused by a general and uniform chilling process, as hitherto supposed, but to the circumstance, peculiar to the earth, that this chilling process goes on at an accelerated rate and more deeply under the marine basins than under the continents.—On the magnetic perturbation observed throughout France on March 30, by M. Mascart. The disturbance, which began about 8.30 a.m., lasted for over two days, gradually dying out on April 1.—Summary remarks on the fauna of Tonquin, by M. Emile Blanchard. These remarks are made in connection with a collection of insects made in the delta of the Red River by M. Langue, and recently forwarded to the Paris Natural History Museum. It comprises 567 species of Coleopteræ, 90 of Lepidopteræ, and a few of Hemipteræ, Neuropteræ, and other orders. Most of them are common to the rest of Indo-China, but several are new, either indigenous or related to genera represented by more or less divergent species occurring in other parts of the peninsula. This collection shows that on the whole a considerable degree of uniformity characterises the local fauna throughout all the coast-lands of Indo-China.—Note on the specimen of rock brought by M. Lesseps from the hill at Gamboa, on the line of the Panama Canal, by M. Fouqué. This specimen, picked up after the explosion by which the hill was removed, is described as a microlithic volcanic rock, an augitic labradorite with optical properties analogous to those usually occurring in volcanic labradorites.—Remarks on the rocks collected during the soundings of the *Talisman*, by MM. Fouqué and Michel Lévy. Amongst these specimens, mostly obtained from depths of from 4000 to 5000 metres, the older metamorphic is much more generally represented than the eruptive series. Sedimentary rocks also occur in considerable abundance including 73 specimens of limestones, 16 of arkoses, and 19 of sandstones, the latter sometimes rich in remains of biotite and muscovite.—A first experiment with an instrument intended to study the roll of vessels at sea, by Admiral Pâris.—Observations in connection with M. Resal's recent note on the flexion of prisms, by M. J. Boussinesq. The supposed error in M. de Saint-Venant's theory of the flexion of prisms with elliptical base is shown to be due to a mistake made by M. Resal himself in his calculations.—Description of an automatic instrument designed to register the heat liberated by living organisms (one illustration), by M. A. d'Arsonval. By means of this extremely sensitive "thermo-electric calorimeter" the physiologist is enabled to determine and measure the quantity of heat liberated by cold-blooded animals, such as frogs and fishes, and even by

inferior organisms, such as insects and larvæ.—Observations on the new planet 254, discovered by M. Palisa at Vienna on March 31, made at the Paris Observatory, by M. G. Bigourdan.—Note on the number of poles at the surface of a magnetic body, by M. Stieltjes.—Construction of the left curve of the sixth order and first genus: transformation of the surface of the third order on a plane, by M. A. Petot.—Note on the late M. Dupuy de Lôme's theory of submarine vessels, by M. Zédé.—Remarks in connection with the preceding note, and on M. Dupuy de Lôme's projected submarine boat, by Admiral Pâris. It is pointed out that the problem of submarine navigation was practically solved in the year 1858 by Admiral Bourgeois, who who actually sailed under water in his *Plongeur*, a model of which is still preserved in the Naval Museum, Paris.—Note on a calculator of steam and fluids at high pressure, by M. Henri Parenty.—On the mathematical problem of anamorphosis, by M. Léon Lecornu.—On a new general method of graphic calculation by means of hexagonal abacuses, by M. Ch. Lallemand.—On the variation produced by a rise of temperature in the electromotor force of thermo-electric couples, by M. H. Le Chatelier.—Note on a new method of photographic reproduction without objective and by the simple reflection of light, by M. Boudet de Paris. The author's numerous experiments prove beyond doubt that a design, a photograph or object of any kind, may be reproduced photographically without the aid of the usual appliances, and with the light of a Carcel lamp.—Note on the tungstates and chlorotungstates of cerium, by M. P. Didier.—On the elimination of the oxide of carbon in cases of partial poisoning, by M. N. Gréhant.—Researches on the therapeutic action of urethane, by MM. A. Mairet and Combemale.—On the reproductive functions of *Doris testudinaria* and some other Gasteropods, by M. E. Bolot.—On some special variations of structure in the organs of the Simple Ascidians, by M. Louis Roule.—On a new process for preserving and economising the hops used in brewing, by M. Louis Boulé. For this process it is claimed that it effects a saving of one-half in the consumption of hops, which are at the same time made to preserve their efficacy for an indefinite period. If generally adopted it will reduce hops to a reasonable price, and remove the inducement to employ deleterious drugs as substitutes.

