THURSDAY, OCTOBER 24, 1872

AGASSIZ AT SAN FRANCISCO

THE completion of its labours by the United States *Hassler* Expedition presents many points of almost dramatic interest. We have the veteran naturalist, a native of the little republic of the old world—having transferred his home to the great republic across the Atlantic, and settled himself to his scientific work at the University in Massachusetts which derives its name from the old seat of learning on the banks of the Cam,—there gathering about him a band of earnest students, the master and his disciples together building up at Cambridge, in the course of a few years, one of the best appointed schools for practical instruction in Natural Science, and one of the finest Museums of Comparative Zoology in the world. The citizens of the Great Republic are constantly discovering within their own vast territories some extraordinary natural production which in old times would have ranked among the great wonders of the world: now a grove of gigantic trees in California; now the marvellous cañons of Colorado; now a wonderful assemblage of hot springs and geysers in Nebraska. But not content with the Government exploration of their own domain, the munificence of a private citizen of Massachusetts fitted out this *Hassler* coasting survey expedition with the necessary appliances, and placed the veteran Agassiz at its head, for the purpose of investigating the natural features of the extremity of the Southern Continent, and the inhabitants of its seas, the latter department being specially placed under the management of the accomplished naturalists Pourtales and Steindachner. Our readers already know how the experienced eye of Agassiz detected in Patagonia the same evidences of extensive glacial action with which he was already so familiar in the northern hemisphere; and the contents of the dredging nets will furnish employment to the staff of American naturalists for many a month to come. After cruising up the Pacific Coast of South America, the voyage of the *Hassler* finally ended in United States territory at San Francisco, where the expedition met with such a reception as has probably never before been accorded to any body of scientific amateurs. The *Alta California* thus welcomes the great naturalist on his return to his adopted country :—

"San Francisco has in its midst a man of science than whom none in America, or out of it, more richly deserves the love and homage and respect of our people. He has come all the way around our Southern Continent, not for gold, as many came, not for silver, as many came, not for diamonds, as many would come or go, but for scientific knowledge, for discoveries in the hitherto unsearched waters of the seas, the unexhausted treasuries of Nature growing, budding, and blossoming along the shores of a continent. When such a man, if there be any other such, chances to visit a distant city, he is quite likely to be made the guest of it, to be *fêted*, and to be made to feel that his merits of head and heart have endeared him to the people, and that the city feels itself honoured particularly, instead of honouring him. All the dukes and princes that ever stepped foot in America, never deserved a tenth part of the attention which is due to Prof. Agassiz. There is in America no man living who, as a scientist, compares with this gentleman in acquirements in his lines of study, and in the triumphs achieved. Many of our citizens have called upon him, and extended such courtesies as private parties may, and perhaps quite as extensively as is agreeable to him. But the question is, what does this city owe to itself in this matter? A public reception by the city would be a very graceful courtesy extended to a very great and most worthy gentleman, and the honour to herself would be one of which every citizen might well be proud. We hope it may be done."

The same paper and the *San Francisco Morning Bulletin* both print full reports of the professor's address on the occasion of his reception in the Pacific Hall by the California Academy of Sciences, heading their article, in genuine American style, by sensation headers of the following description :—"Agassiz. Grand Reception under the Auspices of the California Academy of Sciences. Pacific Hall in a Blaze of Intellectual Light. From Polyp to Mammal. Modified Darwinism—The Prophecy and Advice of a Man of Science."

From the address itself we may be permitted to make a few extracts, for the purpose of illustrating what are the subjects that are now uppermost in the minds of our scientific friends on the other side of the Atlantic. But, first of all, let us cordially congratulate the representatives of Science in that remote State, on the honour which has been reciprocally conferred upon them and upon Agassiz and his fellow workers by the enthusiastic welcome which they have given him, and on the encouragement which his visit has afforded for the further prosecution of their arduous labours. In the words of Prof. Davidson, the Principal of the California Academy of Sciences :—

"Less than one month since, the great master of modern scientific thought and research addressed a few earnest students of science, who have patiently and bravely kept their lamp trimmed and burning. The magic of his words thrilled our hearts and cheered our hopes; but, best of all, that gave renewed confidence to friends who had an abiding faith in our efforts. That you might have a richer feast, we have prevailed upon him to break a long and comparative silence, when he most needed rest and repose. In less than one hour after our last Academy meeting, the seeds sown by him had borne fruit in giving to the Academy a greater number of life members than we had gathered in ten years. Within a fortnight the Agassiz Professorship of Oriental Languages and Literature was established for the Universities of California by the munificent endowment of our fellow citizen, the Hon. Edward Tompkins; and now, after eighteen or nineteen long years of arduous and desperate struggle with poverty in this State of marvellous wealth and boundless properity, the California Academy of Sciences is amply rewarded in being the instrument of introducing to the citizens of San Francisco Prof. Agassiz."

In the opening of his address, Prof. Agassiz made the following remarks on the present aims of science :—

"For the last three years I have been prevented from appearing in public, owing to the indifferent condition of my health. I venture this evening to address you. I have been asked to give some account of the voyage of the *Hassler*, which has terminated its cruise in the harbour of San Francisco. I am afraid that the incidents of that scientific expedition are too monotonous to be very entertaining; and willing as I am to accede to the request, I think I will submit to your attention remarks upon the present aims of Science, which may at least have a more solid foundation than our past efforts during that voyage, to increase the bases and material foundation of knowledge. Allow me to say that this examination, as I may call it, has been entirely incidental to the necessities of the Coast Survey. The good ship which brought us here is

intended to continue the work of the Coast Survey along this coast; but instead of allowing us to make this voyage empty, some scientific gentlemen were invited by the Superintendent of the Coast Survey to take passage in her, and make the most of the opportunity. Liberal citizens of Massachusetts added means to the good will of the Superintendent—so that whatever collections and investigations should be made during the voyage should not be an additional expense to the great international undertaking, or to the Navy.

"I think it desirable that these facts should be known, in order that not too great expectations should be entertained concerning the scientific results of the *Hassler's* voyage; for all that which could be done was done by means supplied by private individuals, and not by the large resources of the Government. Unfortunately, it is almost everywhere still so, that Science has to take the humblest place in the world, as if equal opportunities were yet granted with a reluctant hand. It is only in recent times that the value of research begins to be felt; and I hope to live, old as I am, long enough to see the community, the enlightened community, which has become my second fatherland, appreciate what Science is doing for the general prosperity, and then contribute to the necessities of Science with that generous liberality which characterises the acts of the American people. It is not generally understood—and perhaps we scientific men are at fault in this matter—that Science is at the foundation of all natural progress in the community, in industry, in the arts, in almost everything."

After a few details as to the objects of the study of natural history, he proceeded to explain that "the only difficulty in the way of the study lies in the fact that there are no teachers; that the community lacks teachers in this department; and wherever there are a few educated, they are at once swallowed by the numerous institutions of learning which are organising everywhere. And we cannot educate a sufficient number of them, for the simple reason that there are other walks in life which are more promising in the rewards they secure for their devotees. So Science is always behindhand, and yet it is she who furnishes the primary material for all the progress in modern times."

We need not follow the speaker through his singular misrepresentation of the theory of evolution as taught in this country, viz., that the various forms of life, as we now see them, "may be the work of blind forces, of forces without intelligence, without discriminating power, and without forethought," and that the object of the study of nature is "to determine whether we ourselves are descended from monkeys or whether we are the work of a beneficent Father." We will rather pass on to his peroration, which sets forth some truths at least as applicable to us as to the audience he was addressing:—

"It will no longer do for the coming generation to say, I will accept this or that doctrine, because knowledge is pressing at your halls: but I will say to you, you may know it because you must know it, and unless you are willing to learn it you may grope in ignorance. That is the condition that stares us in the face for the future, and it becomes on that account the duty of every man to foster knowledge and to prepare the coming generation with all those appliances which lead to an independent opinion on all those matters. And that question is pressed upon you for the first time. You have for the first time in your existence as a State a generation which is about ready to enter the University. You have not had that in past generations, in past years, but your children approach the time when they may prepare for college. It is your duty that you have, then, a college which will set measures of the highest aspiration for the coming generation. And you cannot be willing to depend for their education upon the bounty of other States when in your prosperity, when you have rivalled all civilised communities. When I see luxury here, as in the oldest States of the world; when I see here the appliances for all the efforts of man carried to the highest degree, are you willing that your children should go and beg for information at the doors of other countries? It is for you to educate them and to give them those means which will make them find at home those advantages which otherwise you will have to seek for them by parting with them during those very years when their character is shaping. But there is another consideration than that of your immediate necessities here. No community can be utterly great without culture. Culture is the background of every great community. It is, in fact, the true and only test of real greatness."

Are not we in this country also forcing our children "to go and beg for information at the doors of other countries"? As long as we do not provide at home those educational advantages which so many go abroad to seek, we must submit to have to sit at the feet of our own daughter, and to learn from America both how to honour our really great men, and how to attain that scientific position among the nations to which our wealth and our material resources entitle us. The lesson is hard to learn, but it is one which must be learnt either by us or our children; and the longer we leave the task unlearnt, the harder will it be to learn.

RAILWAYS AND SCIENCE

Life of Richard Trevithick, with an Account of his Inventions. By Francis Trevithick, C.E. 2 vols. (London: E. and F. Spon, 1872.)

Life and Labours of Mr. Brassey, 1805-1870. By Arthur Helps. (London: Bell and Daldy, 1872.)

Railways or no Railways; or, The Battle of the Gauges Renewed. By Robert F. Fairlie. (London: Effingham Wilson, 1872.)

THESE three works are directly concerned with railways, though each of them deals with a different aspect of the many-sided subject. It would be out of place in these columns to review in detail each of the publications; they may, however, suggest a few thoughts not inappropriate to the columns of a scientific periodical.

The first on the list takes us back to the birth of the steam-engine, carrying us on through its chequered and roughly-handled youth to the time when it was fairly set agoing on that wonderful career, by means of which the whole face of the earth has been changed as if by the breath of a god, the relationships of nations and of men altered entirely, and civilisation hurried on at a rate almost bewildering. The benefits conferred on humanity by the discovery of the simple scientific principle on which the steam-engine rests, are incalculable, and not to be realised in anything like their fulness by those who, like most now living, have been born to these benefits, and who can only grumble that the advantages of the legacy left them are not by any means what they might be, were they not marred by the officiousness, the avarice, the prejudices, and the blundering stupidity of those who have constituted themselves its trustees. That this has

been a cause of complaint all along is one of the many lessons to be learned from Trevithick's life ; and so will it ever be, until the simple but stupendous and widely beneficent principle which the man of science, by reverent asking, has obtained from the liberal hand of Nature, is not only more thoroughly understood and more scientifically applied by those who undertake to put it to the uses of humanity ; but until Science holds supreme sway over all the actions and thoughts of men universally, until she holds the same place as a guiding principle for the lives of men, and their relationships to each other and to the surrounding universe, that superstition and wild imagination have held for ages. It will only be when education is founded upon a thoroughly scientific groundwork, when men are trained from their youth upwards to regard human and extra-human phenomena with the clear, bold, intelligent vision of science undimmed by superstition, unwarped by prejudice, and unshortened by selfishness, that the full significance of scientific discoveries will ever be realised. Only then will they have a chance of making unobstructed way in conferring upon mankind the innumerable benefits with which many of them are fraught, and in raising the race higher and higher in the scale of civilisation, till that golden age be realised which poets dream of as in the unknown past, but which assuredly lies in the certain though, it may be, far distant future.

These remarks are suggested by the "Life of Trevithick," which, read in the light of the present day, makes one feel somewhat sad, and certainly sorry for the great and unselfish mechanical genius who scattered his inventions broadcast among his fellows, to the great enrichment of the latter, while he himself led a chequered and almost homeless life, dying, at last, penniless among strangers. Trevithick himself was not a scientific man, and seems to have had only a vague notion of the scientific principles upon which his numerous applications of the expansive power of steam were founded. But he was not like many so-called "practical" men, who work only by rule of thumb, and profess contempt for the scientific principles which they put to practical use. Trevithick appears to have had the greatest respect for science, and invariably submitted a new invention, or application of the one simple principle which governed all his inventions, to his scientific friend Mr. Giddy (afterwards Gilbert, and President of the Royal Society), in order that they might be submitted to the rigid test of scientific theory. Had a similar course been followed at a much earlier period, and had the earlier manipulators of steam been animated by the same spirit as well as the enthusiasm, and penetration, and disinterestedness of Trevithick, the steam-engine, instead of remaining the clumsy and unpliable machine it did for so many years, might about a century and a half ago have reached the perfection and wide applicability it has attained at the present day. And it was only in proportion as mechanicians clearly realised for themselves the full significance of the simple laws of steam, and fearlessly allowed them, under judicious control, to work with a powerful purpose upon properly constructed machinery, that anything like the wide-spread benefit was derived from them that they were calculated to confer; in other words, it has only been in proportion as engineers have grounded the rules of their art upon scientific principles that the steam-engine has attained to its present comparative perfection and innumerable labour-lessening and therefore blessed uses. In this it is that the great merit of Watt and Tevithick lies, both of whom had the penetrative genius to perceive that the mighty power which lies latent in a cup of water was almost entirely frittered away for want of proper guidance and a suitable channel wherein to work ; and within a very few years after these men had made their important inventions, the development of the steam-engine had made infinitely more rapid progress than it had done during a previous century,

The history of the application of steam to machinery, the gradual development of the steam-engine, and especially its use for locomotive purposes, must be known to all our readers, and therefore we shall not attempt to repeat the oft-told story. It is one of those "fairy tales of science," which are more wonderful and often more bewitchingly beautiful than any of the thousand myths by which our "rude fore;athers" blindly but naturally attempted to explain the many mysteries of the universe ; and they have the additional merit of being true and therefore undying and never leading to disappointment and distrust. Nor shall we attempt to adjust the relative claims of Watt and Trevithick to priority of invention, or try to show their respective shares in the discovery from which the world is now reaping so much benefit. It is humiliating to think that Watt and Trevithick lived for a considerable time only a few doors from each other in a small Cornish town, each bent upon accomplishing a beneficent and highly useful purpose, and yet never spoke to each other, but on the contrary regarded each other with considerable bitterness all their lives ; and this simply because the one advocated high pressure while the other was pushing the adoption of low pressure engines. Mr. Francis Trevithick, naturally enough no doubt, but with very bad taste and we believe much injustice, speaks of Watt frequently with great bittterness and depreciation as his father's rival, and jealous and ill-speaking opponent. To revive these squabbles serves no good purpose, but merely gives occasion to the world which lies in ignorance to sneer ; the merit of Watt was very great, and so was that of Trevithick, and there is no need whatever to exalt the one at the expense of the other ; each has a lofty and enduring pedestal of his own. We also think it displays considerable want of reflection and of the philosophic spirit to tirade, as Mr. F. Trevithick does, against the ingratitude of mankind towards those men who have conferred upon them great benefits in the shape of useful inventions, and against the deafness of men in place and power towards their claims for assistance and reward. The fact is that all great inventors, like all men of supreme penetration and foresight, are often too far in advance of their own generation to meet with much sympathy and appreciation from it. Mankind are not to be sweepingly blamed for this on any score. The race is yet a long way off perfection ; and if the world ran so close on the heels of its great men as to be able at once to comprehend and appreciate them, these men would not be so great after all. The world, on the whole, acts very honestly, however hardly, to her man of genius, and when she does reach his standpoint, she erects a monument to him if he be dead, or if happily he be still alive, she rewards him with a pension. That Trevithick

should have died penniless was pretty much, we think, nis own blame, attributable to his own reckless imprudence, and his decided and blameworthy weakness of character in being unable to manage the affairs of his own household. It was no merit in him, and no sign of unselfishness, but simply a defect in his character, as it is in that of all men who act as he did.

