THURSDAY, AUGUST 16, 1883

RECENT TRAVEL IN EASTERN ASIA

The Golden Chersonese. By Isabella L. Bird. (London: John Murray, 1883.)

Across Chrysê; being the Narrative of a Journey of Exploration through the South China Border Lands from Canton to Mandalay. By Archibald R. Colquhoun. Two Vols. (London: Sampson Low, 1883.)

Among the Mongols. By the Rev. James Gilmour. (London: Religious Tract Society, 1883.)

Eight Years in Japan, 1873–1881. Work, Travel, and Recreation. By E. G. Holtham, M.Inst.C.E. (London: Kegan Paul, Trench, and Co., 1883.)

WHEN Miss Bird last took leave of her readers, steaming away from the coasts of Japan, her labours and wanderings were by no means over. In this volume she takes up the thread of her narrative exactly where she dropped it in her last book, and we find ourselves with her again just where we parted before, and pay visits first to Hong Kong and then to Canton before starting for the newer ground. If this volume at all falls short in the interest and, we may say, importance of the last, it is owing alone to the Malayan peninsula falling so far short of Japan in both its interesting ancient and marvellous modern history. It is as fresh ground as Japan: for of the eastern half of the peninsula nothing is known but the coast line. Yet commerce promises to open it up; for the export and import trade of the Straits Settlements amounted together in 1880 to £32,353,000. Ironstone, containing 60 per cent. of metal, is said to be used for macadamising the roads at Singapore; and the vastest tin fields in the world are found in the western Malay States.

Miss Bird sailed from a leaden stormy sky on the Pacific into the sunny harbour of Hong Kong to find the town on fire, an incident giving early employment to her graphic pen. Her remarks that, whenever the rocks are quarried there, fever breaks out, is one on which further observations would be valuable. Miss Bird reports also that the Hong Kong hospital doctors have drugs which throw patients into a profound sleep, during which the most severe operations can be painlessly performed, and from which the patients awake without even a headache.

From Hong Kong she makes an excursion to Canton, where her "admiration and amazement never cease." We must remark that the simple exercise of the faculty of seeing seems to give an unusually intense pleasure to Miss Bird. Further on she describes the rough life she led as "very enchanting," even where she owns that the redundancy of insect and reptile life certainly was oppressive! The river population, though looked down upon by the land-dwellers, seem as usual to have been sharpened and improved by the struggle for existence; at any rate Miss Bird seems to prefer their women. Miss Bird stops in the neighbourhood of a Cochin Chinese village where river boats are more crowded than at Canton. Among other low characteristics of the "hideous" inhabitants she notes a wide separation of the great toe from the rest.

In the seas about Singapore there is "nothing scanty, feeble, or pale," while on land she finds a perpetual struggle between man and the jungle, and a power of vegetation which must be a source of wealth to the former when he has numbers and energy to control it. The average temperature there is 80° F., with no greater range in any part than 24°: moist and uniform. This moisture adds greatly to the oppressiveness of the heat—nowhere else did Miss Bird feel it so overpowering as in a canoe on a river at night—but our traveller is one who can feel mere living to be a luxury with the thermometer at 88°, and her powers of endurance are shown by the early collapse of one of the only two companions she made in any part of her journey, although the daughter of the Resident at Malacca. This town is now out of the line of traffic, and Miss Bird describes in equal wealth of words its monotonous silence and sleepiness, and the impression and fascination it produced upon her. It is only 2° north of the equator, and the journeyings which commence from here are in small territories on the west coast of the Malayan peninsula, only 3° further north.

The jungle there is not an entanglement of profuse and matted scrub but a noble forest of majestic trees, many of them supported at their roots by three buttresses, behind which thirty men could find shelter. On many of the top branches of these other trees have taken root from seeds deposited by birds, and have attained considerable size. Under these giants stand the lesser trees grouped in glorious confusion. A long list of such is given, all of which are bound together by the rattan with its tough strands from 100 to 1200 feet in length. An enthusiastic description of magnificent tropical flowers follows here; but elsewhere she reconciles her description with the different one which Mr. Wallace gives by remarking that "a traveller through a tropical jungle may see very few flowers, and be inclined to disparage it. It is necessary to go on adjacent rising ground and look down where trees and trailers are exhibiting their gorgeousness," "where indeed one has to look for most of the flowers." The silence and colourlessness of the heart of the forest, she tells us, and the colour, light, vivacity, and movement among the tree tops contrast most curiously. Even with the latter our masses of flowers, buttercups and daisies, gorse or heather, are compared favourably among very few things of home which are compared favourably with what she finds abroad.

Of the mangrove she notes that the seeds germinate while still attached to the branch—a long root pierces the covering and grows rapidly downwards from the heavy end of the fruit—which arrangement secures that when the fruit falls off the root shall become at once embedded in the mud; of the cocoanut palm, that in loose sandy soil near the salt water it needs neither manure nor care of any kind, but if planted more than two hundred yards from the sea it requires manure or human habitation, and that its fruit takes fourteen months from the appearance of the blossom till the ripe fruit falls; of the nutmeg that it grows like a nectarine on a tree forty or fifty feet high, with shining foliage. A ripe one open revealed the nutmeg, with its dark brown shell showing through its crimson reticulated envelope of mace, the whole lying in a bed of pure white, a beautiful object.

"The sensitive plant with its tripartite leaves, green

above and brown below, is a fascinating plant, and at first one feels guilty of cruelty if one wounds its sensibilities. Touch any part of a leaf ever so lightly, and as quick as thought it rolls up. Touch the centre leaf of the three ever so lightly, and leaf and stalk fall smitten. Touch a branch and every leaf closes, and every stalk falls as if weighted with lead. Walk over it and you seem to have blasted the earth with a fiery tread, leaving desolation behind. Every trailing plant falls—the leaves closing show only their red-brown backs, and all the beauty has vanished; but the burned and withered-looking earth is as fair as ever the next morning."

It is satisfactory to read that the elephant, so near extermination in Africa through the pursuit of the ivory trade, is still plentiful in these forest-covered interiors, though novelty seemed its only recommendation to Miss Bird as a beast of burden. Half a ton is considered a sufficient load for one if it be of metal, but if more bulky, from four to six hundredweight. In passing through the forest an elephant always puts his foot into the hole that another elephant's foot has made. They have the greatest horror of anything that looks like a fence; and a slight one made of reeds usually keeps them out of padi, cane, and maize plantations. The insect which can draw blood from the wrinkled hide of an elephant is curiously small. The boiled or stewed trunk of the latter, we are told, tastes much like beef.

A most tender account is given of the living and dying of a tame monkey, which Miss Bird believes to be an "agile gibbon—a creature so delicate that it has never yet survived a voyage to England"; and curiously human are the differences in disposition between different species of monkeys which she observes. When tamed by living with Europeans these apes acquire a great aversion to Malays.

Some small bright-eyed lizards which ran about her room went up the walls in search of flies. They dart upon the fly with very great speed, but just as you think they are about to swallow him, they pause for a second or two and then make the spring. "I have never seen a fly escape during this pause, which looks as if the lizard charmed or petrified his victim." The Malays have a proverb based upon this fact: "Even the lizard gives the fly time to pray." One evening Miss Bird found seventeen lizards in her room and two in her slippers!

A snake about 8 feet long has gained its name of a "two-headed snake" because after the proper head is dead the tail will stand up and move forwards.

An interesting account is given of a column of ants, officered by larger ones, making their way to the stump of a tree from which the outer layer of bark had been removed, leaving an under layer apparently permeated with a rich sweet secretion, which a quantity of reddish ants of much larger size and with large mandibles were engaged in stripping off. The large pieces which they dropped were broken up and carried away by the smaller ants round the base. Other proceedings which she describes seemed inscrutable to Miss Bird.

Among the gorgeous butterflies, Miss Bird describes one with the upper part of its wings of jet black velvet, and the lower half of its body and the under side of its wings of peacock-blue velvet, spotted; another of the same "make" but with gold instead of blue; and a third with the upper part of the body and wings white with erise spots. All these measured full five inches across their expanded wings. In one opening of the forest only she counted thirty-seven varieties of these brilliant creatures, not in hundreds, but in thousands, mixed up with the blue and crimson dragon-flies, and iridescent flies all joyous in the sunshine. Many birds rival them in beauty of plumage, though some resemble less brilliant European species.

The Malays are fond of animal pets; their low voices and gentle supple movements never shock the timid sensitiveness of brutes. A bird called a mina articulated so plainly that Miss Bird did not know whether a bird or a Malay spoke. Monkeys gather cocoanuts to order for their masters.

The Malays have an elaborate civilisation, laws, and even a literature of their own. They are a decently clothed, comfortably housed, settled, agricultural people, skilful in some arts, especially the working of gold, and they are rigid monotheists. Their houses show good work in lattice and bamboo, carved doorways, and portières of red silk, pillows and cushions of gold embroidery laid over exquisitely fine matting on the floors. Yet Miss Bird says that with no visible reason they have been dwindling away for several generations, and if they were swept away to-morrow not a trace of them except their metal work would be found. But nothing impresses itself so often or so strongly upon Miss Bird as the energy, enterprise, and large emigration of the Chinese. Most of her remarks about them might be thought to apply to the English; and indeed, so far from wishing to correct such an impression, she asserts that "to say that the Chinese make as good emigrants as the British is barely to give them their due. They have equal stamina and are more industrious and thrifty." Though the old hatred of foreigners in their native country does not pass away from them, and Miss Bird heard them mutter the phrase of "foreign devils" as she passed along the streets of Canton, yet the Chinese who are born in the Straits glory in being British-born subjects, and despise the immigrant Chinese. The principal result of British rule seems likely to be, from Miss Bird's account, that the Chinaman, striving, thriving, and oblivious of everything but his own interests, will soon overspread the whole of the Far East. Singapore is to all appearance a Chinese town, with 86,766 Chinese against 1283 European residents.

We think no one can help enjoying this happy traveller's book; though few would be led to think they would enjoy the same journey as thoroughly as she describes doing. One adjective fairly describes all her descriptions of what she meets with—they are superlative!

Mr. Colquhoun's object in undertaking the journey which he records in these two portly volumes, was to find a trade route from Rangoon through Burmah and the Shan States into South-western China. His attention was attracted to this subject by a previous journey to Zimmé or Kiang-mai on the Me Ping, and he accordingly decided to devote his first leave of absence from his official duties in India to attacking his task from the Chinese side. Briefly, then, he went up the Si Kiang, or Canton River, from its mouth to Pêsê, near the borders of Yunnan, and travelled through the southern districts of this province, passing the great towns Kaihua, Linan, and Puerh to Ssumao, immediately on the border of the independent

Shan States, the real goal of his journey. Here, where the most interesting part of his work was to commence, and when he had overcome many obstacles, he found himself compelled to abandon his plan by the refusal of his interpreter to proceed into these strange regions. It is not difficult to understand the bitter disappointment with which he turned northwards, when only a few weeks' journey from Zimmé, and passing almost across Yunnan to Tali, he took the usual route of Gill, Margary, and others through Manwyne and Bhamo, and thence by the Irrawaddy to Mandalay and British Burmah. It is to be hoped, not less in the interests of geography than of commerce, that Mr. Colquhoun may shortly be able to undertake the journey again, aided by the great commercial bodies of England; for we are bound to say that he exhibited throughout the journey many of the highest and most valuable qualities that a traveller can exhibit among strange peoples—patience in overcoming obstacles, unfailing good temper, tact in dealing with officials and with his own followers; and at the same time energy, industry, and skill in making and recording scientific observations. These volumes appear to have been written from day to day as the journey progressed, and this accounts for much repetition, and for an absence of arrangement which is none the less occasionally irritating. But how are we to account for the presence of illustrations in this important and scientific work of such hackneyed subjects as "Chinese Children," "Modes of Dressing the Hair," "Boats at Futshan," &c., such as may be found in any popular volume published on China during the last fifty years? They swell the size of the book, without in any degree adding to its interest or value. In fact, there was ample room for judicious pruning, and a single moderate-sized volume would have been sufficient to contain a full record of the journey, including the excellent maps, and the amusing sketches of the aboriginal tribes of Southern Yunnan. But we must not look our gift-horse too much in the mouth; and the faults to which we have adverted do not prevent Mr. Colquhoun's journey from being one of the most valuable contributions to our knowledge of the geography of China and its southern border-lands that we have had since Lagrée's adventurous journey up the Meikong and through Yunnan to the Yang-tsze about ten years ago. He appears to have settled the hydrography of many of the numerous rivers that flow from Yunnan through the Indo-Chinese peninsula, and his accounts of the various tribes inhabiting the southern borders of that province add much to ethnological knowledge. One fact, of great importance at the present time, which Mr. Colquhoun places beyond doubt is that the Songkoi River, which flows through Tonkin, and which the French regard as the future trade-route into South-western China, can never be used for that purpose with success. Its highest navigable point is cut off from the province by a range of lofty mountains, and when these are crossed, the district reached is a barren one. The real wealth of these regions appears to lie farther to the westward, about Puerh, Ssumao, and in the Independent Shan States, where the traveller found a busy and thriving trade. In the new journey which Mr. Colquhoun is about to undertake with more funds, and with other advantages which he did not possess last year, we are sure he will meet with the success which unfortunate circumstances then snatched from him at the last moment.