BERLIN

Physiological Society, January 29.—Prof. Ewald spoke on the significance of the so-called second swallowing noise. As was known, Kronecker and Meltzer, in their investigations into the mechanism of swallowing, had endeavoured to explain the second noise, audible by auscultation in the region of the stomach six seconds after the movement proper of swallowing, by setting forth that through the act of swallowing, the bit eaten was squirted into the upper part of the œsophagus, and then encountered the peristaltic wave of the œsophagus, where, after six seconds, it attained the lower part, and was pressed into the cardiac orifice. It was the contraction of the lower part of the œsophagus which produced the second noise in question. As the result of observations on sound and diseased persons, as also on animals, Prof. Ewald had arrived at another opinion. According to his view the second swallowing noise was generated by the entrance of air into the cardiac orifice. Both in the case of swallowing anything and also in the case of not swallowing anything, whether it were altogether empty swallowing or only saliva trickling down, air penetrated into the lower part of the œsophagus. Air might, however, likewise penetrate from the stomach upwards. In proof of the correctness of this interpretation of the second noise, there was first the fact that this phenomenon was absent when water was so carefully drunk that no air accompanied it on its passage to the cardiac orifice, and second that the noise was sometimes heard without any bit being swallowed. If, now, the second noise of swallowing had not the significance attached to it by Herren Kronecker and Meltzer, neither could it be regarded as any argument in favour of their view that, as had been maintained by these authors, the piece swallowed stayed for six seconds before the cardiac orifice till it got pressed into it. Far from such being the case, the piece swallowed passed continuously into the cardiac orifice, and finally the co-entering air got pressed, with emission of noise, through the sphincter into the stomach.—Dr. Pohl-Pincus gave a sketch of his experiments designed to determine the influence of excitement of spirits and passionate feelings on the hair of the head. Except in the case of one phenomenon, these experiments proved without result. Through long years' experience he had by facts established that in consequence of excitement the hair of the head showed a changed double refraction in the lowest part lying above the papilla, which he called the root-nodule (*Wurzelknötchen*). While under normal conditions this part of the hair appeared white when polarised, when under moderate excitement it fell out it showed the colouring of blue 1 to yellow 2. Under the highest degrees of excitement, again, the highest shades of colour appeared: blue 2 to yellow 3. What was the connection between this material change of the hair and the excitement could not be ascertained. No doubt the nourishment of the hair and the process of cornification of the hair-cells played a part in the matter.—Dr. H. Virchow produced a series of photographs in which the structure of the corpus ciliare in the eyes of various animals came out to view in its multiplicity.—Dr. Benda showed preparations of the central nervous system which were treated with copper hæmatoxyline, and shortly discussed the advantages of this method of colouring for brain and spinal-marrow preparations.

BOOKS AND PAMPHLETS RECEIVED

"Micro-Organisms and Disease," 3rd edition, revised by Dr. E. Klein (Macmillan).—"Nature and the Bible," 2 vols., by Dr. Fr. H. Reusch, translated by Kathleen Lyttelton (T. and T. Clark).—"Fancy Pigeons," parts 7 and 8, by J. C. Lyell (U. Gill).—"Poultry for Prizes and Profit," part 6, by James Long (U. Gill).—"British Cage-Birds," parts 7 and 8, by R. L. Wallace (U. Gill).—"Bees and Bee-keeping," part 8, by F. R. Cheshire (U. Gill).—"Book of the Goat," part 7, by H. S. H. Pegler (U. Gill).—"An Intermediate Physical and Descriptive Geography," new edition (Stanford).—"British Petrography," part 3, April, by J. J. H Teall (Watson, Birmingham).—"The Rotifera or Wheel Animalcules," part 3, by C. T. Hudson and P. H. Gosse (Longmans).—"Journal of Anatomy and Physiology," vol. xx. part 3, April (Williams and Norgate).—"China: Imperial Maritime Customs, Medical Reports for the half year ended March 31, 1885" (Shanghai).—"Notes from the Leyden Museum," vol. viii., No. 2, April (Brill, Leyden).

CONTENTS