That Trevithick is entitled to be called the "father of the locomotive" there seems to us to be no doubt, from the tediously full statements in the biography by his son; not only so, but he conceived and sketched, and even modelled, many of the improvements, perhaps in a crude form, that have been most recently introduced. In 1796 he made a model of a locomotive; in 1801 he ran one on a rough common road in Cornwall; and in 1803 he astonished the Londoners early one morning by driving the then uncouth creature through ten miles of the streets of the metropolis. Trevethick, however, reaped little benefit or credit from this wonder-working invention, for which the world at the time was not ripe. Of the numerous other applications of steam which Trevethick either thought of or embodied, we may mention the principle of the screw-propeller, the steam dredging-machine, the application of the steam-engine to an infinite variety of purposes in mining and tunnelling, the invention of something very like the borers used in the Mont Cenis tunnel, and the application of steam to nearly every important agricultural and manufacturing process; indeed he actually constructed several thrashing-machines, which many, no doubt, consider quite a recent invention.

It is by reading a biography like this, which takes us back to the middle of last century, and brings us down to nearly the middle of the present, that we are able in some small degree to estimate the benefit which science has conferred upon man in discovering the great but simple principle which underlies every application of steam as a moving power. Not only has it in almost every direction brought manufacturing processes to the highest degree of perfection, increased almost infinitely the power of production, but it has been the means of lessening, directly or indirectly, the severity and the amount of manual toil, thus making the mechanic's life sweeter and easier, and leaving him leisure for self-culture; and in general advancing to a distinctly appreciable amount the civilisation of the race. Especially, as we have already said, has the whole face of the earth been changed by the application of steam to locomotion; and even in this one direction it would be difficult to estimate the benefits conferred upon the race by science. The train and the steamer have done much to lessen and stamp ou old national and district prejudices and animosities, by making the men of various nations more thoroughly and generally known to each other, have enabled populations to circulate more freely, and men to bring their talent or their craft to the market where it was most in demand, have made emigration possible to almost all who care for it, and thus peopled and civilised the waste and barbarous lands of the earth, brought the products of the most remote quarters within easy reach, brightened the existence of many thousands by putting it in their power to see some of the many beauties of this lovely earth—made the world, in short, more manageable, drawn its inhabitants closer together, increased decidedly the sum of human happiness, and helped to bring on the time "when man to man the warld o'er shall brithers be, and a' that."

As to the manner in which Mr. F. Trevithick has written his father's life, we are sorry we cannot speak favourably; either he does not know how to write biography, or he has been either so lazy or so short of time as to give to the public the crude and tedious material out of which a biography might have been constructed, instead of a well-digested and clearly-arranged narrative. The two volumes number upwards of 750 pages, and we believe not 50 of them are Mr. Trevithick's own. It is one of the most confused, most ill-put-together books we were ever compelled to read, and were it not for the intrinsic interest of the subject, it would certainly be the most tedious. The illustrations, type, and paper are excellent, and the book will no doubt be found useful by engineers

The next book on the list, Sir Arthur Helps's "Life of Mr. Brassey," is, it is needless to say, as a work of literary art, infinitely superior to the former, though the subject is one of not nearly so great intrinsic interest and importance. Had the work of writing the life of Mr. Brassey fallen into any other hands, it might have been a very dull and uninstructive affair indeed; but it is impossible for the author of "Friends in Council" and "Thoughts upon Government" to write uninterestingly or inartistically about anything. This life of the great railway contractor has all the quiet and soothing charms of Sir Arthur Helps's well-known style; and dry as the subject looks at first sight, it is full of interest and novelty, of details that few are acquainted with, and which are yet well worth knowing. The book is worth publishing, were it for nothing else than to make the world acquainted with a man of the late Mr. Brassey's exceptionally superior character and great power of organisation; indeed the author tells us that it is as an example of skilful organisation that the life of Mr. Brassey has especial interest for him. We do not intend to give any sketch of the life of the great and universally loved and respected railway contractor; his life, in one sense, takes up the story of the steam-engine where Trevithick's leaves it off. Trevithick and such as he show how steam may be applied to the purposes of locomotion, which brings into play a new set of men, a new profession, as it were, that of contractor, whose business it is to see that suitable roads are made for this horse of man's creation to run upon. That this may be done it is necessary for the contractor to procure an army of navvies and others, officered by all grades of superintendents, from the ganger up to the sub-contractor or agent. Of how much importance careful organisation is in a case like this must be seen by every one, and of as much importance is it that every one, from the engineer and contractor down to the ganger should have a thorough and intelligent—in other words, a scientific knowledge of the department of which he has immediate charge. This was what distinguished Mr. Brassey above many others in his position; he did not work merely by rule of thumb, but raised the business of contractor almost to the dignity of a science; and the thoroughness which was the result of this, combined with the man's noble character, obtained for him the great reputation and extensive employment which he all along possessed. One lesson which this work teaches

above others is that the better educated, the more intelligent, in short, the more scientific, are all, from the highest to the lowest, who are concerned with the practical carrying out of the application of any scientific principle, the more thoroughly and satisfactorily will the work be performed.

The author does not say much—indeed little could be said—about Mr. Brassey's personal life, the greater part of the book being occupied with exceedingly interesting and varied details as to railway construction. Mr. Brassey, as a contractor, we believe, was more or less intimately connected with the construction of many thousand miles of railway in all parts of the world—Europe, Asia, North and South America, Australia—thus bearing a large share in carrying one of the greatest blessings science has conferred upon humanity, to all the ends of the earth. Not only was the railway itself a great benefit to the country into which it was brought, but the mere process of construction was a boon to thousands of its inhabitants. There are extensive districts in France in which the material prosperity of the inhabitants has been permanently raised by the savings which the French labourers realised at the construction of the Paris and Rouen railway. With whatever railway, in whatever country, Mr. Brassey had to do, he always liked to have the principal work done by English navvies; this was even the case in Canada; and some of the most interesting pages of the biography are those in which the railway labourers of other countries are contrasted, in point of character, powers of work, &c., with those of England. Taking them all in all, the latter cannot be beaten for quantity and quality of work. Sir Arthur Helps adds a chapter on "Railways and Government Control," in which he seems to think that it is now high time for Government to take the railways out of the hands of ignorant, irresponsible, conscienceless speculators, and work them itself solely for the public good, which is the last thing thought of by the present managers. One sentence is worth quoting here; we wish we had room for more:—"It has always appeared to me to be one of the most miserable instances of the hide-bound nature of our official system, which is hampered by so many checks and so much dread of small expense, that the most needful undertakings have to be passed by, or touched but lightly, which require the best intellectual force of the nation to be brought to bear upon them."

Mr. Fairlie's book, "The Battle of the Gauges Renewed," proves the truth of what we have already said—the necessity there is that all who are officially connected with railways should be able to perform their work on the basis of scientifically-grounded knowledge, and not in the light of tradition and custom, by unintelligent rule-of-thumb. Both by Mr. Herbert Spencer and Mr. George Darwin it has been recently pointed out that the construction of our railway carriages, instead of being based on a rational attempt to adapt them to new and previously undreamt-of circumstances, is simply a continuation, or rather development, of old forms belonging to the lumbering stage-coach and rude tramway days. That it is so with regard to the common gauge of wheels (4 ft. 8½ in.) is well known, though one would at first sight be inclined to believe that the odd half-inch was significant that this gauge was the result of a careful calculation grounded on the best mechanical principles. That this is not so can be learned from Mr. Fairlie's vigorous, clear, and, notwithstanding the apparent dryness of the subject, really interesting book. When railways were first constructed, about forty years ago, men were too much absorbed in the excitement of the new means of locomotion to give any thought to such an apparently trifling detail as the width that should be maintained between the two rails; and thus the gauge which was in general use among the old and rudely constructed tramways was adopted at mere haphazard, without any thought as to whether there was any good reason for adopting the 4 ft. 8½ in. How old the gauge is, and how it originated, probably no one knows, though we believe that even now not a few railway directors, and even engineers, will be found who maintain that it is a heaven-born institution, and that to alter it would be the height of irreverence and sacrilege, betraying an independence of thought and action worthy only of a nation like America, destitute of tradition. It is not our purpose here to advocate any one gauge as preferable to another, but simply to say that one lesson taught by the three books at the head of this article is, that the present condition of our railways is, to a large extent, the result of mere guess-work, and that only when the construction of every detail, from the steam-engine down to the gate at a crossing, or a pointsman's box, is conducted on rational, *i.e.* scientific principles, can the public, as well as the shareholders, be able to reap without drawback all the advantages which the great application of the power of steam is calculated to produce. On every ground it seems difficult to resist Mr. Fairlie's arguments on behalf of the 3 ft. 6 in. gauge, or even a narrower gauge under certain circumstances; it has been extensively adopted in America, and exclusively in Norway; and, we dare say, most people would be astonished to hear that at Festiniog, in Wales, on the face of a steep mountain, with gradients of 1 in 68 and 1 in 79, and with curves varying in radius from 8 chains to 1¾ chains, there has been at actual work for some years a railway with the miniature gauge of 1 ft. 11½ in. "It is, in fact, the most perfect miniature railway in existence, and deserves to be studied in all its details." Both as a passenger and mineral railway, it has done hard and perfectly efficient work for some years. This, at least, shows that the question of "gauge" is worth being inquired into, as indeed ought every other point connected with the construction and management of railways.

The revelation which results from one inquiry after another, and the harrowing effects of the dreadful accidents which are almost daily occurring, will doubtless have their effect on the public mind, and urge the people of this country either to compel Government to take the railways into their own hands, or, at least, to see to it that they are managed in some kind of rational and intelligent way, for the good of the public, and not for the sole benefit of a few obtuse directors.

M. de Quatrefages, in his opening address at the meeting of the French Association, was too sanguine when he said, "Science is at present supreme," though we believe he was right in asserting, "She is becoming more and more the sovereign of the world;" and only when Science reigns supreme over all the practical affairs of men, shall we be on the high road to perfection, in this direction at least.

OUR BOOK SHELF

Elementary Geology. A Course of Nine Lectures, specially adapted for the use of Schools and Junior Students. By J. C. Ward. (London : Trübner & Co.)

THIS little volume is a praiseworthy attempt to popularise the study of Geology. The descriptions and explanations are, for the most part, well done, and will be easily followed by those for whom the book has been written. The introductory "lectures," which treat of the origin and classification of rocks, of geological agents, of waste and renovation, and of physical geography, are the most satisfactory. When the author comes to deal with the geological history of the English formations, the necessity for condensation often leads him into obscurity; but upon the whole he has managed to give a more readable account than will be found in other introductory lesson books. As the lectures are addressed to a popular audience, we ought not, perhaps, to object to the fine writing in which the author is prone to indulge. But if his little book should come to a second edition (as we hope it may), he might tone down the "beauties," and his work be none the worse, but all the better for the process. Especially would we advise him to expunge the absurd and incoherent "Geological Dream on Skiddaw," and substitute for it a simple and intelligible summary, such as we are sure he is quite capable of giving. The illustrations are unequal; none of them are very creditable works of art, and some are so smudgy as to be almost illegible; but for the most part they serve their purpose.

J. G.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

London University Examinations

MR. CHRISTOPHER HEATH, in his Introductory Address at University College, puts forward the following question, set in the Preliminary School Examination, in support of his remarkable statement that Mechanical and Natural Philosophy have little to do with Medicine:—

"Calculate the quantity of heat lost per hour from each square metre of the surface of an iron steam boiler 0·8 centimetres in thickness, when the temperature of the inner surface of the boiler is 120° and that of the outer surface 119½°, the coefficient of conductivity of iron being 11·5° (referred to 1 cm. as unit of length, 1 min. as unit of time, and the quantity of heat required to raise the temperature of 1 gramme of water from 0° to 1° c. as unit of heat).

"*Solution:* A difference of temperature of 1° in a thickness of 1 cm. of iron will give a loss of 11·5° in 1 min. from a surface of 1 sq. centimetre."

But a difference of ½° in the thickness 0·8 cm. is at the rate of ½ ÷ 0·8 = $\frac{5}{8}$° in the thickness of 1 cm. Hence the loss in 1 min. from 1 sq. centimetre is 11·5 × $\frac{5}{8}$ = 7·1875. Hence the loss in the same time from 1 sq. metre is 71875 units. The loss of heat per hour will now be evident.

Now this is what Mr. Heath designates as a problem on steam boilers which a medical man can never want to solve; would he say that it is entirely foreign to the subject, and expect any member of Senate or Convocation to bear him out, if the examiners inquired how much heat a man would lose through a blanket or through a sealskin coat 0·8 cm. in thickness, &c.? Yet the question is the same, and the iron jacket of the boiler or the sealskin coat are only accidents. Should not a medical student have some idea of the relation between the surface temperature of the body, the quantity of heat passing away from it, and the amount of heat generated in the body by the food given to a patient? Is the production of heat in the human body by the consumption of food carried on on principles so entirely different from those of the production of steam in a boiler that a medical student can afford to be ignorant of and to despise the simplest principles of heat, and to be unable to answer the mildest questions in that subject? Moreover, is it so clearly shown that "the two learned professors have such singularly incorrect ideas as to the requirements of medical students" when they ask a simple question as to the loss of heat from a hot body? It may be that Mr. Heath passed his first M.B. examination before it was considered a matter of importance to note the changes of temperature of the body, or before the use of thermometers by the Faculty, and that he regards those who are guided by such things in their treatment of a patient as altogether Utopian in their ideas. The above consideration of the question may perhaps be a sufficient answer to the shallow statement of the editor of the *Lancet*, in support of Mr. Heath, that "the relation of the question to medical requirements is absurd on the face of it."

As regards the examiners, Mr. Heath is not quite correct in his statement of facts, for the present examiners are not the examiners on whom the sub-committee of Convocation reported four years ago. With regard to the candidates who are rejected at the preliminary scientific examinations, has it ever occurred to the sub-committee of Convocation to inquire of the examiners what standard is actually required for the Pass Examination? If they have not obtained this information from the examiners themselves, their decisions can have very little weight, for they cannot be in a position to judge whether it is from the high standard set by the examiners or from the bad quality of the work that so many are rejected.

What stronger evidence could be adduced of the great value of the Preliminary Scientific Examination than the report of this Committee that "it has tended to give prominence to theoretical and scientific knowledge," seeing that it is in consequence of such knowledge that medical science has advanced with such rapid strides, and that in many cases the whole course of medical treatment has been changed.

The pages of the number of the *Lancet* in which Mr. Heath's lecture is contained, show clearly that to the surgeon, as well as to the doctor, a knowledge of mechanical as well as natural philosophy is of the first importance. Take, for instance, the case reported on page 490 of that journal.

How natural for a man who understands the laws of pressure of air, to apply the cupping-glass for the elevation of depressed cranial bone, in place of an operation which kills in seventy-five cases out of a hundred! Can a surgeon dare to be ignorant of these laws, when the consequences of neglecting them may be so disastrous

It is satisfactory to find, on turning to other medical schools, that it is not the general opinion that the study of Natural Philosophy may be neglected, but rather that "it is matter for regret that more prominence is not given to Physical Science;" for "it is in Physics that we find the explanation of a great mass of medical phenomena; and to the student who has not attained considerable proficiency in that science, many of these phenomena must be unintelligible."

Such being the case, the student will readily see that it will be for his best interests, and will best promote his future usefulness as an intelligent medical man, to acquire a thorough knowledge of the first principles of Mechanical and Natural Philosophy: in so doing, he will have the additional advantage that he will not run such risk of being landed among those who are rejected at the examinations of the University of London, and that not by a severe examiner, but through the ill-advice of which he has been the victim.