Mr. Gilmour's volume is one of the most charming books about a strange people that we have read for many a day. There is much deficiency in the matter of dates, but we gather that he commenced his missionary labours in Mongolia about 1870, and that he is still connected with the Peking mission. He lived amongst this nomad people as one of themselves. He learned the language in a manner that would have approved itself to the late Prof. Palmer, and then he travelled over the vast tract of country lying between the great wall of China on the south and the Amour on the north, sometimes joining caravans, sometimes alone, now staying in Mongol tents, now pitching his own tent on the confines of an encampment, from which the people came out to visit and hear him, or to get from him foreign medicines, which they expected to work extraordinary cures. In addition Mr. Gilmour has lived in towns such as Kalgan, on the southern frontier of Mongolia, Urga and Kiachta, and appears even to have once gone as far as Irkutsk. As a result he knows the Mongols from the inside; he has penetrated into their superstitions, their religion and habits of life, and he therefore is never compelled to hammer out a little substance to cover a large space. Indeed his wealth of material would in some hands have easily been extended to two portly volumes. Of geographical information there is very little, except an account of a journey across Mongolia from Kalgan to Kiachta, on the Siberian frontier; but the customs, religion, superstitions, &c., of the inhabitants of Mongolia are fully described, and the volume may thus be of much value to the ethnologist and student of comparative culture. It is in addition written in a simple and most amusing way.

The complaint that our books on Japan for the general reader are written by "globe-trotters" and travellers who have spent but a short time in the country is in a fair way of being removed. Mr. Holtham's is the second volume published during the past two years in which a resident on his return home has given the public the benefit of his experiences. Mr. Holtham was employed as an engineer on the Japanese railways. For the first two years survey work took him up country, but when the Japanese Government found they were exceeding their funds in various directions, the projected railways were abandoned for the time being, and Mr. Holtham was called in to administer one or other of the two small railways then in actual running order. One of these he extended slowly till it reached Kioto; the other he succeeded in relaying. The nature of the experiences of an engineer surveying for railways may be guessed with tolerable accuracy, but Mr. Holtham tells his story in a quaint and humorous fashion which, if a little strained now and again, is as a rule very taking. In addition to what may be called the professional section of the volume, there are also records of various journeys in the interior, but none of these are on unbeaten tracks; and interspersed everywhere we find interesting and amusing comments on what was going on under the author's eye in society and politics in Japan. It may be commended especially to readers who desire, from whatever motive, to know the conditions under which the scientific and professional

man works under the Japanese Government. Many of these are exceedingly irritating, among them being the incompetence and presumption of native colleagues, who are fond of proceeding in what Mr. Holtham styles "the rough and ready heaven-born-genius-and-see-it-with-half-an-eye kind of way" in cases where his old-fashioned education led him to seek first carefully for facts. The author passes over unpleasantnesses such as these in a very kindly way, but there can, we believe, be no question that many most important elements of the true scientific spirit are sadly lacking in young Japan. Energy, thirst for knowledge, and ingenuity exist in abundance, but we are not so assured of the patience, and caution in research, and respect for the opinions of older and more experienced heads, which are also necessary. Hence, doubtless, we find so many promising schemes come to nought. It is more satisfactory to find that, in Mr. Holtham's opinion, the students who have been so carefully trained under excellent foreign teachers in the Imperial College of Engineering give great promise of subsequent practical usefulness. The foreign staff of the Japanese Railway Department has now been almost wholly replaced by natives, and it will be very interesting to watch the Japanese walking alone. A few years will show how far they were justified in getting rid of the men to whom they owe their substantial public works. However this may be, we can cordially recommend "Eight Years in Japan" as a very interesting and amusing book.

ELEMENTARY APPLIED MECHANICS

Elementary Applied Mechanics. Part II. By Thos. Alexander, C.E., and Arthur Watson Thomson, C.E., B.Sc. (London: Macmillan and Co., 1883.)

IN this volume the authors have pursued the same course as that followed by Prof. Alexander in the first volume of his "Elementary Applied Mechanics," in giving an abundant commentary, illustrated by a large number of practical examples, of those parts of Rankine's "Applied Mechanics" which deal with transverse stresses and the shearing forces and bending moments on beams and cantilevers.

They have thus supplied a want which has long been felt both by teachers and students of a text-book which should treat applied mechanics in a way similar to that pursued in mathematical works.

The work before us is accurate and clearly written, and the explanations given are so full that it may be easily understood by any one whose mental powers are not so hopelessly deficient that he would be liable to incur responsibility for culpable homicide if he were to undertake to design or construct a bridge, or any sort of structure in which defects might be attended with risk to human life.

Thoroughly penetrated with the scientific spirit of Rankine's work, though happily with a more perfect acquaintance with the limits of average human intelligence, the authors have given at length the proofs of the formulæ belonging to this part of applied mechanics, and they have also examined carefully the various cases which occur owing to the different modes of loading a beam.

The results arrived at and the methods employed, many of which are new, have, in each case, been rendered more easy of apprehension by the addition of a solution of the same question by simple graphical methods, nearly all of which depend, by a proper change in the scale on which vertical ordinates are measured, on the use of an invariable parabolic segment which is to be carefully constructed beforehand in wood or cardboard, and employed throughout.

By this means complicated questions on beams with both a dead and travelling load, can be easily dealt with, and the curves of bending moment and maximum bending moment readily drawn.

The mathematics employed are of the simplest character, not extending, except in one or two instances, beyond elementary algebra, whilst those properties of the parabola which are employed are previously proved in the form of lemmas.

But excellent as is the theoretical exposition of principles in the book, we are disposed to attach even greater importance to the large collection of examples scattered through it, in which the facts and formulæ of the text are applied to well chosen practical examples.

It has been a great misfortune, which all teachers of the subject have deplored, that the writers of books on it have spared themselves the labour of compiling a set of numerical examples, which would enable students to obtain that grasp of it which examples alone can give, and at the same time afford them the assurance that the formulæ they have been studying have some practical significance.

Those which are scattered through this work are judiciously selected, and they are accompanied, when necessary, by hints for their solution. We set a high value on this feature of the book, and we believe that a student, even though otherwise unassisted, who should carefully read it and conscientiously work through the examples, would acquire a knowledge, theoretically sound and practically useful, of this part of applied mechanics which he could not gain with the same labour and in the same time from the study of any other book which has been published on the subject. J. F. MAIN

OUR BOOK SHELF

Text-Book of Physics. By J. D. Everett, M.A., D.C.L., F.R.S. Illustrated. (Glasgow: Blackie and Son, 1883.)

THIS book of 300 pages well fulfils the author's intention of providing an elementary text-book which may especially serve as an introduction to the well-known work of Deschanel with which his name is associated. It is full of matter, which is presented to the reader in a thoroughly systematised and acceptable condition.

The definitions, we need hardly say, are excellent and well worthy of the reputation of one who has taken a prominent part in scientific definition and terminology. Indeed we have rarely seen the chief points of scientific interest so clearly explained as they are in this volume.

We give the following as a good illustration (p. 119):—

"Fuel is a reservoir of potential energy, inasmuch as its elements are ready, whenever opportunity is given, to unite with the oxygen of the air and develop a large amount of heat. The words 'whenever opportunity is given' require some explanation. . . . If we have a large stone lying near the edge of a precipice 1000 feet deep, the stone will not move over of itself, but is ready to fall when opportunity is given, and a trifling expenditure of work in moving the stone to the edge will enable it to descend to the foot with terrific violence. . . . In the firing of a gun there is a combination of illustrations of

the kind of action we are considering. First, a little work spent in pulling the trigger releases a strong spring in the lock, and brings about a smart blow with the hammer. This blow liberates the explosive energy of the percussion cap, which in its turn fires the powder. Thus we have a series of processes in which the running down of a small quantity of energy gives opportunity for the running down of a larger."

This is only one illustration out of many which might be given. In fine the student of physics will find in this volume an accurate and clearly cut map of the various districts for the more minute details of which he must of course be referred to other guides. B. S.

Formulaire Pratique de L'Électricien. Par E. Hospitalier, Première Année, 1883. (Paris: G. Masson.)

In his "Formulaire Pratique de l'Électricien" M. Hospitalier has supplied us with a work which cannot fail to be of value as a convenient book of reference. It is divided into five parts. In the first are stated as briefly as possible those general principles with which every one who is in any way connected with electrical matters should be familiar. In the second is given the derivation of the electrical and magnetic units, with which are tabulated all the arbitrary units that have been or are at all generally used. In the third chapter almost every instrument and method that may be employed for making any measurement which an electrician is likely to require is mentioned, and when necessary explained by a figure. Though it must have been difficult to decide what to include and what to omit, surely considering the growing importance of "diagrams" so very useful an instrument as Amsler's planimeter might have been mentioned.

The fourth chapter, which in quantity is equal to all the rest of the book put together, contains a large amount of miscellaneous information. After giving the usual mathematical tables and formulæ, and several tables of the physical properties of bodies, the author treats in succession of batteries, accumulators, electro-metallurgy, thermo-electricity, dynamo-machines, and motors, electric lighting, the telegraph, and telephone.

The fifth chapter consists of a few pages, in which the composition of various alloys, cements, and varnishes, and a few manipulative processes are described. This part might and no doubt will be improved. For instance, a troublesome process of amalgamating iron is given, but no mention is made of the well known property that sodium possesses of making mercury wet iron or platinum.

There can be no doubt that both in the laboratory and in the workshop this will be found one of the most handy and complete books of reference existing. C. V. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

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

"Elevation and Subsidence"

In an article in last week's NATURE on "Elevation and Subsidence" (p. 323), Darwin's theory on the formation of coral islands is contrasted with mine, and it is apparently assumed that my theory is opposed to subsidence in those regions of the ocean where atolls and barrier reefs are situated.

I am not aware I have ever contended for this, but as several writers have lately attributed this opinion to me it may be as well to restate the position. My view is that the characteristic form of barrier reefs and atolls is in no way dependent on subsidence; that subsidence is not the cause of their peculiar features; that these reefs may be met with indifferently in stationary areas, in areas of subsidence, and in areas of elevation; and that elevation and subsidence only modify in a minor way the appearance of these islands.

All naturalists will be willing to acknowledge that Darwin's theory is "simple and admirable," but I do not think it will be generally admitted by those who have carefully examined coral reefs in recent years that it "accounts satisfactorily for all the observed phenomena of coral growth."

According to the explanation given by Darwin, the foundations of the coral reef sink gradually, and the corals, as gradually, build up the reef to the level of the waves. In this way these interesting coral islands are slowly developed.

It appears to me that the chief phenomena of barrier reefs and atolls are more satisfactorily accounted for in another way:—

1. By a physiological fact—the very vigorous growth of the reef-forming species on the outer or seaward face of the reef where there is abundance of food, and the much less vigorous growth and even death of these species on the inner parts of the reefs and in the lagoons, where there is much less food, and where there are other conditions inimical to growth.

2. By a physical and chemical fact—the removal of lime in suspension and in solution from the inner portions of the reefs and from the lagoons, where much dead coral is exposed to the action of sea water containing carbonic acid—the result being the formation, the deepening, and the widening of lagoons and lagoon channels.

My theory is represented as demanding "290 volcanic peaks at the sea level in the Pacific coral area alone."

What I have endeavoured to show is that the sum of all the agencies at work above the sea tends to reduce volcanic cones down to twenty or thirty fathoms beneath the waves, and the sum of all the agencies at work under the sea level tends to build up volcanic cones to within twenty or thirty fathoms of the surface.

In both cases banks are formed on which reef-building corals grow and eventually develop into atolls. The nearer the summit of the cone is to the sea level, whether above or below it, the more rapid is the formation of the bank.

Atolls, as we now see them, should, according to Darwin's theory, be situated on the summits of gigantic pillars of coral, which are probably higher (or deeper) the greater the diameter of the atoll. These pillars should rest on volcanic cones or peaks of continental land; and in the "Pacific coral area alone" should mark the spots where "290 peaks" have subsided. Where are the soundings which corroborate this part of Darwin's theory?