W. G. ADAMS

Physical Laboratory, King's College, Oct. 19

Solar Spectroscope Observations

IN NATURE of the 17th inst. there appear letters from Col. Tennant and Mr. Capron, who seem to doubt that the solar prominences can be seen in England with the facility described by Capt. Herschel in India. I might almost apply Capt. Herschel's words to my own experience last month. With a seven-prism direct-vision spectroscope of Browning (open slit) attached to a 2¼ inch glass mounted on a drawing-room stand, not only the bright lines, but the forms of the prominences, could be plainly seen and were sketched. Of course there were many cloudy days which prevented observations, and there would be many more such in England than in India; but it does not require exceptionally fine weather, only a great deal of practice. Experience only will tell the exact distance at which the slit must be from the sun's limit, and the slightest movement will either put the prominence out of the field or swamp it with a flood of light.

Blackheath, Oct. 18

J. P. MACLEAR

An Additional Note on American Arrowheads

As Mr. Evans has commenced his remarks on North American arrowheads with the assertion, "A prevailing type," &c., it naturally leads one to conclude that that form to which he refers is "the" prevailing type. I judge, further, that by "prevailing," he means "predominant," *i.e.*, in excess of other types or shapes of these relics. I do agree with Mr. Evans that it is *one* of the principal forms, but not so far a "prevailing" type as to merit the assertion of Mr. Evans, made *as* that assertion is.

As to the leaf-shaped form, I have but to remark that, in my own collecting experience, the true leaf-shaped, *i.e.*, the rounded-based, straight-sided, acutely-pointed form, such as Mr. Evans's Fig. 282, constitutes about 4½ per cent. of those gathered in my own neighbourhood; and this I know to be the experience of other collectors, in other and distant localities. This, I submit, is sufficient to show that this form is not even "comparatively rare," but may be better described as "not uncommon."

And so far as workmanship is concerned, I have only to say that if narrow, thin barbs, acute points, sharp edges, and smoothness of the broad surfaces of arrowheads, constitute what has been termed "delicacy of workmanship," then the American forms in horn-stone, jasper, chert, quartz, agate, and some finely-grained slates, cannot be excelled by similar relics found elsewhere, or made from other material. This remark I base on the specimens collected by myself here in New Jersey, which State is not the best locality, by any means, for gathering these objects; and I have found that the western, northern, and southern specimens have excelled those I have collected here at home.

From the above paragraph I have purposely omitted the mineral obsidian, because the arrowheads of this material excel all others wheresoever found, and I wish to make good my assertions without the help of Californian specimens.

I take the liberty of referring those persons interested in these matters to a large series of arrowheads collected here in New Jersey, and now in the collection of Sir John Lubbock. If some of these are not equal to *any* English specimens, I must simply "give in."

CHAS. C. ABBOTT

Trenton, New Jersey, U.S.A., Oct. 10

Merrifield on the Deviation of the Compass

As a review of my little manual on "Deviation," &c., has appeared in NATURE for October 17th, in which I am accused of having "written with looseness and inaccuracy," perhaps you will kindly allow me a small space to answer my critic. He has selected a most unfortunate example to bear out his assertion; and I contend for the accuracy of my statement. "Vertical iron, at the same place, will produce the same deviation in whatever direction the ship's head may be." Here I do not pretend to say (as my reviewer insinuates), that the whole deviation is the same in every position of the ship's head; but I maintain that that part due to *vertical* iron remains constant for the same place until a change of secular variation becomes cognisable. I am at a loss to discover either looseness, inaccuracy, or substitution of cause for effect in what follows, and I am inclined to think, if any exists, it must be on the part of my reviewer

Again, I am not aware of any "singular statements and conceptions" in the larger work on "Navigation and Nautical Astronomy," which are at variance with the matter contained in the small manual under consideration. Perhaps you will kindly permit my reviewer to mention some.

I grant there may be differences of opinion on the merits of any work (as is fully proved in the present instance); but when public statements are made of "inaccuracies," these should either be substantiated or withdrawn.

JOHN MERRIFIELD

Navigation School, Plymouth, Oct. 19

Earth Currents

IT may be interesting to record that during the past few days we have been subject to electric storms, I think I may say unparalleled in their frequency, intensity, and duration. On Oct. 14 a severe one raged from 9.30 A.M. to 1 P.M., and in the evening from 10.20 P.M. to past midnight. On the 15th a still more severe one raged from 9.30 A.M. to 1 P.M., and in the evening from 7 P.M. to 9.5 P.M. On the 17th inst. the currents were very embarrassing from 11.20 A.M. to 12.45 P.M., and from 2.10 to 9.0 P.M.; and on the 18th they were again troublesome.

They differed but little in their character from those usually observed, the currents continually varying in intensity and duration during the periods named. The interruptions to business on the 15th were serious, and many stations could only be communicated with by looping the wires, when more than one existed, into metallic circuits. Circuits running east and west were mostly affected, those running north and south, for instance, between London and Brighton, being but little disturbed. I regret to say that no precise measurements of the strength of these currents have yet reached me.

Southampton, Oct. 21 W. H. PREECE

Aurora Borealis

ON Saturday, Oct. 6, I was walking in our large playground with a friend, about 8.40 P.M., when we saw above us a magnificent red "way" whose direction was E.N.E. When we first looked, this broad band was bifurcated towards the E. end, one fork going more to the east, and the other to the north. In a minute or two this bifurcation disappeared, and in three minutes more the whole had disappeared, leaving the sky as before. It could be nothing but an aurora; at any rate, it was not the light of any fire, it was too magnificent, and for the time that it lasted of too great a length. I took no notes at the time, but feel that I have given you a correct account of the phenomenon, as far as it goes.

Christ's Hospital, Oct. 20 F. JEFFREY BELL

Ocean Currents

IT is to be regretted that the correspondents of NATURE, who for some weeks past have been writing on the subject of Ocean Currents, should ignore the consideration that it is primarily a question of geographical fact, and that any theory which runs counter to that needs no more elaborate confutation than a bare statement of the fact, supported, if necessary, by authoritative evidence. Thus, then, when we find the effect of the earth's rotation put forward, in the way it has lately been, by Mr. Ferrel and Prof. Everett, it is quite needless to examine the calculations which have been adduced; it is sufficient to say that the conclusions arrived at are contrary to geographical fact; that currents do not by any means universally turn to the right in the northern, or to the left in the southern hemisphere;—to name a few amongst many, the Gulf Stream turning to the left round Cape Hatteras, and again towards the coast of Ireland, Rennell's current, the Agulhas current, the Cape Horn current as it turns south near Chiloe, the current through Behring's Strait, are cases in point, currents turning in a manner exactly opposite to that deduced from the theory.

Similarly, when Dr. Carpenter, whether supported or not by several distinguished phycisists, argues from the effect of great differences of temperature in a small trough, as to the effect of much smaller differences of temperature in the incomparably larger ocean, it is unnecessary to follow him into his reasonings, for the conclusion, as he has lately stated it, that there is "necessarily an upper flow from the equator towards the poles," is geographically false. Over a very great part of the North Atlantic there is no prevailing set at all; in the South Atlantic and in the South Pacific the set has a general though slight tendency towards the north; the East Greenland current, the North African current, the South African current, the Peruvian current, and many others, run strongly towards the equator; there is nothing at all resembling a general "upper flow from the equator towards the poles."

As a question of abstract mathematics, Mr. Ferrel is undoubtedly at liberty to prove that every current in the northern hemisphere turns to the right, as much as he was, a few years ago, to prove that there is no air within some twenty or twenty-five degrees of the poles; and as a point of experimental science, Dr. Carpenter's illustrations are pretty, and can be understood without the authority of the distinguished men whose names he brings forward; though I should be loth to believe that Mr. Hawksley, or any other experienced hydraulic engineer, would agree with his idea that water will always find its own level.

But the application of the mathematical problem or the experimental illustration to the case in point is quite a different thing;

they lead to conclusions which we know to be geographically false, and we therefore refuse to accept them.

Royal Naval College, Oct. 16 J. K. LAUGHTON

Fossil Oyster

Ostrea callifera from the Hampstead beds is described at page 145, and figured on Plate I., of Forbes's "Tertiary Fluvio-marine Formation of the Isle of Wight." Perhaps this is the one "Inquirer" has found. T. G. B.

THE PENNATULID FROM WASHINGTON TERRITORY

I PRESUME this disputed organism, referred to in two communications in your number for September 26, is specifically identical with a specimen from Frazer River, British Columbia, presented to me in the autumn of last year, for the Museum of the University, by Mr. Selwyn, Director of the Geological Survey of Canada, and which had been obtained by Mr. Richardson, one of his assistant geologists. I at once recognised it as the axis of a Virgularia, or some similar creature; but there being no means of reference here for the West Coast species, I submitted it to Prof. Verrill, of Yale College, who had no doubt as to its nature, but believed it probably to belong to an undescribed species. There being no sufficient materials for its description, Mr. Whiteaves of this city, who undertook the description of the marine animals procured by the Survey in British Columbia, merely noticed it in his report as an undescribed pennatulid. Its characters were stated by him in a paper read before the Natural History Society of Montreal last winter, and printed in abstract at the time. Mr. Richardson, who returned to British Columbia in the spring, has undertaken to procure, if possible, a perfect specimen, and to have it preserved in alcohol. Should he succeed, we may hope soon to have materials for the description of the species. Mr. Selwyn's specimen, though it has probably lost several inches of its length, being broken at both ends, is five feet one inch in length. It retains, attached to the granulated lower extremity, some traces of animal matter, in which I think I can detect, under the microscope, a few club-shaped spicules.

McGill College, Oct. 11 J. W. DAWSON

DR. HOOKER'S REPLY TO PROF. OWEN

THE Blue Book issued in August last, containing the correspondence between Dr. Hooker, Mr. Ayrton, and others respecting the management of and control over Kew Gardens, included also, in the form of an appendix, a statement addressed to Mr. Ayrton by Prof. Owen, containing various allegations detrimental to the present management of the gardens, herbarium, and museum. The following reply by Dr. Hooker to these allegations has just been printed by order of the House of Commons:—

"Prof. Owen divides the 'aims and applications' of the Royal Gardens of Kew, according to his view of them, under seven heads.

"It is sufficient to state that some of these are recognised by the Government, and specified in their instructions under which the Director carried out his duties; but that others, and those of a most comprehensive nature, have no place there, and are not such as pertain to botanical gardens elsewhere. Amongst these are the agricultural operations specified by Prof. Owen, 'the application of manures, demonstrations of the fittest species of grasses for particular soils . . . methods of irrigation, subterranean pipe, conveyed liquid manures, and so forth,' all of which are being carried out with vigour and success by various agricultural societies and private individuals throughout the country.

"To establish such operations at Kew would involve an enormous expenditure, and occupy many acres of ground now devoted to the legitimate purposes of a botanical garden.

"Illustrations of rock-works, garden sculpture, and ornamental waters, also recommended by Prof. Owen, appear to be equally out of place.

"Prof. Owen is in error in stating that the arrangement of plants in natural groups, with conspicuous labelling, &c., is at Kew 'at present limited to the herbaceous grounds;' as he is also in implying that there is no illustration of 'geographical distribution,' which is, in truth, carried out to an incomparably greater extent at Kew than in any other garden known to me at home or abroad. Prof. Owen cannot have visited the houses devoted to ferns, orchids, succulents, aroids, &c., nor the arboretum, fruiticetum, and pinetum, nor observed the arrangement on the shelves of the two great buildings, the palm stove and the temperate house.

"The fact that a first-rate herbarium and library must be maintained for the purposes of a botanical garden, and in immediate proximity to it, has not only been uniformly admitted and acted upon by successive Governments, but is so universally recognised by naturalists everywhere, that I am surprised that Prof. Owen should dispute it.

"I am sure that were he acquainted with the nature and amount of the duties devolving on this establishment, he would abandon his opinion without hesitation.

"In support of the contrary opinion he refers to that early period in the history of Kew, when its new and rare plants were named at the Banksian herbarium in London. But the naming of a few new and rare plants cultivated at the beginning of the century in a private garden of nine acres, probably at no one time containing more than 4,000 species, is a very different matter from keeping accurately named public collections that occupy 300 acres, and are estimated to contain 20,000 species; and this in an establishment that is annually called upon to name literally thousands of plants from other botanic gardens and nurseries in England and similar institutions abroad. A great deal of the naming, and keeping correctly named, the plants at Kew, can be conducted only by skilled botanists visiting the grounds daily. Large classes of plants are now cultivated that must be named in the houses where they grow; and many more, the tropical especially, could not be sent to a distance to be named, without serious damage *in transitu*.

"To this must be added the necessity of naming and ticketing with copious information the vegetable products of economic interest, in three museum buildings, the illustration of which products by specimens, Prof. Owen admits to be a legitimate object of the Gardens of Kew.

"Nor was the naming of the Kew plants carried out in London, as is supposed; there was a large herbarium in constant use at the Royal Gardens at the very period alluded to, the breaking up of which, when it was proposed to give up the Gardens, necessitated the formation of another.

"No comparison whatever can be instituted between the needs in these respects of the Royal Gardens at Kew and the Zoological Society's Gardens in the Regent's Park.

"The reflections that follow on the conduct of the late and present Directors of Kew Gardens are not suited for official discussion.

"Prof. Owen is in error in asserting that the main end or drift 'of Dr. Hooker's evidence before the Scientific Commissioners is to impress upon them the necessity of the transfer of the collection of dead plants' from the British Museum to Kew.

"My evidence is unequivocally opposed to such a transfer.

"Herbaria are not costly establishments, but the least expensive of all natural history collections; and the objects and applications of botany in its largest sense, are now so numerous and so important, as to render a division of the subject necessary; whence the expediency of

maintaining a country and a metropolitan department, each with a herbarium, as the most essential, but least expensive of its adjuncts, may readily be demonstrated.

"So far from desiring that the British Museum herbarium should come to Kew, I should propose to recruit it from that at Kew, which could be done to its very great advantage.

"Prof. Owen's approval of the saying of 'a great wit and original thinker,' that 'the net result' of a herbarium is the 'attaching barbarous binomials to dried foreign weeds,' will not find an echo amongst those conversant with the subject. Had it been otherwise, successive ministers would hardly have tolerated the existence of the Kew herbarium, or of that at the British Museum either.

"The disparaging remarks that follow on the views of his duties held by the late director, and on his performance of them, are not best dealt with by the counter assertions of his son; they are best disposed of by certain passages in the Treasury Minute that follows Prof. Owen's statements, and by the unanimous verdict of the late director's countrymen and foreigners everywhere.

"The suggestion is offered that an official inquiry should be made of leading gardeners to ascertain 'the kind and degree of information and aid which they derive or have derived from the National Establishment.'

"The answer to this has already been given, in the addresses to the Premier by the Royal Horticultural Society as a body, and separately by its Floral, Fruit, and Scientific Committees; and by the meeting of botanists and horticulturists held in London; and by the concurrent evidence of gardening periodicals throughout this country.

"The statement that the Royal Gardens had not fulfilled their function of introducing new, rare, and beautiful plants is best met by a reference to the pages and illustrations of the *Botanical Magazine*, a work that has issued monthly (and without a month's intermission) from Kew, ever since 1840, edited by the Director, and which is devoted to new, rare, and interesting plants, the larger proportion of which have flowered at Kew.

"The passage relating to the avenue of deodars and limes along the Syon vista, the formation of which is censured as a failure at the cost of 'hundreds or five hundreds' of trees, is founded on a complete misapprehension. Without going into detail, it is sufficient to state that not twenty deodars have been sacrificed, and no limes at all.

"The censuring of the Director for removing the araucarias from Richmond Park to Kew is equally founded on a misapprehension. These araucarias were twice offered to Kew before they were accepted; they stood in a private piece of ground, whence their removal was considered by their possessor to be a necessity; and the alternative of removal to Kew was their destruction.

"My predecessor is censured for neglect of the great araucaria, which, it is implied, is consequently inferior to that of Dropmore. The facts are as follows:—

"This araucaria, with four others, was brought to Kew in 1796, and kept in a greenhouse.

"In 1808 it was planted out in a poor sandy soil, and being supposed to be tender, was enclosed in a wooden house for many months in the year, in consequence of which its growth was checked, and it was rendered so weak that it was almost killed in 1838.

"It was not till the late Director took office in 1840 that the house was abandoned, good soil given to it, and other means taken (which have been sedulously repeated ever since) to encourage its growth.

"It is now a striking object 30 feet high and 90 in girth of the branches; and if not nearly so handsome an object as the Dropmore araucaria, this is partly due to the fact that the Dropmore tree was planted out at once, in a soil and situation as admirably adapted to araucarias as those of Kew are naturally unsuited to them; and partly to the fact, probably unknown to Prof. Owen, that there are two very distinct forms of this species, a conical, and a round-headed, of which the Dropmore specimen belongs to one, and the Kew specimen to the other.

"Of the other four plants, one is that now at Dropmore; a second was killed by cold at Kew early in the century; the third was given to Sir Joseph Banks at Spring Grove; and the fourth at a later period, to Prince Albert, and taken to Windsor.

"In the contrast drawn between the herbarium establishments at the British Museum and at Kew, it is stated that the staff of the former consists of three officers, with aggregate salaries of 850*l.*, and 'that their time is exclusively given to the duties for which they are paid;' whereas the aggregate salaries of the three herbarium officers at Kew is 750*l.*, and that one is Professor of Botany in University College, and another a lecturer at a London Medical School.

"I am surprised that Prof. Owen should be unaware that one of his own three officers is botanist to the Royal Agricultural Society, and another a lecturer at a London Medical School, and editor of a valuable botanical journal.

"Nor does Prof. Owen in his comparison take into consideration that the Kew herbarium is open from 8.30 A.M. till 5 P.M. in winter, and 6 P.M. in summer, whereas the British Museum herbarium is open only from 10 to 4 in winter, and 10 to 5 in summer; as also that the Kew officers have not only the keep of the largest and most frequented herbarium in the world, but of a very large library, and have the duty of naming all the plants throughout the gardens and museums, together with many other duties that do not fall upon the British Museum officers.

"The fact is, that the exigencies of this establishment require that the herbarium should be open during that long period, but the officers are not required to be in attendance, and at their work, for more than seven hours daily throughout the year.

"Those seven hours (and to their honour be it said, often many more) are devoted exclusively to the duties of their respective offices.

"That the officers both of the British Museum and of Kew should be chosen to conduct the very brief professional and other duties which they perform elsewhere (at their own time), is both honourable to themselves, and in many ways advantageous to the establishments with which they are officially connected, always assuming that these vocations do not interfere with their working hours at Kew, and at the British Museum, or with their powers of work during those hours.

"The statement that there are at Kew 'a special curator of the museum, &c., and an assistant at 315*l.* per annum,' is an error.

"There is but one curator for the three museums, and his salary is 120*l.*, rising to 150*l.*, without a house or any other advantage; he has no assistant, and never had one.

"The last of Prof. Owen's statements to which I shall allude are the following, which I quote *verbatim*:—

"'Dr. Hooker has been enabled to publish, or aid in the publication of, 130 volumes on botanical subjects. . . .

"'To the extent or proportion in which the Director's time has been diverted from the immediate aims of the Royal Gardens to this foundation of his scientific fame, the proportion of his salary of 800*l.* per annum must also be placed to his credit of the superaddition of the dead plants to the Botanical Department under the Board of Works, competing with the Botanical Department under the Trustees of the British Museum.'

"The first statement in this extract has no foundation in fact; it would ill befit me to notice the insinuation contained in the last.

"(Signed)

"JOS. D. HOOKER, Director

"Royal Gardens, Kew, Aug. 6, 1872"

THE NEW RHINOCEROS

THE acquisition of a living Rhinoceros belonging to a species hitherto unknown to science, is certainly a remarkable event, and one that may well give comfort to those who may have supposed that the field of zoological discovery is worked out. If so large a beast has hitherto escaped the observation of naturalists, how many smaller animals must there still remain for the zoological explorer. But the truth is that we know less about some of these very bulky animals than those of more moderate dimensions, as their very size renders the collection and preparation of specimens of them more difficult. The importation of such monsters in a living state is a still more serious undertaking, and it is only within the last few years that the Zoological Gardens of Europe have become wealthy and enterprising enough to find funds for such expensive luxuries.

The animal of which we are now speaking, was originally captured near Chittagong, at the northernmost extremity of the Bay of Bengal, in January 1868, by some officers engaged in the supply of elephants for the Indian army. Some natives came into the station, and reported that a rhinoceros had fallen into a quicksand, at a place about sixteen hours' journey to the south, and had been unable to extricate itself. They had pulled it out by ropes attached to its neck, and had bound it between two trees, but were fearful of its breaking loose. Captain Hood and Mr. H. W. Wickes accordingly started with eight elephants, and brought the rhinoceros into Chittagong, where she was kept in a stockaded enclosure, "having a good bath excavated in the ground, and a comfortable shed attached to it." Here "Begum," as she was named, remained for nearly four years. Various negociations were entered into between the Zoological Society of London and the capturers, for her

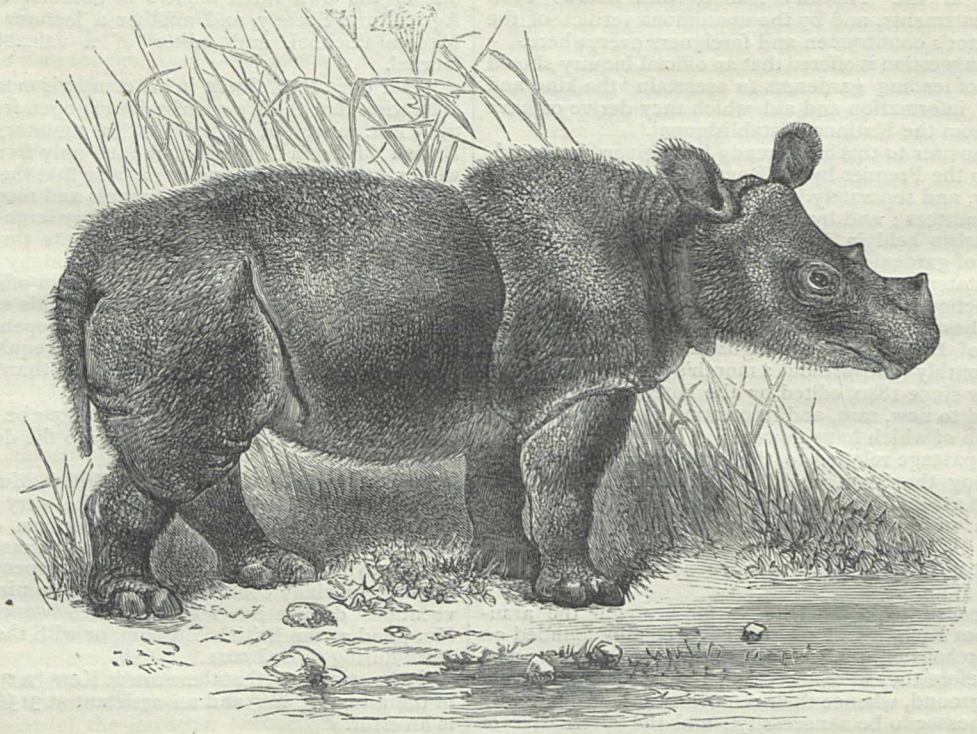

FIG. 1.—SUMATRAN RHINOCEROS

removal to this country, but these never came to any definite result. Besides the difficulty of arranging terms at such a distance apart, there seemed to be some question about the true ownership of the animal, which created additional embarrassment in the transaction. At length in the autumn of 1871, Mr. William Jamrach, the well-known dealer in living animals, being personally in Calcutta, was able to conduct the negociations to a successful result, and on his return to England, in February last, brought the animal with him. Upon her arrival "Begum" was immediately purchased by the Zoological Society, to whom, it was understood, the first offer was to be made, for the sum of 1,250*l*.

During the transit through Calcutta, this rhinoceros was examined by Dr. John Anderson, the Curator of the Indian Museum in that city. Dr. Anderson, thinking it possible that the animal might not live to reach England, had some figures of it made by a native artist, and drew up some notes on its external characters, which he communicated to the Zoological Society of London. In these notes, which have been published by the Zoological Society in their Proceedings (P. Z. S., 1872, p. 129), Dr. Anderson supposes the animal to be a Sumatran Rhinoceros (*Rhinoceros sumatrensis* of Cuvier), but comments upon several points in which it seemed to differ from former descriptions of that species, and upon its occurrence so far north of the hitherto known range of that species. When the rhinoceros arrived in London it was likewise referred to *Rhinoceros sumatrensis*—that being the only known Asiatic species of Rhinoceros with two horns, and was entered under this name in the Zoological Society's register of accessions, and is so spoken of in the new edition of the "Garden Guide." It is likewise mentioned and figured under this name in an article on Rhinoceroses, published in this journal for the 28th of March last. The cut there given is

now reproduced (see Fig. 2), in order to give an opportunity of comparing it with the figure (Fig. 1) of the true *R. sumatrensis*.

In July last Mr. William Jamrach received a female two-horned rhinoceros from Singapore, which is said to have been captured in a pitfall near Malacca, and placed it on deposit in the Zoological Society's Gardens. On comparing it with the female previously received from Chittagong, it became at once apparent that the two animals belonged to distinct, though nearly allied, species. The Malaccan animal, although undoubtedly adult, is much smaller—nearly as much as one third—than that from Chittagong. The fringe of long hairs on the posterior rim of the naked ears, which is very conspicuous in the Chittagong animal, is not present in the Malaccan example, in which, however, the whole interior of the ears is filled with short hairs. The whole body of the Malaccan animal is covered with coarse granulations, which are hardly apparent in that from Chittagong. The tail of the Malaccan animal is shorter and nearly naked; in that from Chittagong it is longer and tufted at the extremity. The head of the former animal is much narrower than that of the latter, as is particularly apparent when the distance between the ears of each is examined from a front view, and there can be no doubt that the skulls of the two animals, whenever they can be compared, will exhibit marked differences in size and structure.

Under these circumstances the Council of the Zoological Society thought it would be advisable to add the second animal also to their living collection, and accordingly agreed to purchase it of Mr. Jamrach for the sum of 600*l*. Unfortunately it did not live long in the Society's gardens.

Upon reference to authorities upon the Sumatran Rhinoceros, which was first described by Mr. William Bell in the Philosophical Transactions of the Royal Society for 1793, and afterwards by Sir Stamford Raffles in this country and by Cuvier and other writers in France, it became evident that the Malaccan animal was the true *Rhinoceros sumatrensis* of authors. This would be presumably the case, because the Fauna of the Britsh settlement of Malacca is nearly identical with that of the adjacent island of Sumatra. The Chittagong animal, its northern representative, is therefore proposed to be called the Hairy-eared Rhinoceros (*Rhinoceros lasiotis*), from its peculiar ear-fringe of long hairs, which has been already spoken of. How far the Sumatran Rhinoceros extends north along the Malayan peninsula is not yet ascertained, because, although Two-horned Rhinoceroses are known to occur in several intermediate localities, it is uncertain to which of the two allied species they belong. The range of *R. lasiotis* is likewise quite a matter of uncertainty at present, the animal being utterly unknown except from the individual in the Zoological Society's Gardens. But it is probable that it extends into Assam, where there are reports of the occurrence of a Two-horned species of Rhinoceros.

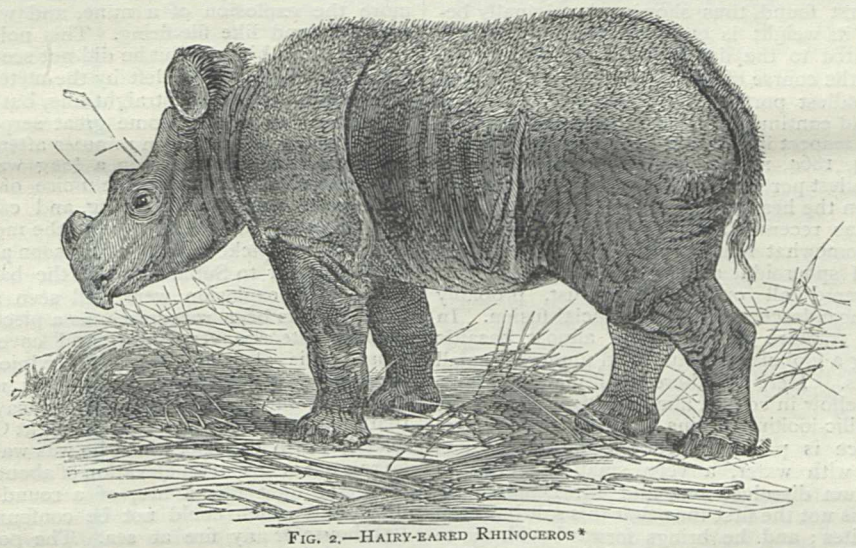

FIG. 2.—HAIRY-EARED RHINOCEROS*

Besides the two Rhinoceroses just spoken of, two other specimens of Asiatic Two-horned Rhinoceroses have been imported alive into Europe since the commencement of the present year. One of these was purchased by an agent of one of the American travelling menageries, and exported to New York; the other is now in the gardens of the Zoological Society of Hamburgh. Both these animals are said to have been received from Singapore, and to resemble exactly the Malaccan animal in London. Of the second a figure and description have been published in a Hamburgh journal (*Der Reform*), which shows that the animal is certainly the true *R. sumatrensis*.

By the addition of these two animals to their Menagerie the Zoological Society have now been able to exhibit side by side specimens of four (out of the six certainly known) living species of Rhinoceros—a wonderful advance, when we consider that a very few years ago the Indian *Rhinoceros unicornis* was alone known in Europe in a living state. The two species remaining to be obtained are the Javan Rhinoceros (*Rhinoceros sondaicus*), a smaller representative of the One-horned Indian, and the White Rhinoceros of Africa (*Rhinoceros simus*). It need hardly be added that any correspondents of NATURE who may be able to assist in supplying these desiderata will not only be conferring a benefit on science, but will be liberally dealt with by the Council of the Society.

P. L. S.

* It should be stated that this figure is drawn on a smaller scale than that of the Sumatran Rhinoceros, the latter being really the smaller animal.—ED.

RECENT FALLS OF METEORITES IN FRANCE AND ITALY

THE French Academy of Sciences has recently received several important and interesting accounts of the fall of two or three meteoric masses in France and Italy. On the 23rd of July, about half-past five on a still afternoon, with a perfectly clear sky and a bright sun, a

violent report, followed by a rumbling noise, was heard in the commune of Lancé, canton of St. Arnaud (Loir-et-Cher). On the following day it was ascertained that the noise had been heard over a wide area of country, and had caused much uneasiness; and a letter arrived from a landowner of Lile-Bouchard, announcing that he had seen a "fiery lance" shooting across the sky in a direction from S.W. to N.E. with great swiftness. Whilst on its way its point appeared to split, giving rise to two meteors, which continued their way parallel to each other for some distance. Another observer south of Tours had also seen them, and described them as having the shape of a bottle, and being of an orange colour. M. De Tastes, who communicated the first account to the Academy, on proceeding to St. Arnaud, was fortunate enough to learn that one of these meteorites had been seen to fall near Lancé, and he was also successful in finding it. Its weight was 47 kilogrammes (about 103 lbs.), and it had penetrated to a depth of 1·40 metres (about 5 ft. 9 in.). On being removed, it broke into three pieces. Of the second meteorite nothing was heard for some time, but it was ultimately found at a place called Pont-Loisel, about 12 kilometres (7½ miles) to the south-west of the place where the other had fallen; and an account of it is given to the Academy by M. Daubrée. It is of exactly the same mineralogical character as the one first found, thus showing it originally belonged to it, but its weight is only 250 grammes, and it had only penetrated to the depth of about half a metre. On ascertaining the course of the meteorite, it was found that this, the smallest portion, had fallen first, and that the larger one had continued its course for some distance farther. In this respect it resembled the meteorite which fell on March 14, 1864, near Orgueil (Tarn-et-Garonne), in which the smallest portion, weighing about 15 grammes, first fell, and then the heavier one, weighing 40 grammes.