JOHN MURRAY

Challenger Office, 32, Queen Street, Edinburgh, August 6

In his article on "Elevation and Subsidence" (NATURE, vol. xxviii. p. 323) Mr. Starkie Gardner has given some very interesting new illustrations, drawn from observations of his own upon lava-fields in Iceland, where it is his belief that tracts have sunk owing to the mere weight of lava poured over them. But there are several places in his reasoning upon the general question of the condition of the earth's interior where he appears to argue upon the supposition that pressure by itself can be the cause of heat, and consequently of an increase of temperature among deeply buried rocks. This, however, as those who are acquainted with the science of energy will know, is clearly a mistake. It is only where pressure has produced motion, and that motion has been destroyed as visible motion in a mass of matter, and transformed into motion among the molecules of the matter, that the mass can be heated thereby.

Supposing that rocks at a considerable depth, and therefore under great pressure, are hot enough to be melted, it does not follow that the pressure is the cause either of the high temperature or of the fusion. We must look for some other cause for that high temperature and fusion, and this can only be guessed at. But it probably arises from the earth having once been an incandescent body—a little sun—which is now gradually cooling.

I have been led to make these remarks because Mr. Starkie Gardner has referred to a publication of my own with greater approbation than it perhaps deserves; but at the same time he says that the views he has put forward in his article present some important differences from mine. I wish therefore to be allowed to say that what I have now mentioned, and the consequences which he has deduced from it, are the only important points in which I should disagree with him. O. FISHER

Harlton, Cambridge, August 13

THE canal which it is proposed to make, connecting the Mediterranean and Red Sea *viâ* the Dead Sea and Gulf of Akaba, will, if carried out, throw considerable light upon the theory discussed by Mr. J. Starkie Gardner in your issue of August 2 (p. 323). The low-lying area which this scheme would submerge occupies the greater part of the Jordan Valley, and extends some distance to the south of the Red Sea, where the depression is at least 1300 feet. If there is any truth in the theory which ascribes elevation and depression to the denudation of rock from one area and its accumulation upon another, the introduction of such an immense weight of water from the Gulf of Akaba into the Jordan Valley will cause considerable subsidence in its vicinity. To what extent this would be the case it is difficult to say, but even a slight subsidence would much facilitate the cutting of the Mediterranean end of the canal.

Derby, Mill Hill, August 4 R. MOUNTFORD DEELEY

"The Speke and Grant Zebra"

ABOUT four months ago I wrote Mr. Joseph Thomson, the explorer who was selected by the Royal Geographical Society to examine the snow-clad mountains in Eastern Africa, and I requested him to look out for the "Speke and Grant" zebra mentioned in NATURE of April 26 last by Sir Joseph Fayrer, and I have had the following reply from Mr. Thomson, dated Mombassa, June 6, 1883:—

"With regard to your two questions I am happy to say that I can give you satisfactory answers.

"Within the last month I have seen hundreds of zebras, and I have shot three—one female and two males. The ground colour is *white* and the legs are striped to the hoofs. Of these facts I am certain, but to make quite sure I shall take care to note their characteristics in detail on my return. I did not know it was a subject of dispute."

The subject of dispute referred to is that the French zoologist, M. Milne-Edwards named a zebra after the President of the Republic, *E. Grevyi*, which appears to be no other than the animal which we shot twelve of in 1860-63. J. A. GRANT

19, Upper Grosvenor Street, W., August 10

The Fisheries Exhibition

THE allusion that you made to the marine invertebrates in our department led one of your scientific readers immediately to examine them. He was surprised to find them properly arranged, classified, and named, with a few exceptions. All the alcoholic specimens were looking bright and beautiful. The specimens of the marvellous Alcyonarian of British Columbia, *Osteocella*, Gray, or *Verrillia Blakeii*, as it is called by those who have sent it, are in a state of perfect preservation. They are not so well accommodated as I could wish, owing to their great length, 6 or 7 feet; still they are to be seen very distinctly, doubled up in a glass jar, 3 feet 5 inches in height, filled with strong alcohol clear as water. The fine specimen of *Cryptochiton stelleri*, collected and contributed by His Excellency the Marquis of Lorne, was also found by your reader to be properly exhibited in a convenient glass jar, and labelled inside and out. The large and interesting collection of marine invertebrates exhibited by the Government of the Dominion of Canada is formed of collections contributed by the Museum of McGill College, Montreal, Laval University, Quebec, and from the Nova Scotia Provincial Museum. The collection of Edible Mollusca was made by the late John R. Willis, of Halifax, N.S.

Canadian Department, I.F.E., August 7 D. HONEYMAN Canadian Commissioner

Birds and Cholera

ALLOW me to relate an anecdote in point. I was with a regiment, to which at the time I belonged, in Mauritius, when that bright and beautiful isle was desolated by Asiatic cholera in the year 1854. It was the subject of common remark that during the prevalence of the epidemic the Indian Minah-bird or starlings—"martins" they used to be called in the island—abandoned, or seemed to abandon, the main barrack square and other open spaces they were wont to frequent in the neighbourhood of Port Louis, and were nowhere to be seen. These birds had been imported from India many years before, and were protected as destroyers of certain insect pests in the sugar-canes. They were correspondingly tame in their habits. Presently they betook themselves to the forest or Grand Bois, remaining in the centre of the little island; they could not have left by sea. They reappeared, or seemed to us to reappear, when the sickness passed away. Mauritius was then one of the stations where meteorological observations were systematically recorded. I rather think that the disappearance of the birds from the haunts of men during the epidemic and their reappearance when it ceased were duly noted by the Colonial Meteorologist, the late Col., then Lieut., A. B. Fyers, Royal Engineers, in his report. At any rate, I distinctly remember his noting another circumstance, viz. that the decline of the cholera mortality in the island, which was sudden and marked, was coincident with a marked change in the electric condition of the atmosphere at Port Louis, as indicated by the pith-ball electroscope.

I venture to suggest that the collection and investigation of trustworthy meteorological data during the prevalence of epidemics and of collateral information bearing thereupon has not yet received as much attention as it deserves from observers outside the medical profession. H. M. C.

August 10

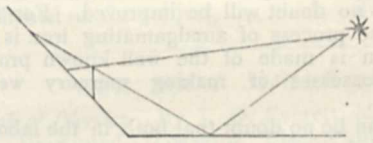
M. Wolf's New Apparatus

THE short abstract given in NATURE (p. 336) of the *Comptes rendus* for July 23, contains a mistake in respect to M. Wolf's paper "Sur un appareil à l'étude des mouvements du sol." It is stated that M. Wolf's apparatus involves the same principle as that by which my brother and I magnified the displacements of the vertical. This is not the case, since he uses an ingenious arrangement of reading by reflection from mercury. In the abstract in NATURE "sol" has been translated "sun" instead of "soil." G. H. DARWIN

Trinity College, Cambridge, August 9

Double Shadows

ONE cloudless evening lately, while walking on a hillside near the southern shore of Loch Etive, Aygyllshire, facing the setting sun, I observed each member of our little company cast a double shadow on the upward slope of the hill; first, the usual complete, well defined shadow cast in clear sunshine; and second, a longer fainter shadow of the upper part of the figure, extending for some distance in the same line beyond the first. The explanation was not far to seek. The loch beneath us was perfectly calm, and reflected the sun's disk with dazzling brilliancy. The second shadow was evidently produced by the reflected rays, thus:—



The phenomenon must be of frequent occurrence, but I do not remember seeing it noticed. I should add it was only observable for a few yards at a particular part of the hillside; a little higher or a little lower it ceased to be visible—doubtless because in the one case the reflected rays fell short, and in the other passed overhead. D. B.

Glasgow, August 2

Regnard's Incandescent Lamp

HERR VON PETERSEN, the engineer of the Zoological Station in this town, recently having occasion to use a powerful light, took advantage of the apparatus described in NATURE (vol. xxvi. p. 108) under the name of Regnard's Incandescent Lamp. He used the apparatus figured and described in NATURE, but neither with air forced through petroleum or benzine, nor even with gas forced through the same liquids, could he raise the platinum wire cage to more than a dull red heat, and the flame was never more brilliant than an ordinary Bunsen burner. The experiments were repeated several times with slight variations, but always with the same result.

I have written this letter at the request of Herr von Petersen, as you do not generally publish communications in a foreign language. ARTHUR E. SHIPLEY

Stazione Zoologica Napoli, July 26

Disease of Potatoes

THE *Sclerotia* referred to by Mr. Worthington G. Smith (in NATURE, vol. xxviii. p. 299) as having destroyed the potatoes in Norway have been sent to me from two different places on our western coast. As I usually travel every summer, I had no opportunity of cultivating them myself; so I sent them to Prof. De Bary of Strasburg, who kindly informs me that he has cultivated them with success. They belong to *Peziza sclerotiorum* (Lib.). The spores of our Norwegian Peziza will produce *Sclerotia*, as he has proved by experiment, also in *Daucus carota*, and very likely in *Phaseolus* and some other plants.

Christiania, August 6 A. BLYTT

Determination of "*H*"

SINCE the publication of a method for the determination of the value of the horizontal component of the earth's magnetism by Mr. A. Gray in NATURE, vol. xxvii. p. 32, I have worked out the value of "*H*" for my laboratory here, and from six sets of experiments carried out during the month of March in a small building constructed free from iron near the laboratory, I find "*H*" to equal 0·18365. The method proposed by Mr. Gray was closely adhered to throughout the experiments.

Taunton, August 8 FREDERIC JOHN SMITH

Fireball

ABOUT 8.25 p.m. on the 11th inst. my attention was suddenly attracted in the direction of the window of my dining-room, which looks south, by a brilliant ball of fire of a deep amethyst colour. It was travelling across the clear blue sky at the rate of about twenty miles an hour in an easterly direction and at an angle of 45°. Before disappearing behind a cloud it seemed to throw a few particles of itself forwards at a greater speed than that at which it was travelling. I trust others saw it under more favourable circumstances, and that they will communicate their experience of its course to you. CHARLES F. CASELLA

The Lawns, Highgate, August 14

Palæolithic Implements at Stratford

ALLOW me to say that a few weeks ago I found an abraded ochreous *oval* Palæolithic implement at *Stratford* (*in situ* two feet from surface). I have shown it to Mr. W. G. Smith, who says it is very interesting, as implements are rare in that locality, and especially oval ones, and he thought it as well for me to communicate with you, as it may interest some of your readers.

49, Beech Street, E.C. G. F. LAWRENCE

EARTH PULSATIONS

FOR many years philosophers have speculated as to whether the surface of the earth is really so stable as it usually appears. With the sudden and violent motions of our soil which we call earthquakes man has been familiar since the earliest times, and the origin of these disturbances has always formed a fruitful source of speculation. With the help of properly constructed instruments, our knowledge of the nature of these movements has during the last few years been greatly extended, and we are brought to the conclusion that these natural vibrations are propagated through the surface of our earth in a manner very different to that which we should have anticipated from our knowledge of elastic solids. Another order of earth movements which, in the hands of Timoteo Bertelli of Florence, M. S. di Rossi of Rome, and other Italian investigators, have recently received considerable attention, are *Earth Tremors*. From observations carried on during the past ten years it would appear that the soil of Italy is practically in a perpetual state of vibration, even in districts far removed from volcanic centres. On account of the smallness in the amplitude of these motions they are only to be observed with the aid of specially constructed instruments. Messrs. George and Horace Darwin, in connection with their experiments on the disturbance of gravity caused by lunar attraction, have shown that these movements are common to the soil of Britain. Like observations have been made in Japan, and it does not seem improbable that after further experiments have been carried out we shall be brought to the conclusion that the surface of the whole globe is affected with similar microseismical disturbances.

In addition to these minute movements, which escape the attention of the ordinary observer on account of the smallness of their amplitude, theoretical investigation has shown that there may be existing in the soil on which we live movements which have escaped our attention on account of the slowness of their period. These motions for want of a better term I call *Earth Pulsations*. Mr. George Darwin in his last report to the British Association has shown that movements of that nature may be produced by barometrical variation. A rise of the barometer over an area is equivalent to loading that area with a weight, in consequence of which it is depressed. When the barometer falls, the load is removed from the area, which in virtue of its elasticity rises to its original position. This fall and rise of the ground completes a single pulsation.

On the assumption that the earth is extremely rigid, Mr. Darwin calculates that if the barometer rises an inch over an area like Australia, the load is sufficient to sink that continent two or three inches.