M. Daubrée has recently analysed the meteorite, and his results are somewhat remarkable. The largest piece is of an unequal spheroidal shape, with a rounded surface; it is covered all over with a crust, probably caused by the incandescence and superficial fusion. In appearance the fracture is black, and almost basaltic looking, showing a globular structure and numerous small spheroidal grains. Here and there small metallic grains are to be seen, yellow in colour, like iron bisulphide, these and other metallic-looking grains showing much better when the surface is polished. Its specific gravity was 3·80. Treated with water, a very small quantity of chloride of sodium dissolved out, and M. Daubrée remarks that this is not the first time that this salt has been found in meteorites; and he brings forward evidence to show that it could not have been derived from the soil in which the meteorite was buried, but that it must have formed part of it when it fell. No traces of any salts of potash, nor of any sulphates or hyposulphates could be found. Dissolved in nitric acid, a silicate was found, which was proved to consist chiefly of magnesium and protoxide of iron, and there was an undissolved residue, part of which was colourless, the remainder dark black. By means of spectrum analysis, copper was thought to be recognised; but calcium, barium, and strontium were shown to be absent. No carbon was found; but, as usual, cobalt and nickel accompanied the iron. The following is the complete analysis:—

Free iron combined with nickel and cobalt			7·81
Iron and other metals combined with sulphur		9·09	14·28
Sulphur combined		5·19	
Silicate	Silica	17·20	42·42
	Magnesia	13·84	
	Iron protoxide	11·33	
	Manganese protoxide	0·05	
Part unattacked by acid			33·44
Sodium chloride			0·12
Water			1·24
		Total	99·31

In its general appearance this meteorite resembled that which fell July 11, 1868, at Ornans (Doubs), but differs from it in the absence of free iron oxide. Other characters distinguish it from the black meteorites of Rutlam (East Indies) and that of Tadjera, near Sétif (Algeria).

Several meteorites have also lately been seen in Italy, which have excited considerable attention. One on the evening of the 8th of August, at about eight minutes past 11, was seen at Rome, and also at Velletri, Naples, and Palermo. A more interesting one than this was seen near Rome, at about 5.15 mean time, on the morning of the 31st of August, of which Padre Secchi has communicated a long account to the Academy. At about 5.15 in the early morning on that day a globe of fire, well marked and a little red in colour, appeared on the horizon towards the S.S.W., proceeding towards the N.N.E. Its progress was at first slow, but this gradually increased, and it left behind it a luminous train like a cloud lit up by the sun. When it had reached its highest point, E.N.E. from Rome, it suddenly expanded and took the shape of a cone having its base rounded in front; it brightened up greatly and finally disappeared. Three or four minutes after its disappearance a tremendous detonation was heard, which caused, in many places, houses and glass to rattle. This explosion was dull, different to thunder, and resembling more the explosion of a mine, and was followed by a rolling sound like file-firing. This noise was heard by Padre Secchi himself, but he did not see the globe of fire. The vapour-like residue left by the meteorite was at first in the shape of a long straight line, but it soon enlarged, and turned about like some great serpent until it disappeared about ten or fifteen minutes afterwards.

This meteor was also seen a long way from Rome, at Viterbo and at Veroli, but the noise of the explosion in each place was equally strong, and caused houses and glass to rattle. A small piece of the meteorite which fell near him was picked up by a curé soon after the explosion at Affile, near to Subiaco, where the ball of fire and the noise of the explosion were well seen and heard. The fragment has been recognised as a piece of a very ferruginous meteorite, very hard, and covered over with a crust. It is also said that at Orvinio "black stones" have been picked up. But this is not all. A well-instructed farmer had assured me, says Padre Secchi, that the same morning at 3.30, being at Casale S. Lorenzo, near to Porto d'Anzio, whilst he was waiting for his men, he saw out at sea, at an elevation of about 30° or 40°, a mass of fire or light like a fire, of a round form, apparently fixed, and which could not be confounded either with a lighthouse or any fire at sea. The position of this fire was exactly the same as that from which the meteorite afterwards appeared, and which he saw very distinctly in the heavens at 5.15, when he was so much struck with the coincidence of direction that he judged it to be the same mass of fire which had then reached the earth. The size of the meteorite at its first appearance and at the moment of explosion is represented as little less than the diameter of the moon. The extreme distances at which it was seen are 150 kilometres (93 miles) apart.

Another meteorite was seen at Subiaco on August 6, at four in the morning; and another near Ascoli on the 18th of September. J. P. E.

DARDANELLES AND BOSPHORUS UNDER-CURRENT

IT will be in the recollection of such of your readers as have followed the discussion on Ocean Currents, that I ventured nearly two years ago* to predict the existence of an Under-current of dense Ægean water into the Black Sea, "on the double ground of *a priori* and *a posteriori* necessity;"—that is, I affirmed it to be a necessary result of the excess of Specific Gravity in the water

* Proceedings of Royal Society, Dec. 8, 1870, § 123.

of the Ægean above that of the Euxine; whilst, I argued, if the salt continually passing out of the Black Sea by the surface-current were not thus replaced, the continual excessive influx of River water would, in time, wash the whole of the salt out of its basin.

My position was assailed by Captain Spratt, who affirmed (1) that his own experiments in the Dardanelles had shown the existence of still water beneath twenty fathoms; and (2) that the return of salt to the Black Sea was effected by a *surface* in-current during the winter, when the rivers are low, and when the wind sets *from* the Ægean along the Dardanelles, the Sea of Marmora, and the Bosphorus.

On an examination of Captain Spratt's experiments, however, I came to the conclusion that, when rightly interpreted, their results bore out *my* view of the case; and, as I stated in my letters of Nov. 14, 1871, my interpretation of them had the sanction of three eminent Naval Surveyors. Captain Spratt maintained that because a surface-buoy from which a "current-drag" was suspended at a depth beneath twenty fathoms *remains stationary*, the waters in which the "drag" hangs must also be *motionless*. To me, on the other hand, it appeared indisputable that if the surface-buoy is floating in a *current* which puts a strong strain on the suspending line, that strain would draw the "current-drag" through *still* water; so that the stationary condition of its suspending buoy can only be accounted for on the supposition that the action of the surface-current on it is *neutralised by some pressure in the opposite direction*, which can be nothing else than that of an under-current *meeting* the "current-drag."

The question is discussed in an Appendix to the forthcoming Report of my last year's work in the *Shearwater*, of which the following (written on board of her a year ago) is an extract:—

"Now since, according to Captain Spratt, this stationary condition of the 'current-drag' was shown at all depths below forty fathoms in the Sea of Marmora (even down to 400 fathoms), and at all depths below twenty fathoms in the Dardanelles, it seems an irresistible conclusion that whilst there is a rapid superficial *out*-current, running in the Dardanelles at the rate of $2\frac{1}{4}$ miles per hour, there is a deeper *under*-current from twenty fathoms to the bottom, running more slowly *in*wards from the Ægean into the Sea of Marmora through the Dardanelles, and thence, it may be presumed, through the Bosphorus, into the Black Sea. And this conclusion finds complete confirmation in the results of a comparison between the respective Densities and rates of movement of the Dardanelles water at different depths, as observed by Captain Spratt himself. For whilst the progressive decrease in the movement of the 'current-buoy,' from $2\frac{1}{4}$ knots at the surface to almost nothing at twenty fathoms, indicates (as just now shown) first a cessation of all movement in the stratum in which the 'current-drag' hangs, and then a reversal in the direction of the current as the lower depth is approached,—the Density increased from 1,020 at the surface to 1,028 at twenty fathoms, and 1,029 at forty fathoms; the surface-water thus corresponding with that of the Sea of Marmora, whilst thewater of the entire stratum from twenty fathoms to the bottom was equal in density to that of the Mediterranean. I hold, then, that the existence of an Under-current of dense Mediterranean water through the Dardanelles into the Sea of Marmora, is incontestably proved by the very experiments and observations which have been adduced by Captain Spratt as demonstrating the unsoundness of the Under-current doctrine."

Having understood that the *Shearwater*, on the completion of the Survey of the Gulf of Suez, would proceed to the Dardanelles, I requested the Hydrographer to direct that the question of the Under-current should be thoroughly examined; and he issued instructions accordingly.

I yesterday learned through the *Levant Herald*:—(1) that the existence of a strong Under-current has been placed beyond all question, a boat having been carried along by the "current-drag" suspended from it, *in opposition to the surface-current*: (2) that the rate of this Under-current is estimated as greater than the speed of the *Shearwater's* steam-launch; and (3) that it runs at a depth of twenty fathoms,—precisely that at which my interpretation of Captain Spratt's experiments has led me to predicate its existence.

I venture to think that this verification of my prediction will be regarded as a confirmation of the general Physical Theory of Under-currents on which it was based; and it is now for those who oppose that Theory to show by what other force than the difference in the *weight* of the Ægean and the Black Sea columns, consequent upon their great difference in Specific Gravity, the Dardanelles Under-current can be sustained.

WILLIAM B. CARPENTER

NOTES

MR. C. MELDRUM writes from Mauritius that he has been looking into the subject of the West Indian hurricanes, and he believes that they show a periodicity of frequency corresponding nearly with that of sun-spots. So far as he has yet examined the subject, the maximum of cyclone frequency is a year or two after that of sun-spots. It was so ten years ago, and is so again probably, the mean cyclone frequency occurring in 1862, and this year, 1872, being the most marked for hurricanes since. We greatly regret to hear that Mr. Meldrum is suffering severely from illness brought on by over-work. It will scarcely be credited that the only allowance made to him by the Government for an assistant is 50*l.* per annum!

WE learn from the *Gardener's Chronicle* that M. Milne-Edwards has undertaken a task for which all naturalists owe him thanks. The archives of the Museum of Natural History in the Jardin des Plantes contain a collection of 6,000 volumes and more than 1,500 manuscripts, which are almost entirely unknown to the scientific world; for nearly 60 years the dust that lay upon them has never been disturbed. In 1803 it was proposed to create a special department for these and other works and documents, but the idea was abandoned, and since that time the collection has remained huddled away in a corner, on account of space being wanting in the library of the museum. M. Milne Edwards has determined that such a state of things shall not be perpetuated, and has arranged that the collection shall be carefully examined, catalogued, and placed at the disposition of the scientific world. The manuscripts include a considerable number by Buffon, Cuvier, and Daubenton; there is a series of 24 pen-and-ink drawings by the last-named naturalist, representing the various types of Merino sheep, and exhibiting great artistic ability, and many albums filled with drawings of plants and flowers. It is proposed to add the books to the library of the museum, but there is so little space to be disposed of there, that it is expected the MSS. will be transferred to the great National Library, in the Rue Richelieu.

SIR DAVID BAXTER, who endowed in his life-time a Chair of Engineering at the University of Edinburgh, has by his will left the munificent gift of 40,000*l.* for the general purposes of the University.

THE death is announced, on the 16th inst. at Torquay, at the age of 75, of Lady Hooker, widow of Sir W. J. Hooker, K.H., formerly Director of the Royal Gardens, Kew.

MR. RAY LANKESTER, M.A., Fellow of Exeter College, Oxford, writes to correct the statement in our University Intelligence last week, that he has been appointed Deputy to the Linacre

Professor of Anatomy and Physiology in that University. He is merely delivering a course of lectures at the request of the Linacre Professor, which the Professor has hitherto been in the habit of delivering himself.

BY a majority of two to one the managers have decided to remit the question of the admission of lady medical students to the practice of the Edinburgh Royal Infirmary to a committee, to report "whether, and to what extent, it is practicable to give instruction to females within the wards of the Infirmary." The minority desired that arrangements should at once be made for the instruction of lady students. *Apropos* of this subject, a moiety of the 1,000*l.* recently promised by Mr. Walter Thomson to the funds of the Committee for securing a complete Medical Education of Women in Edinburgh has been forwarded to the Executive Committee; (1) in payment of expenses that have to be incurred in prosecuting the claim of women to the highest medical education obtainable in the University of Edinburgh and elsewhere; and (2) in assisting or encouraging lady students who have been subjected to extra charges by the obstacles interposed in Edinburgh.

A NEW University is to be opened on November 1, at Klausenburg, the capital of Transylvania.

MR. THOMAS HOWARD, of the King and Queen Iron Works, Rotherhithe, who was for 37 years an Associate of the Institute of Civil Engineers, has bequeathed to it the sum of 500*l.*, free of legacy duty, which sum he has, by will, directed "to be invested, and the interest thereof to be applied in such manner and under such conditions and instructions as the Council of the said Institution may think most expedient, for the purpose of presenting, periodically, a prize or medal to the author of a treatise on any of the uses or properties of iron, or to the inventor of some new and valuable process relating thereto, such author or inventor being a member, graduate, or associate of the said institution."

THE following are among the publishers' announcements for the coming season :—By Mr. Murray :—The Expression of the Emotions in Man and Animals, by Charles Darwin, F.R.S. (with photographic and other illustrations); Records of the Rocks, a series of Notes on the Geology, Natural History, and Antiquities of North and South Wales, Siluria, Devon, and Cornwall, by the Rev. W. S. Symonds, F.G.S. (with illustrations); Travels in the Eastern Caucasus, on the Caspian and Black Seas, especially in Daghestan, by Lieut.-Gen. Sir Arthur Cunynghame, K.C.B. (with map and illustrations); The Geography of India, Ancient and Modern, an Elementary Manual for Students and General Readers, by Col. Yule, C.B. (with maps and woodcuts); The Longevity of Man, its Facts and its Fiction, including Observations on the more Remarkable Instances, and Hints for Testing Reputed Cases, by William J. Thoms, F.S.A.; Metallurgy of Gold, Silver, and Mercury, by John Percy, M.D., F.R.S., Lecturer on Metallurgy at the Royal School of Mines (with illustrations); The Geological Evidences of the Antiquity of Man, by Sir Charles Lyell, Bart., F.R.S., 4th edition revised; Metallurgy of Fuel, Wood, Coal, Copper, Zinc, &c.; also, Metallurgy of Iron and Steel, by John Percy, M.D., F.R.S., Lecturer on Metallurgy at the Government School of Mines (new and revised editions, with illustrations, 2 vols.); Siluria: a History of the Oldest Rocks in the British Isles and other Countries, by Sir R. I. Murchison, F.R.S. (5th and cheaper edition, with maps, plates, and woodcuts). By Messrs. Macmillan :—The Forces of Nature, a Popular Introduction to the Study of Physical Phenomena, by Amédée Guillemin, translated from the French by Mrs. Norman Lockyer, and edited, with Additions and Notes, by J. Norman Lockyer, F.R.S. (illustrated by 11 coloured plates, and 450 woodcuts); Papers on Electrostatics and Magnetism, by Prof. Sir W. Thomson, F.R.S.; The Depths of the Sea: An Account of Investigations conducted on board H.M.'s Ships *Lightning* and *Porcupine* in the Years 1868-9, under the Scientific Direction of W. B. Carpenter, M.D., F.R.S., J. Gwyn Jeffreys, F.R.S., and Wyville Thomson, LL.D., F.R.S., edited by Dr. Wyville Thomson (with illustrations). By Messrs. L. Reeve and Co. :—Lahore to Yarkand, Incidents and Natural History of the Expedition of 1870, by Dr. Henderson; On Harvesting Ants and Trap-door Spiders, by J. T. Moggridge, F.L.S.; Vol. 2 of the English Edition of Prof. Baillon's Natural History of Plants; and the Fifth Part of Hanley and Theobald's Conchologia Indica. By Messrs. Blackwood and Sons :—A Manual of Palæontology for the use of Students, by H. Alleyne Nicholson, M.D., D.Sc. Professor of Natural History and Botany, University College, Toronto (with 400 engravings); Advanced Text-Book of Botany for the Use of Students, by Robert Brown, M.A., Lecturer on Botany under the Science and Art Department of the Committee of the Privy Council on Education. By Messrs. A. and C. Black :—School Manual of Zoology, by Andrew Wilson (with illustrations; New Edition of Jukes' Scotch Manual of Geology, edited by Alfred J. Browne; New Edition of Elements of Mineralogy, by James Nicol, Professor of Natural History in the University of Aberdeen. By Messrs. H. S. King and Co. :—The Forms of Water in Rain and Rivers, Ice and Glaciers, by John Tyndall, LL.D., F.R.S. (with 32 illustrations); Physics and Politics, by Walter Bagehot, being vols. 1 and 2 of the International Scientific Series. By Messrs. Lockwood and Co. :—A rudimentary Treatise on Coal and Coal mining, by Warington W. Smyth, M.A.; Weale's Dictionary of Terms, new and enlarged edition, edited by Robert Hunt, F.G.S.; Waterworks for the Supply of Cities and Towns, with a description of the Principal Geological Formations of England as influencing Supplies of Water, by Samuel Hughes, new edit.; Projection, Orthographic, Topographic, and Perspective, giving the various Modes of Delineating Solid Forms by Constructions on a Single Plane Surface, by J. F. Heather, M.A.; A First Book of Mining and Quarrying, with the Sciences connected therewith, for use in Primary Schools and Self-Instruction, by J. H. Collins, F.G.S.; Places and Facts in Physical and Political Geography, for the use of Candidates in Public and Private Examinations, by the Rev. Edgar H. Rand; a Course of Analytical Chemistry, specially prepared for Universities and Science and Art Departments, Advanced and Honours Examinations, by W. W. Pink. By Messrs. S. Low, Son and Co. :—The Arctic Regions, illustrated with Photographs, taken on an Art Expedition to Greenland, by Wm. Bradford; with descriptive Narrative by the Artist; in 1 vol. royal broadside, 25 inches by 20 inches, bound in morocco; The Atmosphere, by Camille Flammarion, translated under the superintendence and revision of James Glaisher (with numerous woodcut illustrations and 10 beautiful chromo-lithographs). By Mr. Maclehose :—A Class-Book of Qualitative Chemical Analysis, by John Ferguson, M.A. By Trübner and Co. :—Mythical Zoology, or the Legends of Animals, by Angelo de Gubernatis, Professor of Sanskrit and Comparative Literature in the Instituto di Studii Superiori e di Perfezionamento, at Florence (2 vols.); A Practical Treatise on Pure Fertilisers, and the Chemical Conversion of Rock Guano, Marlstones, Coprolites, and the Crude Phosphates of Lime and Alumina generally, into various valuable Products, by Campbell Morfit, M.D., F.G.S. (with 28 Illustrative Plates or Construction Plans, drawn to Scale Measurements); Human Physiology, the Basis of Sanitary and Social Science, by T. L. Nichols, M.D. (with illustrations).

PROF. GALLOWAY, of the Royal College of Science, Dublin, has two works nearly ready for the press :—"How the Natural Sciences are Taught, and how they ought to be Taught; with a Scheme for rendering more efficient the Government Science Schools;" and "A Manual of Applied Analysis."

THE first meeting for the season of the Victoria Institute took place on Friday last, when a number of new members were elected, the Society being stated to be greatly on the increase. The first paper to be read during the coming session will be by Mr. Charles Brooke, F.R.S., on Force and Energy.

THE Geologists' Association will hold its first meeting for the season on Friday evening, Nov. 1, when Dr. Hyde Clarke will read a paper on the Influence of Geological Reasoning on other Branches of Knowledge.

AMONG the courses of University Lectures and other means of scientific instruction announced to be given at Harvard University, Cambridge, U.S.A., during the present session, are the following:—On General Entomology, by Prof. Hagen—Mondays, Wednesdays, and Fridays, at the Museum of Zoology. Geological Excursions, by Prof. Shaler, on Saturdays—about eighteen during the year. On the Structure and Affinities of the Brachiopoda, by Prof. E. S. Morse—Mondays and Wednesdays, in Roylston Hall. On General Ornithology, by Mr. J. A. Allen—Wednesdays, at the Museum of Zoology.

THE following is the programme of papers to be read at the Winter Session, 1872-73, of the Glasgow Society of Field Naturalists:—On the present tendencies of Science, by J. Allan, Oct. 15.—On the Distribution of Plants, by D. Gregorson, Oct. 29.—A Life History of *Nematus saliceti*, together with some account of its Parasites, by P. Cameron, jun., Nov. 12.—On Spiders, by S. M'Donald, Nov. 26.—On Zoophytes, by W. D. Benson, Dec. 10.—On the Exotic Plants of Clydesdale, by R. M'Kay, Dec. 24.—On the Definition of Species, by Alex. Watt, Jan. 7, 1873.—Notes of Observations on Marine Zoology, by John Harvie, Jan. 21.—Notes of Observations with the Microscope, by G. Barlas, Feb. 4.—Botanical Gleanings from the Rubbish Heaps of the City, by G. Horne, Feb. 18.—On the Cynipidæ of the Glasgow District, by P. Cameron, jun., March 4.

A SERIES of short lectures is about to be delivered at the Ipswich Museum by the Curator, Mr. J. E. Taylor, and other gentlemen, illustrative of the objects in the museum. They will be held on Friday evenings throughout the winter, and admission will be free.

THE first of Abbé Moigno's long-contemplated *Salles du Progrès* was inaugurated on Tuesday evening, Oct. 15, at 30, Rue du Faubourg Saint Honoré, by a distinguished assembly, including M. Otto Struve, the Russian Astronomer. The praiseworthy object of the Abbé in establishing these assemblies is to popularise Science by means of lectures, exhibitions, conversaziones, &c., in which the instructive is combined with the entertaining. On Tuesday he detailed the programme which he intended carrying out at future meetings, and those present were entertained by the performance of some pieces of music. This last rather novel feature in scientific assemblies forms a regular part of the Abbé's programme. One or more pieces from the works of great masters of music will be performed at each meeting.

THE British Association Meeting at Brighton has already begun to bear fruit in that town. A desire has been aroused among several of the inhabitants to know more of Natural Science, and a course of science lectures in the Dome, chiefly to working men, has been projected. But the ladies have taken the initiative, and the germ of a Ladies' Educational Association has already been planted. Prof. W. F. Barrett has been invited to give the first course of lectures on Experimental Physics. The introductory lecture on the "Study of Natural Knowledge," was given last Friday afternoon, when, in spite of the wet, upwards of 50 ladies assembled. Miss Goulty, of 2, Sussex Square, Brighton, to whom it is right to add the effort is mainly due, has permitted the use of her spacious schoolrooms for these lectures. The second lecture on "Magnetism" will be given to-morrow (Friday) afternoon.

SIEBOLD'S NEW RESEARCHES IN PARTHENOGENESIS *

II.

SIEBOLD'S experiments extended over four years, and although some hundreds of nests were more or less observed, only thirty-seven—but these amply sufficient—gave the answer to his questions, passing successfully through all the stages above noted. Firstly, they furnished a virgin colony in a nest absolutely free from eggs and larvæ—except a few advanced larvæ purposely left in some nests and noted down—which colony laid eggs; secondly, these eggs produced without exception (some few eggs not developing) males.

The method of recording which was used must be mentioned to give a notion of the accuracy of the observations. A series of plans of each nest was kept, each cell being represented and its contents at different dates. Successive plans were used for recording the successive changes in the number of cells of the nest, and in their contents at different periods of the observations. Signs jotted down in the plan cells indicate such facts as these—*e.g.*, the cell contains a "parthenogenetic egg," or "a second parthenogenetic egg which was laid after a first one had disappeared," or "a larva sprung from the queen," or "a parthenogenetic male larva," &c., &c. A second record was kept, and is given for twenty-two cases, in which the following facts were noted:—Number of the nest, date it was made moveable, number of cells at that time, day of emergence of first worker-female, date of destruction of queen, eggs, and grubs, number of larvæ and pupæ left undestroyed at this date, date of first laying of parthenogenetic eggs, date of first emergence of parthenogenetic larvæ, date of first emergence of drones born from queens' eggs (these were null in most cases, and were always so late as not to affect the experiments by possibly impregnating the worker-female), number of the same, number of cells observed when the experimental conditions were established, date and duration of the experiment, maximum number of female workers employed in the affairs of the nest, number of larvæ, pupæ, and wasps of the parthenogenetic brood found at the conclusion of the experiment. After the account of the artificially obtained results, two cases are recorded in which Siebold found a parthenogenetic colony naturally established by the same accident which had destroyed their queen and comb.

Before concluding this chapter of his book, Siebold makes the very important observation that the facts observed in the parthenogenesis of Polistes are in opposition to the view maintained by Leydig, viz., that the sexual differentiation of the egg is independent of its fertilisation, and that the evolution of the male sex is due to diminution of nutrition and warmth. Bessels has already, in opposition to Landois, shown that this is not the case in the bee. If it were true for Polistes, the eggs laid in the early year, when it is cold, and when there is only the queen to attend to the larvæ, should produce drones. On the contrary, they produce females, and the drones appear precisely at the time when warmth and nourishment are most abundant.

Siebold concludes, therefore, that (1) the eggs bring with them from the ovary the capacity of differentiating themselves as males, and (2) of developing themselves, independently of male influence into male individuals; (3) but the same eggs can be changed in these properties by the influence of the male sperm elements, and proceed to develop as female individuals.

The second chapter, very short, is on Parthenogenesis in *Vespa holsatica*, which was inferred to occur from the observation of a naturally-produced queenless colony, the larvæ in the cells of which were all male.

The third chapter is on Parthenogenesis in *Nematus ventricosus*, the larva of which is known as the Gooseberry-caterpillar. Since three or more generations of these leaf-wasps occur in the season, they furnished abundant material, and the old supposition of parthenogenesis first put out as regards them by Robert Thorn, in the *Gardener's Magazine*, 1820, is shown by Siebold to be justified by carefully conditioned experiment. Some valuable observations on the anatomy of the generative organs, and on the curious increase in the size of the egg after it is laid, are given. The parthenogenetically produced progeny are in this case also male. The results of the *Nematus* experiments were not ready for publication until after the issue of the present work, and we

* "Beiträge zur Parthenogenesis der Arthropoden." Von C. Th. E. von Siebold, Professor der Zoologie und Vergleichenden Anatomie in München. (Leipzig: Engelmann, 1871.)

have received, through the kindness of Dr. Dohrn, a copy of the Sitzungsberichte of the Munich Academy of November 4, 1871, in which they are fully given. It appears that though an occasional female appeared among the male broods produced by unfertilised females, this was, in every case where it happened, fully accounted for by the accidental access of a fertilised female, or some such misadventure, duly noted in the records kept of the observations.

Of the fourth and fifth chapters, treating of Parthenogenesis in the Lepidoptera, *Psyche Helix*, *Solenobia triquetrella* and *lichenella*, we have not space to speak in detail. The same intimate inquiry, and the same very necessary prodigality in the amount of material subjected to experiment, which we noted above as to Polistes, characterise Prof. Siebold's treatment of these cases. The parthenogenesis in these cases produces female broods, and though the male of *Psyche Helix* has been discovered since Siebold's former researches on this moth, his conclusion is by no means invalidated, for the males are excessively rare. They were first discovered by Claus, of Marburg, who has indicated characters by which future observers may distinguish the sex of the caterpillars. Out of many hundreds of broods reared by Siebold, taken in various places, ranging from the Baltic to the plains of Lombardy, only once did he obtain males. There appear to be thus broods which are entirely female, and broods which are of mixed sexes. The conditions under which the male sex makes its appearance are not yet ascertained. It is exceedingly desirable that those who may be fortunate enough to come across a mixed brood, should make experiments to ascertain if all the eggs which are fertilised produce males. The females of the purely female broods are completely developed in every respect, having perfect copulatory organs, and the egg is furnished with a micropyle; therefore, as Siebold maintains, they must not be called pseud-ova. It should be mentioned that the inquiries necessary to establish the identity of the species, and the distinctive characters with regard to these little moths, have occupied a great deal of our author's time and attention, and are here recorded. In regard both to Psyche and Solenobia examination with the microscope was employed to determine the absence of male elements from the *receptaculum seminis*; and we have moreover an account of the structure of the ovaries. In relation to this matter, Professor Siebold takes the opportunity of replying to some criticisms of his former work by M. Plateau, who appears to have made little of the arguments based on the proof thus obtained of virginity, without knowing the real extent and nature of Siebold's studies, having, in fact, only read of them in an imperfect abstract. It appears also that M. Plateau took "ein einziger Fundort" to mean "un naturaliste collecteur," an amusing mistake to which our attention is drawn in a note, p. 155. We may briefly mention here with regard to Solenobia, that it appears that *S. lichenella* is only the female brood of *S. pineti*, of which males and females regularly occur. No structural difference appears to exist between the two kinds of females, but the former, on escaping from the chrysalis-sac, at once proceed to lay eggs, which produce invariably females; whilst the latter wait for copulation, and if that be withheld, die, and dry up without laying their eggs. These insects offer most promising material for further researches on the conditions attending the differentiation of sex.

We now come to the sixth and last chapter, on "the Parthenogenetic Reproduction in Apus and allied Crustacea." Already, in 1856, Siebold had stated his supposition that *Apus cancriformis*, *Limnadia gigas*, and *Polyphemus oculus*, in which species no males had been observed, presented examples of true parthenogenesis, and were not to be regarded as bud-producing "nurses," in a so-called alternation of generations. Leuckart subsequently expressed the same opinion with regard to the reproduction, independent of males, observed in *Daphnia*, *Apus*, and *Limnadia*. Ever since that period Siebold has continually kept an eye upon Apus. In 1858 the males of Apus were discovered by Kozubowski, and Siebold received specimens from various localities. He thus learned to distinguish with perfect facility the two sexes, and was enabled now to convince himself that, as with the Lepidoptera above spoken of, so with Apus, broods occur which are entirely destitute of males, and go on reproducing parthenogenetically, whilst other broods occur in which both sexes are present. The number of Apus of two species—*Apus cancriformis* and *Apus productus*—examined by Siebold, amounts actually to some thousands. He received quantities taken from various ponds in middle Europe (Apus occurs in shallow pools which dry up during parts of the year, and it can be taken in immense quantity), and had the opportunity of studying one pond—that at Gossberg, near Munich, with minuteness, from the year 1864 to the year 1869 inclusive, besides casual examinations of the same pond in 1857 and 1858. Time after time, taking several hundreds of the Apus from the pond, he never found a single male amongst them. On one occasion he had the whole contents of the little pond removed with the greatest care, so as to feel sure that he had obtained every Apus present. He received on this occasion 5,796 specimens of Apus, *every one of which being carefully examined* proved to be female. At the same time 2,576 specimens of Branchipus were obtained from the pond, which were, as usual, of both sexes. In those cases where ponds afforded both males and females of Apus, it is remarkable that the proportion of the sexes was very variable. The highest proportion of males appears to be in a case recorded by Sir John Lubbock, who found thirty-three male and thirty-nine female *Apus productus* in a pond near Rouen, whilst among 193 specimens of *Apus cancriformis*, from a locality near Krakow, only one male occurred. What is most important about this variation in the proportion of males to females is that in two or three localities, furnishing mixed generations of Apus, from which he has received, year after year, numbers of specimens, Siebold has observed an apparent constantly-augmenting disproportion of males to females, and he is led to the supposition that in these cases the males will at last cease altogether, and thus a female generation be produced which will continue to reproduce itself parthenogenetically, as in the Gossberg and a great number of other ponds. This is, however, by no means proved; and we have no idea at present as to how the males may make their appearance again, or what are the conditions affecting their development and extinction. It occurred to Siebold that an objection might be urged against parthenogenesis in Apus, in that, although he examined consecutive generations and found them always female, he could not be sure that males had not been present before he took his specimens, and had not died and decomposed after having fertilised the females. To meet such an objection, he firstly made himself thoroughly acquainted with the male generative organs and the spermatozoa, and secondly with the ovaries and their development. He found the spermatozoa to be motionless like those of other Crustacea, and he never succeeded in detecting any of them in the female genitalia amongst the specimens belonging to supposed female generations. But he equally failed to find spermatozoa or a receptacle for them in the female genitalia of the specimens of mixed generations, and therefore no conclusion could be drawn from the observation. The structure and development of the ovum, however, made this observation decisive, since it was found that an egg-shell forms round the ovum in the uterus, and, in the absence of a micropyle, fertilisation, if it takes place at all, must be accomplished before this shell is hardened. A further proof of another kind was obtained by experiment. Having removed eggs from females, which certainly at the time contained no spermatozoa, Siebold placed them in a small tank, and from these obtained Apus-embryos. Others were reared to maturity from eggs taken in the pond.