The tides which twice a day load our shores cause the land to rise and fall in a similar manner. On the shores of the Atlantic, Mr. Darwin has calculated that this rise and fall of the land may be as much as five inches. By these risings and fallings of the land the inclination of the surface is so altered that the stile of a plummet suspended from a rigid support ought not always to hang over the same spot. There would be a deflection of the vertical.

In short, calculation respecting the effects of loads of various descriptions which we know are by natural operations continually being placed upon and removed from the surface of various areas of the earth's surface, indicate that slow pulsatory movements of the earth's surface must be taking place, causing variations in inclination of one portion of the earth's crust relatively to another. That pulsatory motions of this description have repeatedly been observed it may be shown that there is but little doubt. The magnitude of these disturbances however is so great that we can hardly attribute their origin solely to the causes which have just been indicated. Rather than seeking an explanation from agencies exogenous to our earth we might perhaps with advantage appeal to the endogenous phenomena of our planet. When the barometer falls, which we have shown corresponds to an upward motion of the earth's crust, we know from the results of experiment that microseismic motions are particularly noticeable.

As a pictorial illustration of what this really means, we may imagine ourselves to be residing on the loosely fitting lid of a large cauldron, the relief of the external pressure over which increases the activity of its internal ebullition; the jars attendant on this ebullition are gradually propagated from their endogenous source to the exterior of our planet. This travelling outwards would take place much in the same way that the vibrations consequent to the rattle and jar of a large factory slowly spread themselves farther and farther from the point where they were produced.

Admitting an action of this description to take place, it would then follow that this extra liberation of gaseous material beneath the earth's crust would result in an increased upward pressure from within, and a tendency on the part of the earth's crust to elevation. If we accept this as an explanation of the increased activity of a tremor indicator, then such an instrument may be regarded as a barometer, measuring by its motions the variations in the internal pressure of our planet.

The relief of external pressure and the increase of the

internal pressure it will be observed both tend in the same direction, namely, to an elevation of the earth's crust.

This explanation of the increased activity of earth tremors which is I believe due to M. di Rossi, is here only advanced as a speculation—more probable perhaps than many others. We know how a mass of sulphur which has been fused in the presence of water, in a closed boiler, gives up in the form of steam the occluded moisture upon the relief of pressure. In a similar manner we see steam escaping from volcanic vents and cooling streams of lava. We also know how gas escapes from the pores and cavities in a seam of coal on the fall of the barometrical column. We also know that certain wells increase the height of their column under like conditions. The latter of these phenomena may be added to that which we have already mentioned, as a result consequent on diminution of atmospheric pressure, which, by its tendency to render an area of less weight, facilitates its rise.

The next question is as to whether we have any direct evidence of such heavings and sinkings in our earth's crust.

Although some of the proofs which are brought forward to show that slow pulsations like these are phenomena which have been repeatedly observed are unsatisfactory, taking them one with another they indicate that these pulsatory phenomena have a real existence.

Pendulums for instance which have been suspended for the purposes of seismometrical observations, have, both by observers in Italy and Japan, been seen to have moved a short distance out from and then back to their normal position.

This motion has simply taken place on one side of their central position, and is not due to a swing. The character of these records is such that we might imagine the soil on which the support of the pendulum had rested to have been slowly tilted and slowly lowered. They are the most marked on those pendulums provided with an index writing a record of its motions on a smoked glass plate, which index is so arranged that it gives a multiplied representation of the relative motion between it and the earth. As motions of this sort might be possibly due to the action of moisture in the soil tilting the support of the pendulum, and to a variety of other accidental causes, we cannot insist on them as being certain indications that there are slow tips in the soil, but for the present allow them to remain as possible proofs of such phenomena.

Evidences of displacements of the vertical which are more definite than the above are those made by Bertelli, Rossi, Count Malvasi, and other Italian observers, who, whilst recording earth tremors, have spent so much time in watching the vibrations of stiles of delicate pendulums by means of microscopes. As a result of these observations we are told that the point about which the stile of a pendulum oscillates is variable. These displacements take place in various azimuths, and they appear to be connected with changes of the barometer.

From this and from the fact that it is found that a number of different pendulums differently situated on the same area give similar evidence of these movements, it would hardly seem that this phenomena could be attributed to changes in temperature, moisture, and the like. M. S. di Rossi lays stress on this point, especially in connection with his microseismograph, where there are a number of pendulums of unequal length which give indications of a like character. The directions in which these tips of the soil take place, which phenomena are noticeable in seismic as well as microseismic motions, Rossi states are related to the direction of certain lines of faulting.

Bubbles of delicate levels when examined by a microscope change their position with meteorological variations, but Rossi also tells us that they change their position, sometimes not to return for a long time during a microseismic storm. Here again we have another phenomena pointing to the fact that microseismic disturbances are the companions of slow alterations in level.[1]

The more definite kinds of information which we have to bring forward, tending to prove the existence of earth pulsations too slow in period to be felt, are those which appear to be resultant phenomena of great earthquakes.

The phenomena that we are certain of in connection with earth vibrations, whether these vibrations are produced artificially by explosions of dynamite in bore holes, or whether they are produced naturally by earthquakes, are, firstly, that a disturbance as it dies out at a given point often shows in the diagrams obtained by seismographs a decrease in period; and secondly, a similar decrease in the period of the disturbance takes place as the disturbance spreads.

As examples of these actions I will refer to the diagrams which I have given in a paper on the "Systematic Observation of Earthquakes" in vol. iv. of the *Transactions of the Seismological Society of Japan*.

In a diagram of the disturbance of March 1, 1882, it seems that the vibrations at the commencement of the disturbance had a period of about 3 per second, near the middle of the disturbance the period is about 1·1, whilst near the end the period has decreased to ·46. That is to say, the back and forth motion of the ground at the commencement of the earthquake was six times as great as it was near the end, when to make one complete oscillation it took between two and three seconds. Probably the period became still less, but was not recorded owing to the insensibility of the instruments to such slow motions.

We have not yet the means of comparing together diagrams of two or more earthquakes, one having been taken near to the origin and the other at a distance. The only comparisons which I have been enabled to make have been those of diagrams taken of the same earthquake—one in Tokio and the other in Yokohama. As this base is only sixteen miles, and the earthquake may have originated at a distance of several hundreds of miles, comparisons like these can be of but little value.

The best diagrams to illustrate the point I wish to bring forward are those at the end of the paper just referred to. These are the results obtained at three stations in a straight line, but at different distances from the origin, of a disturbance produced by exploding a charge of dynamite in a bore hole. A simple inspection of the diagrams shows that at the near station the disturbance consisted of back and forth motions which, compared with the same disturbance as recorded at a more distant station, were very rapid. Further, by examining the diagram of the motions, say at the near station, it is clearly evident that the period of the back and forth motion rapidly decreased as the motion died out.

Then illustrations are given, as examples out of a large series of other records, all showing like results.

Although we must draw a distinction between earth waves and water waves, we yet see that in these points they present a striking likeness. Let us take, for example, any of the large earthquake waves which have originated off the coast of South America, and then radiated outwards, until they spread across the Pacific, to be recorded in Japan and other countries perhaps twenty-five hours afterwards, at a distance of nearly 9000 miles from their origin. Near this origin they appeared as walls of water, which were seen rapidly advancing towards the coast. These have been from 20 to 200 feet in height, and they succeeded each other at rapid intervals, until finally they died out as gentle waves. By the time these walls of water traversed the Pacific to, let us say, Japan, they

[1] Since my return to Japan in January, 1883, I may mention that I have commenced series of observations on earth tremors and earth pulsations, and on several occasions have observed very marked coincidences between barometrical depressions and these movements. Not only are these atmospheric changes accompanied with microseismic storms, but there are deflections in the stile of a pendulum, and changes in the position of the bulbs of delicate levels, which at such times can be seen with the naked eye to SURGE back and forth through a small range.

broadened out to a swell so flat that it could not be detected on the smoothest water excepting along shore lines, where the water rose and fell like the tide. Instead of a wall of water 60 feet in height we have long flat undulations perhaps 8 feet in height, but with a distance from crest to crest of more than 120 miles.

If we turn to the effects of large earthquakes as exhibited on the land, I think that we shall find records of phenomena which are only to be explained on the assumption of an action having taken place analogous to that which takes place so often in the ocean, or an action similar to that exhibited by small earthquakes and artificially produced disturbances if greatly exaggerated.

As a remarkable instance of such phenomena we may take the great earthquake of Lisbon on November 1, 1755. In Spain, Northern Italy, the South of France and Germany, Northern Africa, Madeira and other Atlantic Islands, the effects of the disturbance which created so much devastation in Portugal were also more or less severely felt as violent movements of the soil.

In other countries further distant, as, for instance, Great Britain, Holland, Norway and Sweden, and North America, although the records are numerous, the only phenomena which were particularly observed were the slow oscillations of the waters in lakes, ponds, canals, &c. In some instances the observers especially remarked that *there was no motion in the soil.*

Pebbly Dam in Derbyshire, which is a large body of water covering some 30 acres, commenced to oscillate as a strong current from the south.

A canal near Godalming flowed 8 feet over the walk on the north side.

Coniston Water in Cumberland, which is about five miles long, oscillated for about five minutes, rising a yard up its shores. Near Durham a pond 40 yards long and 10 yards broad rose and fell about 1 foot for six or seven minutes. There were four or five ebbs and flows per minute.

Loch Lomond rose and fell through about 2½ feet every five minutes, and all other lochs in Scotland seem to have been similarly agitated.

At Shirbrun Castle in Oxfordshire, where the water in some moats and ponds was very carefully observed, it was noticed that the floods began gently, the velocity then increased, till at last with great impetuosity they reached their full height. Here the water remained for a little while, until the ebb commenced, at first gently but finally with great rapidity. At two extremities of a moat about 100 yards long it was found that the sinkings and risings were almost simultaneous. The motions in a pond a short distance from the moat were also observed, and it was found that the risings and sinkings of the two did not agree.

During these motions there were several maxima.

These few examples of the motions of waters without any record of the motions of the ground at the time of the Lisbon earthquake must be taken as examples of a very large number of similar observations of which we have detailed accounts.

Like agitations it must also be remembered were perceived in North America and in Scandinavia, and if the lakes of other distant countries had been provided with sufficiently delicate apparatus, it is not unlikely that like disturbances would have been recorded.

The only explanation for these phenomena appears to be that the short quick vibrations which had ruined so many cities in Portugal had by the time that they had radiated to distant countries gradually become changed into long flat waves having a period of perhaps several minutes, and in countries like England these pulse-like movements were too gentle to be perceived excepting in the effects produced by tipping up the beds of lakes and ponds.

The phenomenon was not unlike that of a swell produced by a distant storm.

At Amsterdam and other towns chandeliers in churches were observed to swing. At Haarlem floods rose over the sides of tubs, and it is expressly mentioned that no motion was perceived in the ground.

At the Hague a tallow chandler was surprised at the clashing noise made by his candles, and this the more so because no motion was felt under foot.

At Toplitz the pulsation of the ground appears to have manifested itself in effects upon the springs. The flow of the principal spring was greatly increased. Before this increase it became turbid, and at one time stopped. Subsequently it became clear, and flowed as usual, but the water was hotter and more strongly mineralised.

At one or two places, as, for instance, in Britain, slight earthquakes were experienced. These, however, were local, and in every probability were secondary disturbances produced by the pulsations causing ground in a critical state to give way.

In this earthquake I think, then, that we have a clear case of the production of pulsations in the soil that were too slow to be felt by ordinary observers.

Motions like these might be called slow earthquakes, and it does not seem unlikely that they are the resultants of all large disturbances. When they accompany a large earthquake like that of Lisbon, their cause is evident. But when we see the waters of lakes and ponds oscillating, the bulbs of levels disturbed, and the plummet line of pendulums displaced, the reason of these phenomena are not so apparent. It would seem possible that in some cases pulsations producing these phenomena might have their origin beneath the oceans, or deep down beneath the earth's crust. Perhaps, instead of commencing with the snap and jar of an earthquake, they may commence as a heaving or sinking of a considerable area, which may be regarded as an uncompleted effort in the establishment of an earthquake or a volcano. The very fact that we know that volcanoes rising from deep oceans have in the first instance forced their way against a pressure of at least three or four tons to the square inch, indicates to us the existence of internal pressures tending to raise the crust of the earth, which pressures are infinitely greater than any of the pressures which we have upon the surface of our earth produced by tides and variations in the barometrical column. If we follow the views of Mr. Mallet in considering that the pressures exerted on the crust of our earth may in volcanic regions be roughly estimated by the height of a column of lava in the volcanoes of such districts, we see that in the neighbourhood of a volcano like Cotopaxi the upward pressures must have been many times greater than the pressures already mentioned—sea level being taken as the line of hydrostatic equilibrium. The chief point, however, is that beneath the crust of our earth enormous pressures exist tending to cause eruption; and farther, that these are variable. Before a volcano bursts forth we should expect that there would be in its vicinity an upward bulging of the crust, and after its formation a fall. Farther, it is not difficult to conjecture other possible means by which such pressures may obtain relief.