The relative size of male and female is a question about which there is some interest; differences which have been observed seem to depend on this, that Apus continues growing as long as the pond in which it lives does not dry up, and hence the eggs which hatch soonest give the largest-sized progeny. In his tabular statements Siebold gives measurements of the specimens examined by him at different times from various localities.

A few words must be said here upon the very extraordinary history of the ovum of Apus made out by Siebold, the structures being identical, whether the female examined belonged to a parthenogenetic or digenetic brood. The essential female organs of reproduction in Apus may be roughly described as two large tubes placed on either side the alimentary canal, opening externally at the posterior end, and giving off towards the other end primary and secondary branches. On the ends of these short secondary branches are situated the egg follicles. Four cells appear in each egg follicle in a very early stage of its development, and one of these takes on more rapid growth—becoming the egg-cell—whilst the others disappear as deutoplasmogen or vitellogenous cells; the egg then acquires some size and a red colour, and has a visible germinal vesicle. But such eggs are much smaller than the eggs observable in the main stem of the ovarian tube, and this appears to be the very startling explanation. The eggs escape from their

follicles as a matter of course, and pass along the canal leading from it to a primary branch of the ovarian tube, and there two and sometimes three of these eggs *fuse into one mass*, around which a shell is secreted, and which thus forms the actual egg—really a threefold egg; and from such a wonderfully formed egg only one embryo develops. Unfortunately we are not told what becomes of the germinal vesicles; according to the drawings they seem to disappear at this stage. We know of the development in the tunicate *Pyrosoma* of five embryos from one egg, here we have the converse case of one embryo developing from three eggs. Siebold appears to have convinced himself that the fusion is a normal thing, and not due to any pressure or osmotic action taking place during the microscopical examination. The structure of the ovary of Apus is figured in a plate.

As to the other crustaceans named, which are *Artemia salina* and *Limnadia Hermanni*, the occurrence of parthenogenetic broods is inferred from the descriptions of other writers whose works are criticised at some length, and also from examination of specimens. It seems not impossible from an observation of Zenker that in *Artemia salina* parthenogenetic alternate with digenetic broods. In the beginning of the year 1851 this observer found three males among one hundred females, later in July the same pond furnished thousands of females, but not one male.

In conclusion, Prof. Siebold, whilst adopting Leuckart's term "Arrenotoky," to designate the phenomenon of the parthenogenetic production of male offspring, as seen in the Hymenoptera, proposes the parallel term, "Thelytoky," for the pathenogenetic production of female offspring as demonstrated now conclusively in some Lepidoptera and Crustacea. It seems to us that a third term should also be available for the case of mixed offspring (that is of two sexes) such as "Amphotoky;" and the terms need not be limited to parthenogenetic cases. In his concluding remarks, whilst repeating the expression of his conviction that parthenogenesis will be found more and more to be of frequent and fixed occurrence in various classes of animals, Siebold alludes with caution to the list of cases in which parthenogenesis is stated to occur, given by Gerstaecker in Bronn's "Classen und Ordnungen des Thierreichs." Gerstaecker rightly enough distinguishes cases in which parthenogenesis has been observed as an accidental and rare exception, and those in which it has a definitely recurring place. Siebold considers (and after the great pains he has himself expended on the cases recorded in this book, he is fully warranted in so doing) that many of the examples put forward by Gerstaecker require a more careful testing, and he offers some remarks on parthenogenesis in the gall-flies, and in the silkworm moth. Finally, he alludes to cases among Vertebrates in which indications of a power of development in the egg, independent of the male element, have been observed. The most remarkable of these is that quoted by Leuckart in his work already cited, which Siebold omits here, but has done justice to in the short supplementary paper read at the Munich Academy since the publication of this book. In 1844 Prof. Bischoff found ova in the uterus of an unimpregnated sow, which exhibited segmentation of the yelk, some into two and four, and others into sixteen and twenty divisions. Other cases here given are as follows:—In the oviduct of a three-year-old rabbit, thoroughly separated pathologically from the uterus, Prof. v. Hensen of Kiel found ova in various stages of yelk-division, and some of their cells had even advanced into a branched condition. Dr. Oellacher of Innsbruck has observed stages of yelk-division in unfertilised hen's eggs. In fishes, in 1859, Agassiz observed yelk-division occurring in the eggs of Gadidæ, whilst yet in the ovary, and considered it to be due to impregnation, even stating that he had seen certain fishes place themselves in such a position as to favour this supposed intra-ovarian fertilisation. Burnett has since investigated the case, and concludes that the yelk-division is independent of fertilisation, a supposition which is rendered in every way probable from other researches on the fish egg; but, curiously enough, Dr. Burnett thinks these eggs should be regarded as "germs," and not as "true eggs," an opinion to which Siebold, of course, is completely opposed, and which, in invertebrate cases, has been shown to be untenable.

Siebold does not allude to those cases of ovarian cysts found occasionally in the unfertilised human female, and containing hair and teeth—a phenomenon which we should be glad to see further discussed and investigated, since, as far as we can remember, the origin of the contents of such cysts from irregularly developing ova is probable. The eel is suggested as a possible parthenogenetic vertebrate. It is a very strange fact that we are still ignorant of the ripe eggs and embryos as well as of the males of the eel, even as in the time of Aristotle. With the following words of that greatest naturalist, addressing them to those who still refuse to accept the existence of Parthenogenesis, Siebold ends his book:—"More belief must be given to observation than to theory, and this last is only worthy of belief when leading to the same result as experience."

E. RAY LANKESTER

ON SOME NEW POINTS IN THE MOUNTING OF ASTRONOMICAL TELESCOPES *

THE very great inconvenience attendant upon the use of the ordinary position circle of a micrometer divided on a metallic limb, and the necessity of having small lamps hung on to the micrometer for producing that very useful character of illumination of the wires known as the "dark field," has induced me to introduce some modifications in this (to the observer at least) very important part of an equatorial instrument.

These modifications have already been applied with success, and for the first time (as far as I am aware) to a 7-inch refracting telescope now in course of erection at the Observatory of the Royal Artillery Institute, Woolwich; and I have (in consequence of this success) been ordered to adapt them to the Great Equatorials now in course of construction for the Royal Observatory, Edinburgh, and the Observatory of the Lord Lindsay, Aberdeen.†

The rack and pinion tube carrying the eye piece or micrometer revolves freely in the casting which forms the lower end of the telescope tube, and carries a brass plate (all cast in one piece), on which is cemented a flat ring of plate glass, muffed on back, and in front varnished with an opaque varnish. Through this varnish the divisions are cut, so that on being illuminated from behind, the divisions appear bright upon a black ground. The vernier is similarly treated, and the whole of this circle, being covered with a cap, with a glazed window only sufficiently large to expose the vernier and about 15° of the circle, is protected from possible injury and is read most conveniently through this window, being illuminated by a beam of light constantly directed upon it from a lamp hanging on end of the declination axis, as will be afterwards explained.

Between the fixed casting which forms the end of the telescope tube and that which revolves in it is another metallic circle cut into 360 teeth on edge, and with 90 holes drilled accurately on face: into the teeth on edge is geared a screw which is mounted on fixed casting, one revolution of which is of course equal to an angular movement of 1°.

In the other (outer) moveable brass circle is mounted a steel pin working up and down in a small cylinder; this pin, being pressed down by a small spiral spring, enters into one or other of the 90 holes in the intermediate circle, and thus clamps the whole eye-end to the intermediate circle, in which condition a slow motion is obtained by the endless screw. When it is desired to move the eye-end through a large angle, the rack and pinion tube is grasped by the hand, and in doing so the hand almost necessarily grasps also a small steel trigger which lifts the steel pin out of the hole, frees the moveable circle, and allows it to be placed in any angular position. When the desired position is approximated, and the trigger relieved, the pin drops into the nearest hole, and the endless screw is then used for final setting.

The diagram will I think explain the various matters of illumination.‡

From a lamp hanging upon the end of the declination axis is sent a beam of slightly divergent light through this axis, which is hollow; this slightly divergent beam is utilised for six different purposes, three portions of it being reflected out in different directions to illuminate portions of the declination circle, of which one is for a long reader for setting from eye-end, and the other two for micrometer microscopes subdividing the 10′ division of circle into single 1″ arc.

None of these are shown in diagram, but the other three purposes for which the light is utilised, viz., for position circle,

* Paper read before the British Association at Brighton in Section A, Aug. 20, by Howard Grubb, C.E., F.R.A.S.

† The breech-piece and position circle of the Woolwich Equatorial were here produced.

‡ The original diagram showed all three illuminations, and of different colours. Here it has been thought better to show the dark field by itself, and the bright field and position circle illuminations in a separate diagram.

bright field illumination, and dark field illumination of micrometer, are shown.

The position circle illumination is very simple (see Fig. 1), a single reflector R, attached to the inside of the tube directs a constant beam of light on the back of the glass circle at P.

The bright field illumination is effected by a very small central reflector, R′, which sends the light directly into the field of the micrometer.

This method is, I believe, now generally considered to give the best results, and has, as far as I am aware, but one disadvantage, viz., that the arm which supports the small mirror produces a little diffraction, and consequently deterioration of definition.

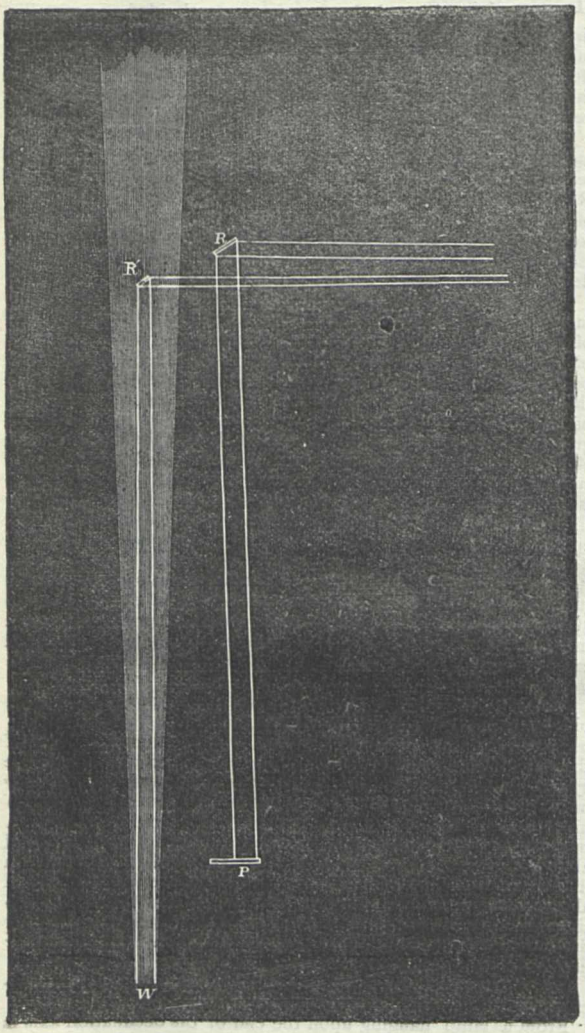

FIG. 1

This objection I have in some measure reduced by making the arm and mirror removeable at pleasure by pulling or releasing a string, so that while actually observing, it can be removed and replaced instantaneously.

In devising the dark field illumination, I started on the hypothesis that there were two essential points to keep in view, viz., that the lines should be illuminated on both sides (not one), and that the angle at which the light should be thrown upon the wires should be very great, so that the blackness of the field as seen through the eye-piece should not be injured.

I found that the best result is obtained by placing four prisms of total reflection round the field of the micrometer, just behind the wires, and of such an angle that the light thrown upon them should be reflected upon the wires at an angle such as is shown in the diagram Fig. 2, where W is the position of the wires in the focus of the objective.

In order that this scheme of illumination should be carried out effectually from the light of a single lamp hanging on the declination axis, it is necessary that a certain annular portion of the micrometer which embraces these prisms should be constantly illuminated from this lamp, and this is effected in the following way: a portion of the slightly divergent beam of light, shown in Fig. 2, proceeding from the lamp on the declination axis, is passed through a very low power convex lens, *l*, which renders the beam slightly convergent.

This is not necessary, but a mere matter of convenience, as it reduces the necessary size of the reflector and lens afterwards required. The light is now taken up by a reflector, R, within the tube, and directed towards the eye-end at such an angle that it crosses the axis of the telescope just at the inner end of the eye-piece tubes, X; hence it is passed through a piece of glass of a peculiar shape, P P, which I call, for want of a better name, an annular prism lens. This piece of glass has a hole cut in it large enough to admit the whole pencil of light from the object glass.

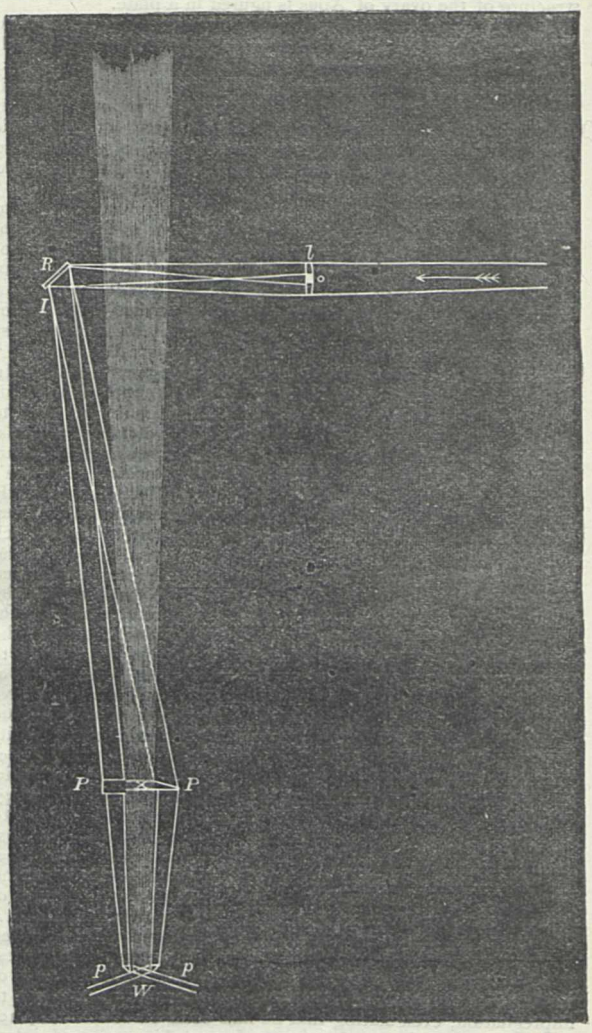

FIG. 2

The use of this annular prism lens is twofold:—

1st. It has to alter the direction of the beam of light before diagonally thrown across the tube, RX, to that parallel to the axis of the telescope; and

2nd. It is necessary that it should have a slightly converging effect to reduce the size of the illuminated circle it produces.