Should these pressures then find relief without rupturing the surface, it is not difficult to imagine them as the originators of vast pulsations which may be recorded on the surface of the earth as wave like motions of slow period similar to the motions in the outer area of a tract disturbed by a destructive earthquake.

That slow, undulatory motions or changes in the vertical do occur in the crust of the earth, whatever may be their origin, we have numerous phenomena which certainly admit of explanation on such an assumption.

In Switzerland from time to time we hear of oscillations in the waters of lakes known under the name of *Rhussen* and *Seiches*. These, it may be remarked, are common to the lakes and inland seas of many countries.

Other examples of what may have been a slow oscil-

lating motion of the earth's crust are referred to by Mr. George Darwin in his Report to the British Association in 1882. One of them was made by M. Magnus Nyrén at Pulkova, who, when engaged in levelling the axis of a telescope, observed spontaneous oscillations in the bulb of the level.

This was on May 10 (April 28), 1877. The complete period was about twenty seconds, the amplitude being 1″·5 and 2″. One hour and fourteen minutes before this he observes that there had been a severe earthquake at Iquique, the distance to which in a straight line was 10,600 kilometres, and on an arc of a great circle 12,500 kilometres.

On September 20 (8) in 1867 Mr. Wagner had observed at Pulkova oscillations of 3″, seven minutes before which there had been an earthquake at Malta.

On April 4 (March 23), 1868, an agitation of the level had been observed by M. Gromadzki, five minutes before which there had been an earthquake in Turkestan.

Similar observations had been made twice before. These, however, had not been connected with any earthquakes, at least—Mr. Darwin remarks—with certainty.

Like phenomena are mentioned by M. S. di Rossi, in his "Meteorologica Endogena."

Thus on March 20, 1881, at 9 p.m., a watchmaker in Buenos Ayres observed that all his clocks oscillating north and south suddenly began to increase their amplitude, until some of them became twice as great as before. Similar observations were made in all the other shops. No motion of the earth was detected. Subsequently it was learnt that this corresponded with an earthquake in Santiago and Mendoza.

Another remarkable example illustrating the like phenomena are the observations which were made on December 21, 1860, by means of a barometer in San Francisco, which oscillated, with periods of rest, for half an hour. No shock was felt, nor is it likely that it was a local accident, as it could not be produced artificially. On the following day, however, a violent earthquake was experienced at Santiago.

This brings me to the end of the few important illustrations of the phenomena of earth pulsations which I have at my disposal. With a little trouble I have no doubt that these might be greatly multiplied. As they stand, however, I think that they are quite sufficient to convince us of the existence of phenomena which hitherto have been almost entirely overlooked. That disturbances of the vertical are from time to time produced by long pulse-like waves can, with these examples before us, hardly be doubted. It must, however, be noted that they are of a different order to those phenomena which were so carefully sought for by the Darwins at Cambridge.

JOHN MILNE

Tokio, Japan

ON THE SUPPOSED HUMAN FOOTPRINTS RECENTLY FOUND IN NEVADA[1]

DURING the past summer various accounts have been published of the discovery of human footprints in sandstone near Carson, Nevada. The locality is in the yard of the State prison, and the tracks were uncovered in quarrying stone for building purposes. Many different kinds of tracks were found, some of which were made by an animal allied to the elephant; some resembled those of the horse and the deer; others were apparently made by a wolf. There were also tracks made by large birds.

The footprints occur in series, and are all nearly in the same horizon. Some of the smaller tracks are sharp and distinct, but most of the impressions are indefinite in outline, owing apparently to the fact that the exact surface on which they were made is not usually exposed.

[1] Abstract of a paper read before the National Academy of Sciences, at New York, November 17, 1882.

The supposed human footprints are in six series, each with alternate right and left tracks. The stride is from two and a half to over three feet in extent. The individual footprints are from eighteen to twenty inches in length, and about eight inches wide. The distance between the line of right-hand and left-hand tracks, or the straddle, is eighteen to nineteen inches.

The form and general appearance of the supposed human tracks is shown in Fig. 2, which is a reduced copy of one of the impressions represented by Dr. W. H. Harkness, in his paper before the California Academy of Sciences, August 7, 1882. The shaded portion was restored by him from other footprints of the series. A

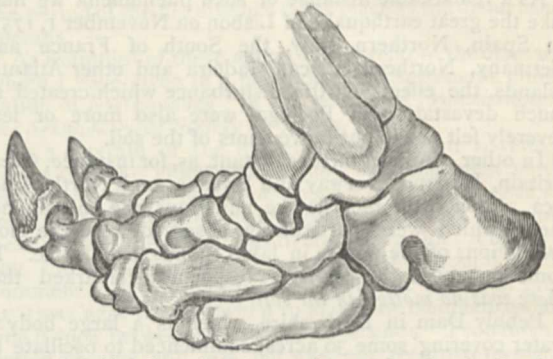


FIG. 1.- Left hind foot of *Mylodon robustus* (after Owen). One-sixth natural size.

copy of this impression was given also by Prof. Joseph Le Conte, in his paper before the same Society, August 27, 1882.

The size of these footprints, and especially the width between the right and left series, are strong evidence that they were not made by men, as has been so generally supposed.

A more probable explanation is that the impressions are the tracks of a large sloth, either *Mylodon* or *Morotherium*, remains of which have been found in essentially the same horizon. In support of this view it may be said that the footprints are almost exactly what these animals would make if the hind feet covered the impressions of

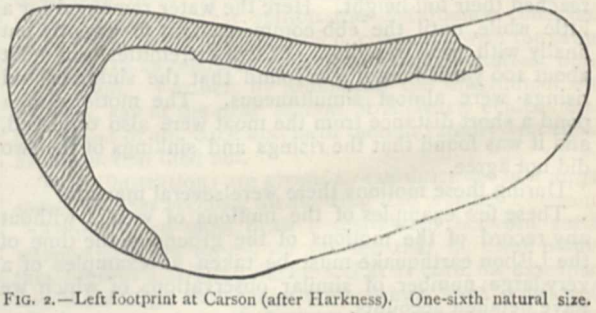


FIG. 2.—Left footprint at Carson (after Harkness). One-sixth natural size.

those in front. In size, in stride, and in width between the right and left series of impressions, the footprints agree closely with what we should expect *Mylodon* or *Morotherium* to make. In Fig. 1 the bones of the left hind foot of a species of *Mylodon* are represented, the figure being reduced to the same scale as the accompanying cut, Fig. 2, of one of the supposed human footprints.

The geological horizon of these interesting footprints is near the junction of the Pliocene and Quaternary. The evidence, at present, appears to point to the Equus beds of the upper Pliocene as the nearest equivalent.

Since the above communication was read, the writer has had an opportunity of examining photographs and casts of the Carson footprints, and is confirmed in his opinion that the supposed human tracks were made by large

Edentates. The important fact has recently been determined that some of these tracks show impressions of the fore feet. The latter are somewhat outside of the large footprints, as would naturally be the case if the animal changed its course. O. C. MARSH

WINTER LIFE AT FORT RAE

IT was not until the beginning of December that our winter really set in, but when it did so there was no mistake about it, as the 1st of the month began with the thermometer at −34°, and except for some mild weather at Christmas, the cold continued through that month. January was colder still, the thermometer once or twice approaching −50°, but in the early part of February a violent storm was accompanied by a remarkable rise of temperature (to +20°), and followed by some mild weather, since which the thermometer has again fallen, reaching −39° a couple of days ago.

This, however, I am informed by the inhabitants, is the mildest winter that has been known for many years, and I have no doubt that a temperature of −60° is not uncommon in severe winters.

It is strange how much less one feels this extreme cold than might be imagined. For the first day or two it was unpleasant, but after that the system seemed to accommodate itself to it, so that a day when the temperature was anywhere above −15° felt quite warm and pleasant. To-day, for instance, I am writing with my window open, although the thermometer is several degrees below zero, and there is a light breeze. There have been days, it is true, when—with the thermometer near −30°, and a strong breeze blowing, filling the air with snowdrift like a dense fog—outdoor exercise was most unpleasant, probably resulting in a frozen face, but such days were not very numerous, a strong wind, even from the cold quarter (the north-west), sending the temperature up in a way that I cannot quite account for.

Now the climate reminds me of Davos Platz, the sun having considerable power; there is, however, more wind. Yesterday the black bulb *in vacuo* read 82°. The only drawback is the intense glare from the snow, which makes coloured spectacles a necessity.

During the first part of the winter we were a little anxious about food, not that we were in any danger of starvation, as the Indians had brought in quantities of dried meat in the autumn, but dried meat is a most unpalatable article of diet, and requires strong teeth and a strong digestion; and then the fishery was not as productive as usual, and the daily produce of the nets (which are set under the ice) was gradually diminishing. At last, however, the deer made their appearance some forty miles from this, and since then our supplies of fresh meat have come in regularly. Rabbits, too, have lately become most numerous. These animals are the great resource of the Indians in times of scarcity, but they are not always plentiful. They are said to attain their maximum once in ten years, when they seem to suffer from a disease which shows itself in lumps on their heads; the following year there is hardly a rabbit to be seen, and then they gradually increase for another ten years.

The winter has passed very uneventfully. On November 17 and two or three following days there were magnetic disturbances of great violence, due, no doubt, to the large sunspot. The displays of aurora at that time, however, were not of any remarkable brilliancy; we have had far brighter ones since, with far less magnetic disturbance. But as a rule the auroras have not been remarkable, though a night seldom or never passes without more or less—the brilliant coloured ones one reads about are conspicuous by their absence. For the most part they are all of the same yellowish colour, showing the single characteristic bright line in the spectroscope, but a bright aurora usually shows more or less prismatic colouring along the lower edge, with a spectrum sometimes of one or two additional bright lines, as a rule towards the violet end of the spectrum, though on one occasion I observed a bright band in the red.

Aurora is very rarely seen until night has quite set in, but on three occasions we have seen it shortly after sunset, and on these occasions it was of a reddish or copper colour, as though partly coloured by the sun's light; it must, I think, have been associated with thin cloud. Its motion and shape showed it to be aurora.

The terrestrial radiation thermometer placed on the snow generally showed a depression of from 10° to 20° on every calm, clear day throughout the winter, even by day when sheltered from the sun. The lowest readings were, as might be expected, with the dry north-west wind. Sometimes the first warning of an impending change of wind to the south-east was given by a rise of this thermometer before the barometer was affected.

A thermometer suspended on the outer wall of the observatory at times read 9° or 10° lower than one in the screen, owing to radiation, and I think that the common practice of exposing unsheltered thermometers may explain some of the low temperatures sometimes reported from this country.

Our daily routine of observations goes on very regularly. Lately wolves have taken to prowling about the neighbourhood, and the observer on duty goes to visit the thermometers armed with a huge club; of course a gun or axe cannot be allowed near the observatory on account of the magnetic instruments.

A remarkable epidemic of influenza made its appearance here in January. We first heard of it among the Indians far to the north-west of this. When it arrived here it attacked every soul in the place—Indians and whites—fortunately in a very mild form, and we hear that Fort Simpson, on the Mackenzie, suffered in the same way. Such an occurrence is most unusual in this country. With this exception we have all enjoyed good health.

We expect the ice to break up about the middle of June, and then will come the reign of the mosquitoes, which make the summer the most disagreeable season of the year in this country. Fortunately they do not last long in this latitude, and by the end of August, when we set out on our homeward journey, they will be over.

Fort Rae, March 25 HENRY P. DAWSON

THE NORWEGIAN NORTH-SEA EXPEDITION[1]

II.

DR. MOHN continues his description of Jan Mayen Island as follows:—

"The northern part of Jan Mayen is larger and more elevated than the southern. From its central tract towers the monarch of the island, Mount Beerenberg, an extinct volcano, rising in regal majesty to the height of 6400 feet. The crater measures 4360 feet in diameter. The upper cone, which shelves at an angle of 42° and attains an altitude of about 2000 feet, would, to judge from the black spots so conspicuous on its western declivity, appear to be composed of ashes. The base supporting the cone slopes out in every direction at an angle of from 8 to 10 degrees, and this incline is retained towards the north and east to a depth of at least 1000 fathoms beneath the sea-level. The edge of the crater has a jagged appearance, and the loftiest peak lies on the west side of the mountain Towards the north the wall of the crater has partially given way down to a height of from 600 to 700 feet. The depression thus formed extends northwards towards the north coast of the island, bounded on either side by diverging mountain ridges, that here and there project ledge-like one above the other. This is Beeren-

[1] Concluded from p. 350.

berg's *val del bove*, which constitutes the snow-field for the largest of its glaciers, that jut out from the north side of the mountain. On the east side, too, are seen prominent ribs, all of which intersect the nevés of the east side; towards the south and west, however, the surface of the outer cone would appear to be remarkably smooth, at the edge of the crater only being furrowed with shallow depressions between the jags. The base of Mount Beerenberg shelves towards the west, south-west, and north-east, with a comparatively gentle incline, either to the water's edge or the low-lying shore; towards the north and east, however, the descent at the coast is very abrupt, exhibiting precipices 1000 feet high. In several places the base of the mountain is intersected by deep ravines, through which the glaciers find a passage to the sea.

"The height of the southern part of the island cannot be compared to that of the northern. The southern land constitutes a wide plateau, which, in a south-easterly and southerly direction, exhibits numerous precipices along the coast, but, towards the north-west, has extending before it a low-lying foreland, less than 300 feet above the sea. The height of the plateau I estimated at 1000 feet. Rising above this tableland are seen several summits; the loftiest, which has apparently a conical form, and may therefore be of eruptive origin, can hardly attain an altitude of 1600 feet above the sea-level.

"The low middle tract of the island, which is built up of compact masses of lava, and bears numerous eruptive craters, has at its lowest point an elevation of only 200 feet, or perhaps even less, whereas the crater summits reach a height of 400 to 600 feet. The altitude of Fugleberg we found by observation to be 490 feet; that of Egg Island was estimated at 400 to 500 feet.

Fig. 4.

"As shown by Carl Vogt, the base of Mount Beerenberg is composed partly of layers of lava, and partly of layers of tuff, that would appear to have flowed or been discharged from the great central crater previous to the formation of the upper cone of ashes. The middle tract of the island exhibits a similar structure, and, to judge from its appearance, also the southern part. Above this stupendous mass of lava rise a number of small parasitic craters, the greater part of which have retained a conical form. Such, for instance, are Sars's crater, the crater east of the southern glacier, the Esk and Vogt craters, Danielssen's and Blytt's craters, and the craters in the vicinity of Guinea Bay. Fugleberg on the west coast, and Egg Island on the east, are no longer conical, the outer edge of the crater having given way and fallen into the sea. Some of the parasitic craters are built up of lava, and would appear to have sent forth considerable currents, as the Vogt and Esk craters; the summit of others consists of loose erupted masses, cinders, and ashes (rapilli), as the craters in the vicinity of Mary Muss Bay and Guinea Bay; others are composed of layers of tuff, tuff-conglomerate, and compact masses of lava, as the Fugleberg, and others again of ashes alone, as Egg Island and the Berna crater.

"The chief volcanic fissure in which Jan Mayen Island is built must obviously extend in the longitudinal direction of the land, parallel to the volcanic line of Mount Hecla. Meanwhile, the grouping of the parasitic craters would seem to intimate the existence of transverse fissures running from W.N.W. to E.S.E.; for in that direction there are, apparently, several rows of parasitic craters, as the Esk, Vogt, Berna, the Fugleberg, and Egg Island, Hoyberg, and the crater in the vicinity of the 'pilot-boat' (?). Must we regard it as mere accident that each of the terminal craters towards the south-east in the two first rows should have discharged ashes alone?

"Jan Mayen has no valleys of considerable extent; the

large ravines in the northern part of the island are filled with glaciers, and the southern land would appear to be but little intersected by vales or ravines. Of brooks or rivulets very few have been observed. A characteristic feature, distinguishing the coast of Jan Mayen, are the fantastic-shaped rocks that in many places rise abruptly from the sea, of which we have mentioned several. They are no doubt in greater part fragments of lava detached from currents that had flowed into the sea.

"The coasts of Jan Mayen are, as previously stated, in many places lofty and precipitous. In some localities, however, there is a low expanse of foreshore consisting of lava, partially covered with sand. This foreshore, which is separately marked on the map, lies so low in places as

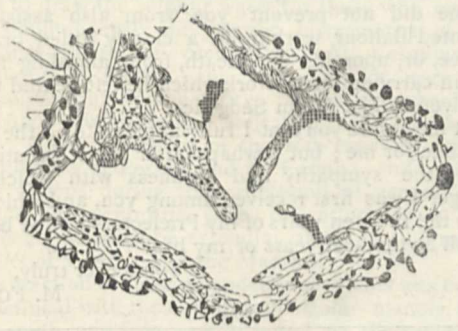


FIG. 5.

to be covered with driftwood. Some localities, too, exhibit a low sandy beach, bestrewn with large quantities of driftwood, the jaws and vertebræ of whales, bits of wreck, and seaweed.

"Nowhere on the shores of Jan Mayen has a harbour been found that could afford a ship or a boat shelter in all kinds of weather.[1] Hence, to land is possible only with the sea comparatively smooth, which it rarely is, save when drift-ice encompasses the island. Specially noteworthy are the two lagoons, cut off from the sea by barriers of black sand, only a few feet high and a couple of hundred paces broad. They both contain fresh water, the surface of which lies but very little above that of the sea. The lagoon on the west side of the island is deep enough to afford a good harbour were the barrier cut

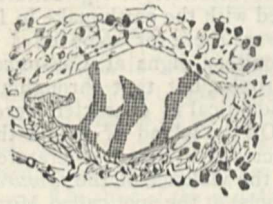


FIG. 6.

through to a sufficient depth. The lagoon on the east side is comparatively shallow.

"Jan Mayen lies wholly within the Greenland Arctic current. At a depth of from 10 to 20 fathoms the temperature of the sea is all the year round below zero. In the winter there is frequently open water off the coasts of Jan Mayen, sealers often passing to the west of the island. The summer is naturally cold, from the presence of ice-cold water so near the surface of the sea. The northern part of Jan Mayen rises, at a height of about 2300 feet, into the region of perpetual frost. The upper cone of Mount Beerenberg is snow-capped, save on the steepest parts of its declivity, where the black mountain-wall is seen protruding. The base of Beerenberg is girt with a belt of snow, from which prodigious glaciers take their origin, nine of the largest reaching down to the water's edge. The southern part of the island would not appear to be glaciated. Large patches of snow are everywhere observed throughout the summer in the vicinity of the sea.

"Jan Mayen has but a meagre flora. Bright herbage, however, is not wanting; the green carpet of moss, in places of considerable extent, forms a striking and pleasant contrast to the black, brown, and red of the surrounding rocks. The plants collected by Dr. Danielssen

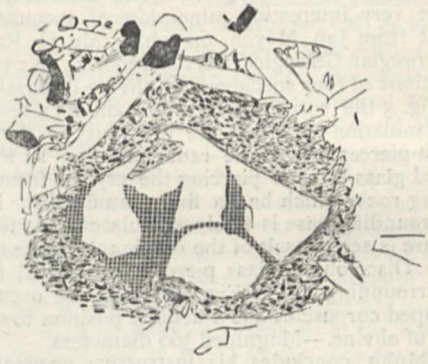


FIG. 7.

on the isthmus south of Mary Muss Bay, are, according to Prof. A. Blytt, as follows:—

"*Saxifraga cæspitosa*, L.
„ *nivalis*, L.
„ *oppositifolia*, L.
„ *rivularis*, L.
Ranunculus glacialis, L.
Halianthus peploides, Fr.
Cerastium alpinum, L.?
Draba corymbosa, R. Br.
Cochlearia officinalis, L.
Oxyria digyna, Campd.
Catabrosa algida, Fr.

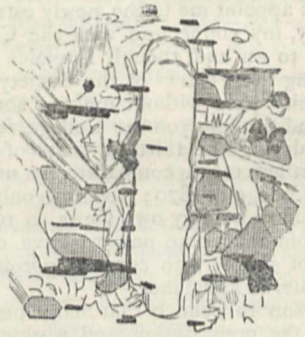


FIG. 8.

"Of mammiferous animals, the Polar Fox, *Canis lagopus*, is by no means rare on Jan Mayen. Of birds, Mr. Friele has noted the following species:—

"*Somateria mollissima*, Leach.—Rare.
Larus glaucus, Brün.—Common.
Fulmarus glacialis, Lin.—Exceedingly abundant.
Grylle Mandti, Licht.—Abundant.
Uria aara, Schlegel.—Abundant.
Mergulus alle, Lin.—Abundant.
Tringa maritima?

"If the land fauna of the island is meagre, that of the sea is proportionately rich, a fact which the numerous zoological memoirs published in this General Report will sufficiently attest."

[1] Little Sand Bay would appear, according to the account in the "Zeespiegel," to be a good harbour for boats, protected as it is by an outlying chain of islets.

Fig. 4 again shows the island in its winter garb, and is from a drawing made by Lieut. Ring, R.N., when commanding the sealer *Capella*.

"We have Sars's crater, on the slope shelving towards Cape North-East; we see, too, the great glaciers on the north side, also Cape North-West and Muyen's Cross Cape, in a line with the point of view; and the low tract of the island, with the heights of the southern part, are boldly defined in the picture. The crater of Beerenberg, with its sunken edge on the north side, is also seen, and lower down a huge, cauldron-shaped depression, from which the great northern glaciers take their origin."

Some very interesting mineralogical specimens were brought from Jan Mayen, on which Mr. H. Reusch, of the Norwegian Geological Survey, reports. We reproduce illustrations of four specimens of olivine in basalt.

In Fig. 5 the surrounding rock exhibits a remarkably fine granulation in immediate proximity to the crystals, which it pierces in sac-like ramifications. In Fig. 6 discoloured glass is seen piercing the crystal from the surrounding rock, which has a fine granulation. In Fig. 7 the surrounding base is finely granulated. At the top of the figure is seen basalt of the dominant degree of granulation. Discoloured glass pierces the crystal from the rock surrounding it. In Fig. 8 the iron ore occurring as rod-shaped corpuscles has a definite position towards the crystal of olivine.—Magnified 360 diameters.

Dr. Mohn concludes his instructive account of the geography of this fruitful expedition by some brief observations on Bear Island and Spitzbergen, at various points of which the *Voringen* touched.

SCIENCE AT CAMBRIDGE

WE understand that Dr. M. Foster, who, upon his appointment as Professor of Physiology at Cambridge, ceased to be Prælector at Trinity College, addressed to the Master of Trinity the following letter, which perhaps may interest those of our readers who are not acquainted with the peculiar organisation of our old Universities.

Shelford, Cambridge, July 28, 1883

MY DEAR MASTER,—The University having done me the honour to appoint me to the newly established Chair of Physiology, my connection with the College as Prælector comes to an end, though I rejoice that I am still counted among the Fellows of the Society. I cannot let this opportunity pass without making some attempt to thank you, and through you the College, for all you have done for me during the thirteen years of my Prælectorship. You called me, a comparatively unknown young man, to the College in 1870; you not only at once gave me leave to follow out my own views as to what I ought to do, but from that time onward have constantly supported me, not simply with cordial approbation, but also with most material assistance.

I have reason to believe that many persons not conversant with the organisation and working of the University, are under the impression that the necessary expenses which my work has entailed have been provided out of University funds. But I am sure that the authorities of the University would be the last to wish that anything done by the College should be considered as done by the University. And as a matter of fact, when I say that I was allowed the use for four years of one room, and for ten years of two rooms, in the University buildings, and that during the last three years I have enjoyed the advantages of the admirable laboratory which has been built for me, with use of gas and water, I have mentioned all that I have received from the University, with the exception of grant of microscopes to the late Prof. Balfour and myself in common. Not only my own remuneration has come from the College, but all the really large expenditure involved in my teaching physiology, save what has been met by the fees of the students, has been provided for in one way or another by the College.

At the outset the College gave me a large grant of money for apparatus, and some years afterwards a second smaller grant. During the whole thirteen years I have received from the College an annual sum for the payment of my laboratory servants; and for several years past two demonstrators (one at a comparatively high salary), as well as during the past year three assistant demonstrators, have been paid partly from the tuition fund of the College, partly by funds which, though furnished by private liberality, cannot be wholly dissociated from the College. I think I may fairly say that I have never asked anything of you in vain. I might add that what you have done for me did not prevent you from also assisting our lamented Balfour, working in a closely allied branch of science, or, upon his sad death, from affording material help in carrying on the work which he left behind through aid given to Mr. Adam Sedgwick.