This arrangement so far performs perfectly in all but one particular. It throws a strong beam of light constantly upon the four prisms *p p*, and illuminates the lines well; but although no direct light can enter into the field from the mirror placed so far out of the cone of rays from the objective, still the light thrown against the side of the eye-piece tube is sufficient to completely destroy the effect of this illumination. The difficulty, however, has been completely removed in this way :—

I should first mention that the eye-piece or micrometer tube is made double, an outer parallel tube and an inner taper one, and it is between these two that it is required that the light should be brought to the four prisms or micrometers, any light shining into the inner tube doing mischief by injuring the blackness of the field.

On the lens used to give a slight convergence to the light is placed a circular opaque disc, O, of a certain size easily ascertained. A lens, I, of a suitable focus being then placed near the reflector, an image is formed of that opaque disc just over the eye-piece tube at X, and of such a size, when properly adjusted, that no light can possibly enter the inner tube.

Thus, while not a single ray of light can by any possibility enter the inner tube, a flood of light is sent down between the inner and outer tubes, and directed upon the four prisms in whatever angular position they may be.

It only remains to say that both the intensity and colour of the light for both characters of the illumination are under complete control of the observer while actually observing.

One other matter is perhaps worthy of note.

The want of a convenient method of mapping nebulæ or faint stars by a reticulated diaphragm of bright lines in the field of view has long been felt, and the various methods of using diamond scratches on glass or illuminated lines are subject to objection, and troublesome to manage. A simple method of using an image of such a diaphragm instead of the actual diaphragm itself here suggests itself.

Referring to the portion of the rays used for bright field illumination, and shown in Fig. 1, suppose the small diagonal mirror, R', to be replaced by an equally small prism having such a convex power that it forms an image of any object at the end of the declination axis exactly in the same plane as the image formed by the objective—then any kind of reticulated diaphragm of bright lines on dark ground can be placed on the end of the declination axis which would have a suitably prepared carrier for them, and their image would be seen in the field of the telescope of any colour and any intensity desired.

SCIENTIFIC SERIALS

THE *Scottish Naturalist* for July is rich in articles of interest, mostly brief, and chiefly relating to Entomology and Ornithology. Many deserve notice, but we have been especially interested in one on the nest of *Formica rufa* and its inhabitants by the editor, Dr. Buchanan White.

IN the *Journal of Botany* for August, Dr. Trimen describes and draws the genuine *Ranunculus cherophyllos* Linn. which has been detected in Jersey, but was not heretofore known as a native of Britain. Dr. Hance describes a new species of Iris, *I. tomiolopha*. The Rev. J. M. Crombie contributes some notes on the Lichens in Sowerby's Herbarium.—In the September number, Dr. Hance describes another new species belonging to the Bignoniaceæ, *Spathodea cauda-felina*. Mr. T. R. A. Briggs contributes Notes respecting some Plymouth plants, and Dr. A. Ernst Notes on a small collection of Alpine plants from the summit of Naiguta in the mountains of Caracas.—The first article in the October number is Mr. Hayne's paper, read at the Brighton meeting of the British Association on the Flora of Moab. Mr. J. G. Baker, who has paid great attention to the Liliaceæ, has a monograph of the two genera *Dasylirion* and *Beaucarnea*. Another British Association paper, Mr. Hemsley's Summary Analysis of the Phanerogamic and Fern Flora of Sussex, is reprinted. The Rev. E. O'Meara contributes a continuation of his recent researches in the Diatomaceæ; and the Rev. J. M. Crombie, a description of a new erratic British *Parmelia*. Mr. Leo Grindon forwards a suggestive paper on the non-occurrence near Manchester of certain common British plants.

THE last part of the *Proceedings of the Swedish Academy of Sciences* for 1871 (Öfversigt af Kongl. Veterskaps-Akademiens Förhandlingar, Arg. 28, No. 7), opens with a notice by Prof. Lilljeborg of the occurrence of a South European species of Bleak (*Leucaspius delineatus*, Heckel) at Landskrona in Scania.—The same author has also a notice of the occurrence of *Limnadia gigas* (Hermann) in Sweden, which will prove of considerable interest to the student of Crustacea, as in it he gives a very detailed description, illustrated with good figures, of the structure of this curious species, and also gives a list of the other species of Phyllopoda, six in number, which inhabit Scandinavia. Prof. Lilljeborg is inclined to identify this species with the *Monoculus lenticularis* of Linnæus.—Prof. Nordenskiöld publishes a short paper, containing a table, on the fixed and variable atomic volumes of simple bodies.—The Swedish expedition to Greenland of the year 1870 originates two papers, namely, a valuable essay on the Phanerogamic flora of Disco Bay and Auleitsivik Fjord by Prof. S. Berggren; and a series of calculations of geographical positions worked out by M. E. Jäderin.—M. L. K. Daa discusses the origin and meaning of the name of Grumant applied by the Russians to Spitzbergen, and cited as an evidence of the independent discovery of that inhospitable land by the Russians; M. Daa states that Spitzbergen was named East Greenland by its earliest English and Dutch visitants, and he maintains that "Grumant" is merely a corruption of "Grönland."—Mr. H. D. J. Wallengren publishes a Contribution to the knowledge of the Lepidopterous fauna of the island of St. Bartholomew in the West Indies. He gives a list of 34 species belonging to various families from the Rhopalocera to the Crambidæ, with remarks on their characters and distribution. Three species are described as new, namely, *Graphiphora bartholemica*, *Micra Stâlii*, and *Palthis Walkeri*.—M. L. J. Igelström notices the discovery of sandstone *in situ* in the Gefleborg district.

SOCIETIES AND ACADEMIES

PHILADELPHIA

Academy of Natural Sciences, April 9.—Prof. Leidy directed attention to some fossils upon which he made the following observations :—Several teeth and jaw fragments from the Loup Fork of the Niobrara River, Nebraska, obtained by Prof. Hayden, appear to indicate a large species of Felis, not previously described. The most characteristic specimen consists of an upper sectorial molar about as large as that of the Bengal tiger, and consequently much too large for either of the largest American cats, the panther and the jaguar. It is as much too small to have pertained to the American lion, *Felis atrox*, for its breadth is but slightly greater than that contained in the lower jaw, from which the latter was described. Breadth of the crown of the tooth is 15½ lines; its thickness in front 8 lines. The measurements in the corresponding teeth of a Bengal tiger are, 16 lines in breadth, and 7½ lines in thickness in front. The form of the fossil tooth is the same as in the other feline species. The extinct species may be named *Felis augustus*. A distal extremity of a humerus, from the Niobrara River, about the size and construction of the corresponding part in the Bengal tiger, may belong to this species. Another fossil, consisting of a detached body of a vertebra, apparently indicates an extinct reptile allied to *Plesiosaurus* and *Discosaurus*. The specimen, recently received from Prof. Hayden, was obtained in 1870, on Henry's Fork of Green River, Wyoming. It is free from attached matrix, and was the only specimen pertaining to the animal which was found. It probably belonged to a formation of earlier date than that of the same locality, which has yielded other fossils previousiy described. The vertebra is from the base of the tail, and is much shorter in relation to its other dimensions than in *Plesiosaurus* or *Discosaurus*. The extremities are concave, and encircled near the margin of the articular surfaces with a narrow groove. Posteriorly there are two larger articular facets, as widely separated as the bone would permit, for the junction of a chevron. Anteriorly there are no marks of chevron attachment. The roots of strong transverse processes or diapophyses project from the sides of the body just above the middle. The neural arch was completely co-ossified with the body, leaving no trace of its earlier separation. The breadth of the body is 23 lines, its depth 19 lines, and its length 1 inch. Viewing the specimen as probably representing a genus different from those mentioned, I propose to name it with the species as *Oligosimus grandævus*. Another fossil is a remarkable specimen, obtained by Prof. Hayden in the "Black Foot Country" at the head of the Missouri River. It looks as if it had formed part of the dermal armour of some huge saurian or perhaps of an armadillo-like animal. It is imperfect, and looks as if it were half broken away. In its present state it is hemiovoid, about two inches in diameter, concave below and convex above, where it is

covered by about fifteen large mammillary bosses. Accompanying this specimen there is a distal phalanx, which may belong to the same animal. It is rather less than two inches long. The articular surface is transversely elliptical, 1¼ inch wide, and 11 lines deep, and feebly depressed, so as to indicate a moderate degree of mobility. The upper surface of the bone slopes to the end, and is transversely convex. The extremity is expanded at the borders. Beneath are several vascular perforations. Though the specimens are not sufficiently characteristic to determine positively whether they belong to a mammal or a reptile, or whether they even belong together to the same animal, the former one is so peculiar that I am disposed to regard it as representing a genus and species, which may be named *Tylosteus ornatus*.—Mr. Cope made the following remarks on a curious habit of a snake:—"I had for some time a specimen of *Cyclophis æstivus*, received from Fort Macon, N. Ca., through the kindness of Dr. Yarrow, living in a wardian case. The slender form of this snake, and its beautiful green and yellow colours, have led to the opinion that it is of arboreal or bush-loving habits. It never exhibited such in confinement, and instead of climbing over the caladia, ferns, &c., lived mostly underground. It had a curious habit of projecting its head and two or three inches of its body above the ground, and holding them for hours rigidly in a fixed attitude." In this position it resembled very closely a sprout or shoot of some green succulent plant, and might readily be mistaken for such by small animals.

PARIS

Academy of Sciences, October 7.—M. Faye, President. M. A. Trécul read a paper entitled "Observations on the various parts of the Flower of *Campanulaceæ*," and his long paper was followed by an account of some "new experiments intended to show that the germs of the ferment which produces wine come from the exterior of the skin of the grape," by M. Pasteur. The author prepared forty flasks with long necks, which were twisted and bent in the now so well known fashion first used by this chemist. Ten flasks were partly filled with grape-juice, and allowed to rest; ten others, also containing juice, had introduced into them a few drops of water, in which a small piece of grape-skin had been washed; the next ten had juice and water from the skin like the last, but were boiled; and the last ten contained juice and a few drops of the interior of a grape carefully extracted by means of a glass tube, without bruising the skin. The series containing the unboiled juice and grape-skin washings were soon full of mycelium and beer-yeast, and a few days after of *Mycoderma vini*, within forty-eight hours of the appearance of which they were in a state of violent fermentation. None other of the flasks were changed in the slightest degree, even after days; and the author states that they will remain unchanged for years. M. Fremy replied to this in a note on ferments, in which he states that M. Pasteur confounds ferments with the spores of mould. M. Fremy believes the ferment to be generated in the fermentable liquor, and that fermentation can also be started by mould spores by a secondary action, hence he considers that M. Pasteur has only proved that this latter kind of fermentation is produced by the grape-skin. M. Pasteur replied that he only intended to prove that the juice of the grape is not of itself alone capable of fermenting, and that neither the albuminous matters of the juice nor the parenchyma cells are developed into ferment cells by the action of atmospheric oxygen alone. At the request of M. Dumas, M. Pasteur then read an account of some "new facts serving to elucidate the theory of true fermentation." M. Fremy again criticised the paper, and after a reply from M. Pasteur, the subject dropped. M. A. Trécul then read a note confirming several of M. Pasteur's observations, and was followed by M. Faye with a note on a memoir of Mr. Clerk-Maxwell, "On the stability of the Saturnian Rings."—A note from M. Otto Struve, "On the exactness which should be attributed to the constant Co-efficient of Aberration determined at the Pulkowa Observatory," was then read, and next came "Researches on Crystalline Dissociation" (continuation), by MM. P. A. Favre and C. A. Valson. This paper, containing a great number of numerical results, was followed by "Studies on the Echinodermata," by M. S. Lovén, and by a paper on the structure of heterogeneous vegetables, by M. Th. Lestiboudois.—M. de Caligny then read a note on the effects of the communication of a lateral movement to a stream of water traversing a reservoir, and on the sand-banks which thence result. This was an account of some experiments made by the author. He finds that banks are deposited almost parallel to the stream.—M. Chevreul then read a note relating to a work on colour, by M. P. Havrez, which he presented to the Academy; and M. Dumas presented a pamphlet by M. de Jacobi, entitled "On the galvanic deposition of iron by a powerful electro-magnetic solenoid." The author hoped by these means to deposit permanently magnetic iron, but failed; the deposit, however, was composed of agglomerations of crystals, whilst iron deposited in the ordinary way is smooth and amorphous.—M. J. M. Gaugain then presented his second memoir on the induction currents produced in M. Gramme's machine, which was referred to the Physical Section.—A note on the efficacy of lightning conductors, by M. W. de Fonvielle, was sent to the commission on that subject. A note from M. Laborde, on auroræ, storms, and waterspouts, was sent to the Physical Section, and the Aerostatic Commission received memoirs from M. Reynal and M. Babé and a letter from M. Braconnier, all on aërial navigation.—A note from Raoult de Couesquelon on a "New System of Masked Batteries" was sent to the Commission on Military Art, and two notes from M. Duclaux, two from M. Cornu, and an article from the Journal *La Gironde* by M. Laliman, all on *Phylloxera*, were sent to that Commission.—M. de Saint-Venant then presented a note from M. J. Boussinesq on "Lines of Summit (*faîte*) and Thalweg," which was followed by a note from M. Béchamp "On the action of borax on fermentation." The author demonstrates that the boric acid of the borax is not the cause of the peculiar action of this body, as that acid does not produce the effects of borax. Hydric sodic carbonate, however, acts in a strictly analogous way; hence the author decides that it is the sodium present in the borax which determines its action.—A note from M. E. Monier "On the determination of the amount of vegetable matters in contaminated potable waters" then followed. The author uses a method now abandoned by all the best analysts of water in this country, namely, titration with potassic permanganate.—M. E. Gouriet then read a paper "On certain exterior characters which distinguish the different sexes of the River Craw-fish (*Astacus fluviatilis*)." The author finds the following differences:—If the length of the animal be taken as 100, then the antennæ in the male are 67·83, and in the female 57·18. The weight of the animal being 100, the great claws are in the male 27·81, in the female 12·92; moreover, the female abdomen is much more developed than that of the male.—A note from M. Brown "On the relations between electricity and mephitic emanations" closed the session.

BOOKS RECEIVED.

ENGLISH.—The Clematis as a Garden Flower: T. Moore and G. Jackman (Murray).—The Travelling Birds: Cuthbert Collingwood (C. Bean).—Synopses: Physical Geography, Geology, Mineralogy, and Palæontology, D. Page (Blackwoods).—Revised List of Vertebrate Animals in the Gardens of the Zoological Society.

FOREIGN.—Grundriss der Chemie gemäss der neueren Ansichten: der unorganischen Chemie dritte Auflage: C. Rammelsberg.—Incendio Vesuviano del 26 Aprilo, 1872: L. Palmieri.—Der Ausbruch des Vesuv vom April 26, 1872: L. Palmieri.—Vereins für Erdkunde zu Dresden, Nos. 8 and 9.

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