Let me assure you that I fully appreciate all the College has done for me; but perhaps after all I feel still more keenly the sympathy and kindness with which as a stranger I was first received among you, and which have made the thirteen years of my Prælectorship the brightest as well as the best years of my life.

Yours ever truly,
M. FOSTER

THE ISCHIA EARTHQUAKE

A SLIGHT shock of earthquake occurred in Casamicciola at seven o'clock on Sunday morning, at the Gurgitello, where that of July 28 created the most ruin, but it was limited to that spot, and caused no damage. It is reported that a fissure a kilometre in length and thirty kilometres in depth has opened on the south-west flank of Mount Epomeo. The smoke ejected from the *fumaroli* at the summit of the mountain has considerably diminished in quantity. The Naples Academy of Sciences has appointed a Commission to investigate the telluric conditions of Ischia.

The following communication from the *Times* correspondent at Rome is important:—

"From a second report made by Prof. Michele Stefano di Rossi, head of the Central Geodynamic Observatory at Rome, to the Minister of Agriculture, on the phenomena connected with the earthquake in Ischia, it appears that not only were there for some days beforehand very distinct premonitory signs at Casamicciola of the impending catastrophe, but that throughout the peninsula forewarnings, identical in character, were numerous and widespread. On the island of Ischia there was an extraordinary increase in the temperature of the thermal waters and in the violence of the *fumaroli* (*i.e.* the natural smoke funnels) at the spot called Monte Cito. These phenomena were noticed eight days before the catastrophe occurred. On these important points the evidence which Prof. di Rossi obtained is abundant. There is less conclusive testimony concerning the shrinking and consequent scarcity of the drinking water in the wells. But he has absolutely certified that, commencing from a period a fortnight anterior to July 28, many slight shocks of earthquake, of almost daily recurrence, were felt, and subterranean rumblings were heard. Phenomena identical with these preceded the earthquakes in Ischia in 1828, 1851, and 1881; and Prof. di Rossi emphatically states that had an observatory been established in Ischia after the earthquake of 1881, according to the advice he then gave, and the phenomena which manifested themselves at Cassamicciola from July 20 onwards been communicated to him at the Central Observatory in Rome, he would not have hesitated an instant in pointing out the imminent danger of an impending

seismic disturbance. While the above-mentioned phenomena were occurring in Ischia, without their being communicated to Rome, or even, for want of means, properly noted on the spot, the existence of unusual subterranean activity was simultaneously marked by the instruments in all the observatories on the mainland. That activity, though varying in intensity in different places, manifested a general and regularly progressive augmentation. Slight shocks of earthquake were felt at various points. On July 25 the Solfatara of Albano, on the extinct Latin volcanoes on the southern side of the Roman Campagna, sent forth sounds never before remarked. On the same day a widely extended earthquake, reaching from Cosenza to Catanzaro, occurred in Calabria. On Friday, the 27th, the hissing noises from the Solfatara of Albano were so acute that the people did not dare to draw the sulphur water for those who needed it, and simultaneously the seismic instruments at Pesaro registered severe oscillations. At Vesuvius on the evening of Friday, the 27th, shocks were felt, with an augmentation of activity. There were shocks at Latera, upon the Ciminian volcanoes, and shocks at Perugia. On the afternoon of the 28th renewed activity was manifested at Pesaro and at Fermo; and in short the observations during that afternoon of general calm throughout the peninsula gave indications of a vast subterranean disturbance, extending as far as all Umbria, the district of Viterbo, and the Marches.

"The direction of these extended movements was everywhere identical with those at Casamicciola—namely, from north to south, and from east to west. At the same time also, on the morning of the 28th, the flow from the principal source of the sulphur streams, near Tivoli, showed a considerable diminution; while simultaneously an increased quantity of carbonic acid gas was given forth. The regular observations at Bologna, at Pisanello, near Piacenza, and at Rome, showed that there was a distinct lowering in the levels of the wells before July 28, and as marked a rise after that date. These facts confer increased credibility on the imperfect evidence of there having been a deficiency of water in the wells at Casamicciola. Moreover, on the morning of Sunday, the 29th, the usually very cold waters of the Solfatara of Albano were in a boiling state. The intimate connection between these phenomena on the peninsula and the catastrophe in Ischia is more than evident, and their distinct dynamic and volcanic character absolutely excludes the idea of a mere local sinking in the level."

NOTES

TELEGRAMS from Drontheim to Vienna announce that the members of the Austrian expedition to Jan Mayen have arrived there safe and well, after an absence of six months. This was one of the circumpolar observing parties, and during the year's residence on Jan Mayen neither officers nor men suffered from scurvy or other disease. The chief of the expedition telegraphs to the Geographical Society of Vienna that they have made "perfect observations, rich collections, and taken geodetic and photographic views of the island."

DURING the coming year, we learn from *Science*, experiments will be made at the physical laboratory of Johns Hopkins University with a view to aid in establishing an international unit of electrical resistance. The experiments will be carried on under the direction of Prof. Rowland, with an appropriation from the Government of the United States. The results will be communicated to the International Commission of Electricians meeting in Paris.

DR. ROBERT MOFFAT, the famous African missionary, has died at the advanced age of eighty-seven years. He was among the first to show the way to Central South Africa, and added not a little to our knowledge of the Bechuanas and other tribes south of the Zambesi. He was Livingstone's father-in-law, and the special direction of the great missionary-traveller's African work was to a considerable extent due to Moffat's example and advice.

THE Ninth Annual Conference of the Cryptogamic Society of Scotland will be held at Dumfries on September 11, 12, and 13. Fellows who purpose attending the Conference are requested to communicate with the local Secretary, Mr. J. Rutherford, Jardington, Dumfries.

THE statue of the brothers Montgolfier was unveiled at Annonay on Monday, as part of the ceremonies commemorative of the centenary of the inventors of balloons. M. de Fonvielle writes to us from Annonay, August 12: "This celebration has been organised merely by private exertions in continuation of the banquet given by the Académie d'Aërostation of Paris on November, 1882, to commemorate the centenary of the first private experiment tried by Joseph Montgolfier at Avignon in his rooms. A local committee was formed in Annonay under the presidency of M. Séguin, the eldest son of Marc Séguin, Member of the Institute, a nephew of the Montgolfier to whom is attributed the creation in France of tubular boilers and metallic bridges. M. Henry Vidon of Annonay was appointed general secretary. The exertions of the Committee were very successful, and about 4000*l.* were collected, principally in the immediate vicinity of Annonay and at Paris; foreign subscriptions were very few. It was decided to erect on the Place des Cordeliers, where the first experiment took place on June 5, 1783, a statue representing the two brothers inventing the 'Montgolfière.' The plaster cast has been executed, and will be inaugurated to-morrow before a large audience. The ceremony will begin at two o'clock with a speech delivered by M. Séguin, after which a small Montgolfière will be sent up from the exact spot where the first experiment took place. On Saturday an aëronautical ascent was made from the Champs de Mars with a small balloon of 3000 cubic feet, the largest that the gas establishment could fill without inconvenience."

IN the just published parts 4 and 5 of his "Abbildungen von Vogelskelettes," Dr. Meyer, of Dresden, proves that the Notornis from the South Island of New Zealand belongs to a different species from that from the North Island—*Notornis mantelli*—and he names the former *N. hochstetteri*. It is known that Prof. Owen founded on some fragments of the skull and the bones from the North Island in the year 1848 the genus Notornis, and that he called the species, without then knowing a skin, *N. mantelli*, after the discoverer. The two skins, which were figured by John Gould in the years 1850 and 1869, and which now adorn the galleries of the British Museum, came from the South Island, and were identified with the bones from the North Island. The Dresden Museum having acquired the skin and skeleton of a specimen of Notornis hunted in the year 1879 on the South Island—all three specimens were procured from within a range of ninety miles—Dr. Meyer compared his skeleton with Prof. Owen's life-size figures in the *Transactions of the Zoological Society*, and found them to be different, which fact is not to be wondered at, as New Zealand has proved to be very rich in species of flightless birds, and as the Notornis fragments came from another island than the three skins and the skeleton, perhaps Notornis became extinct on the North Island, whereas it still survives in certain parts of the South Island. Dr. Meyer is of opinion that if the bones and the skull had been taken out of the skins preserved in the British Museum, one would have known already in the year 1850, or at least in 1869, that they differed from the *Notornis mantelli* fragments of the North Island. The name of those skins, therefore, must be altered, according to Dr. Meyer to *N. hochstetteri*. Dr. Meyer has figured the skeleton of *N. mantelli* in plates 34–37 of his work.

WE are glad to see that the system of appointing men as professors who only teach, and scarcely that, is now being discussed in the United States. It is to be hoped that it will soon be discussed here. The following letter from a correspondent in Germany to the *New York Nation* of July 26 gives the last contribution to the ventilation of the subject:—"SIR,—The controversy carried on in your journal in regard to professorial salaries has not failed to attract considerable attention in Germany, and especially the comparisons instituted between the financial condition of American and that of German professors. As some wrong ideas seem to prevail in America on the subject of the remuneration of university professors in this country, I should like to call attention to the real state of affairs. In the first place, it must be understood that a man who is elected to fill a chair at some German university is not expected to act merely as a teacher. His abilities as an instructor are, as a rule, regarded as a matter of minor importance, if they are at all taken into consideration on his appointment. But he is required to advance science; and, to enable him to fulfil the expectations entertained of him, the Government feels bound to make him financially independent. A grand laboratory or observatory or clinic is placed at his disposal, enormous sums are voted to defray the expenses of the most costly scientific experiments, and, in order to allow him to devote himself exclusively to the advancement of his science, a large salary insures him against the necessity of undertaking extraneous labour. The salary of an 'ordinary professor' amounts to 15,000, often 20,000 or 25,000 marks ($3500 to $5000) per annum. Besides his regular pay he receives the fees paid him by those who attend his lectures. At large universities, like those of Berlin, Breslau, Munich, and Vienna, these fees may reach extraordinary amounts. At Berlin, Reichert, the Professor of Anatomy, is paid 120 marks ($30) by each student for the lecture on anatomy and the concomitant dissecting exercises, during the winter term alone. There were over 400 students, and the sum thus received by one professor amounts to over 48,000 marks. A professor of law or philosophy generally gets 20 marks from each student for a course of lectures extending over one term, and delivered three or four hours a week. As a professor usually delivers more than one course of lectures a term, and as his lectures, especially at a very large university, may be attended by about 150 or 200 students, the emoluments which he enjoys besides his salary may be considered as affording him quite a respectable income. Added to this, the 'ordinary professor' holds his position during good behaviour. Should he choose to resign in his old age, he has claims to a good pension. Socially the professors rank as high as officers, which signifies the respect in which the devotees of science are held in this military country. Prof. Esmarch of Kiel is allied by marriage to the Imperial family of Germany. This care which the German people takes of its savants, in absolving them from the necessity of engaging in the 'madding strife' for existence, is the main secret of the success of the German university system and German scientific triumphs. When the brain-power of the American nation shall be concentrated under such favourable conditions at a few grand seats of learning, and the drudgery of the pedagogue be exchanged for the fruitful labour of the independent scientist, then the youth of America will no longer be compelled to seek opportunities for intellectual development in Europe alone.—L. N."

ESTES AND LAURIAT, Boston (U.S.), announce, the *Nation* informs us, several important new publications: "Ornithology of the World," a popular treatise by Dr. Elliott Coues, fully illustrated; the same author's "Key to North American Birds," revised to date and entirely rewritten, with the incorporation of a practical manual of field ornithology; "The Natural History of Man," a popular work based on Hellwald's "Naturgeschichte des Menschen," which has been translated by Mr. J. S. Kingsley, and edited by him in conjunction with Messrs. W. H. Dall, F. W. Putnam, and Stephen Salisbury, jun.; "Travels in Mexico," by Fred. A. Ober, well equipped with drawings from the author's photographs and with maps.

ON July 19 a terrible hailstorm is reported to have passed over the Government of Tomsk in Siberia. The hail-stones were as big as eggs. Two women struck on the head were killed on the spot, besides a number of animals and birds. A terrible hailstorm is also reported to have raged in Iowa on the night of August 7. The track of the storm was four miles wide, passing through three counties. All vegetation was destroyed in its course. One woman lost her life, and many persons were injured. Twenty-two cattle were killed. The hail fell in some places to a depth of five feet. On the Rock Island, Chicago, and Milwaukee Railroads the trains were blocked; and at Lonah station nine freight cars were blown from the rails.

A SPECIAL correspondent of the *Daily Telegraph*, who has been on a visit to Mr. Stanley, and has journeyed a considerable distance up the Congo, contributes the first of a series of letters to Tuesday's issue of that journal, accompanied by a map and a rough sketch.

IT appears from recent analyses communicated to the Kieff Society of Naturalists, that the *Sorghum saccharatum*, of Minnesota, U.S., which was recently introduced into the Russian provinces of Poltava and Kieff, yielded as much as 14·2 to 16·7 per cent. of its weight of crystalline sugar, thus exceeding the average percentage of sugar, which commonly is from 9 to 9·5 per cent.

AN illustrated "Circular of Information," distributed by the United States Bureau of Education, directs attention to a very general yet very sad deficiency, viz. imperfect hearing. Dr. Sexton in it points out that it causes, among other things, defects in pronunciation through children not knowing the correct sound; and failure and ill temper among teachers who may be unaware of their pupils' defects or their own. He urges that the hearing of all pupils should be examined each session, and no one accepted as teacher who has not passed an aural test. He strongly recommends dental inspection of pupils, as from diseased teeth especially arise deficiencies of hearing, from which follow, first, the appearance of stupidity, and eventually the reality. Among the practical precautions recommended, abstinence from bathing seems a very costly one, but few pamphlets could show so clearly the interaction of physical and mental education.

MR. MATTIEU WILLIAMS points out that on p. 350 of NATURE, the dimensions of Jan Mayen are stated in "geographical miles," but that it is evident the old Norwegian sea mile is the measure used. This is equal to four English geographical miles. The length of the island is, therefore, thirty of *our* geographical miles. Mr. Williams says the "old" sea mile and the long land mile have, since July 1879, been legally superseded by the kilometre.

VOL. III. Part VII. of the *Transactions of the Essex Field Club* contains several long papers of interest, besides a considerable number of shorter ones. Among the former are "The Ancient Fauna of Essex," by Dr. H. Woodward; "The Macro-Lepidoptera of the District around Maldon," by Mr. G. H. Rayner; "Deneholes," by Mr. T. V. Holmes; "Primeval Man in the Valley of the Lea," by Mr. W. G. Smith; "On the Species of the Genus *Primula* in Essex," by Mr. Christie; with Mr. Meldola's presidential address, and a notice and portrait of the late Sir Antonio Brady. The society has also issued in a sepa-

rate form a collection of papers and memorials on the protection of wild animals and plants, and on the present condition and future management of Epping Forest.

AT the recent examination for the Licence ès Sciences Physiques in Paris, an English student, Mr. P. J. Hartog, B.Sc. Vict. Univ., passed first of the sixty-six candidates, though by three years the youngest of any.

DURING the latter part of this and the early part of next month a geographical congress and exhibition will take place in Douai. M. Ferdinand de Lesseps has been elected president. Belgium, Holland, Denmark, and Sweden will be represented.

THE United Steamship Association of Copenhagen has offered a free passage by their vessels to all Danish fishermen desirous of visiting the Fisheries Exhibition.

ON August 2, at about 10 p.m., a brilliant meteor passed from south to north over the town of Linköping in Sweden. When in the north-west it burst, spreading an intense pale blue light, and leaving a light smoke in the air which could be distinguished for several seconds. On July 23, at 10.15 p.m., a magnificent meteor was observed at Södertelje in Sweden. It went in a north-westerly direction, leaving a luminous track on the sky.

AS the representative of Sweden in the International Phytopathological Association, recently formed, Dr. J. Eriksson, botanist at the Academy of Agriculture, has been chosen. He is now engaged in collecting statistics and examples of diseases of plants, which it is the object of the Association to study and eradicate.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus* ♂) from India, presented by the Hon. Mrs. Pigott Carleton; two Maholi Galagos (*Galago maholi*) from South Africa, presented by Dr. Hugh Exton; a Rude Fox (*Canis rudis*) from Demerara, presented by Mr. Clement J. Bateman; a Suricate (*Suricata zenik* ♀) from South Africa, presented by Mr. Chas. H. Wootton; a Collared Peccary (*Dicotyles tajaçu*) from South America, presented by Mr. Fritz Zurcher; three Peregrine Falcons (*Falco peregrinus*), European, presented by Mr. J. Snowdon Henry, F.Z.S.; two Javan Adjutants (*Leptoptilus javanicus*) from Java, two Indian Tantalus (*Tantalus leucocephalus*) from India, presented by the Hon. W. H. Ravenscroft; a Sclater's Curassow (*Crax sclateri* ♀) from South America, presented by Mr. John Ardran; a Wood Owl (*Syrnium aluco*), British, presented by Mr. G. Carrick Steet; two Ring-tailed Lemurs (*Lemur catta*) from Madagascar, a Black Bear (*Ursus americanus* ♂) from North America, a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, deposited; three Indian Pythons (*Python molurus*) from India, purchased; two Mule Deer (*Cariacus macrotis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE SATELLITES OF SATURN.—Dr. W. Meyer has published corrected, or what he calls definitive, elements of the satellites *Enceladus*, *Tethys*, *Dione*, *Rhea*, *Titan*, and *Japetus*, chiefly founded upon his observations at the Observatory of Geneva in 1881, the mean motions however being determined from a comparison of the Geneva observations with the elements assigned by Jacob from measures of the satellites made at Madras during the years 1856-58. The mean distances and periods resulting from Dr. Meyer's investigations are as follow:—

	Mean distance in equatorial radii of Saturn.	Period. d. h. m. s.
Enceladus	3·8661	1 8 53 6·92
Tethys	4·8116	1 21 18 25·62
Dione	6·1629	2 17 41 9·29
Rhea	8·6082	4 12 25 11·57
Titan	19·9111	15 22 41 23·16
Japetus	57·9303	79 7 49 24·84

The other elements of the orbit of the outer satellite *Japetus* a e subjoined; those of Jacob are added for comparison. Meyer's epoch is 1881 Nov. 0·0 G.M.T.; Jacob's is 1858 Jan. 0·0 G.M.T.

	Meyer.	Jacob.
Mean longitude	200° 8′ 53″	... 294° 31′·1
Longitude of peri-Saturnium ...	353 5 7	... 349 20
,, ascending node ...	142 17 27	... 143 1·3
Inclination to ecliptic	18 26 50	... 18 37·9
Eccentricity	0·028916	... 0·028443
Semi-axis major (for mean distance of Saturn)	514″·711	... 514″·96
Mean diurnal motion	4°·538273	... 4°·538042

TEMPEL'S COMET OF SHORT PERIOD (1873 II.).—Prof. Krueger, in transferring to the *Astronomische Nachrichten* the few positions lately given in this column, mentions that M. Schulhof of Paris, who has undertaken the calculations for the comet, promises an ephemeris in due course for that periodical.

THE BISCHOFFSHEIM OBSERVATORY AT NICE.—M. Perrotin, Director of the Observatory of Montgros, near Nice, lately founded by the munificence and scientific spirit of M. Bischoffsheim of Paris, has made an excellent beginning in the proposed work of that establishment. The Observatory is provided with a refractor of 15 inches aperture, and about 18 feet focal length, the object glass by MM. Henry of the Observatory at Paris, the mounting by Eichens and Gautier. This instrument M. Perrotin applied in June last to measures of a number of the more interesting double-stars, and amongst them several very difficult objects. The magnifying powers most frequently employed were 750 and 1000, with occasional use of 400 and 650. We make a short selection from M. Perrotin's results:—

Star.	Epoch.	Angle.	Distance.
		°	″
42 Comæ Berenicis ...	1883·51 ...	11·5 ...	0·535
44 Böotis	— ·47 ...	240·6 ...	4·925
γ Coronæ Borealis ...	— ·53 ...	138 ...	(0 17 elong.)
ξ Scorpii	— ·52 ...	11 5 ...	1·16
ζ Herculis	— ·52 ...	99·5 ...	1·49
Σ 2107	— ·49 ...	231·2 ...	0·57
Σ 2173	— ·53 ...	35 *e* ...	0·15 *e*
τ Ophiuchi	— ·51 ...	252·1 ...	1·66
70 ,, ...	— ·49 ...	45·6 ...	2·28
λ Cygni	— ·51 ...	80·3 ...	0·65

With respect to Σ 2173 M. Perrotin remarks that his results confirm M. Otto Struve's opinion that the star revolves in about forty-six years. The above measures of the rapid binary ζ Herculis are closely represented by Dr. Doberck's last orbit.

THE LATE TRANSIT OF VENUS.—The last number of the *Comptes Rendus* of the Paris Academy of Sciences is almost wholly occupied by the preliminary Reports from the various expeditions sent by the French Commission for the observation of this phenomenon, and one or two expeditions acting in co-operation with the Commission. The observations of contacts, &c., appear in these Reports. The stations included are Petionville, Hayti; Puebla, Mexico; Fort Tartenson, Martinique; St. Augustin, Florida; Santa Cruz, Patagonia; Cerro-Negro near San Bernardo, Chili; Chubut, Patagonia; Rio Negro (4h. 21m. 20s. W. of Paris and 40° 47′ 51″ S.); Hoste Island, Orange Bay, Tierra del Fuego; and Bragado, Buenos Ayres. It is gratifying to note the general success which attended these expeditions, even at the most southern station in Orange Bay, the latitude of which was 55° 31′ 28″.

A CONTRIBUTION TO THE STUDY OF THE TRANSMISSION EASTWARDS ROUND THE GLOBE OF BAROMETRIC ABNORMAL MOVEMENTS[1]

II.

WHEN the fact of these simultaneous movements is recognised, the irregularities in the transmission eastwards of the abnormal movements can be in great part explained. For instance, taking the movements B″ of the Zanzibar curve, it is found to recur at B′ and B in the Belgaum and Bombay curves after an interval of six months, that is to say, about one month longer than the average, and is moreover of much greater magnitude in these curves than at Zanzibar. But it is noticeable that in the

[1] Concluded from p. 356.

month of November there was a very prominent simultaneous downward movement at the three stations, a movement which must have bent the curves very considerably out of the shape they would have taken had it not occurred, and it is allowable to suppose that the proper minimum in the Belgaum and Bombay curves corresponding to B″ of the Zanzibar curve took place in the month of October, 1881, that is to say, after the normal interval of five months, but was masked by the greater minimum in November, due to the simultaneous movement. Then again in the case of the maximum movement C, C′, and C″, the period between C and C″ is, if five months be assumed to be the normal, quite regular; but between C′ and C″ it is only four months, that is, one month shorter than usual. A reference to the dotted lines shows that in the month of January, 1882, all three curves were upheaved by a simultaneous movement, while in the following month they were all three depressed simultaneously. By the co-operation of these two simultaneous movements, the maximum C′ was apparently quickened in its course by one month, and hence the irregularity. Again, with regard to the double oscillation D, D′, and D″ (1 and 2) in the Zanzibar curve the first downward bend D''_1 is greater than the second D''_2; but in the Belgaum curve they are very nearly equal, and in the Bombay curve the first is even less than the second. On glancing down at the Zanzibar curve for the month of April, it is observable that an upward movement took place then; and if it be supposed that the upward impulse was felt at all the three stations simultaneously, but that this impulse was not so great at Bombay and Belgaum as the downward impulse due to the travelling movement coming from Zanzibar, then the actual effect at those two stations would be the resultant of the two impulses, that is to say, a downward movement of less amplitude than would have occurred had there been no simultaneous movement in that month.

The apparent acceleration of the movement A, A′, and A″ is susceptible of a similar explanation, though not quite so satisfactorily, and it may perhaps be admissible to reserve for it an explanation which will present itself hereafter.

The existence of these simultaneous movements seems not only to afford an explanation in great part of the irregularities observable in the eastward transmission of the travelling movements, but also to clear away an objection that was brought forward by Mr. E. Douglas Archibald to the acceptance as an established theory of the eastward movement of abnormal variations. He asked (*vide* NATURE, vol. xxiii. p. 400) "Why the barometric waves should commence on one meridian rather than one another." Now it is very noticeable (if a reference be made to the curves) that all the marked features of the curves—those features that are transmitted eastwards—occur in months when there are simultaneous movements at all the three stations, that in fact the simultaneous movements are the initial ones. And in the light of this fact the answer to Mr. Archibald's objection is that they do not commence on one meridian rather than on another, but (so far at any rate as the three stations under consideration are concerned) on all meridians simultaneously. But it is likely enough that they may be greater on one particular meridian, or at one particular point on that meridian, than on those on either side of, or about it, that in fact they result from a slight heaping up or withdrawing of the atmosphere over, or from, one part of the earth's surface, in which case the heap, or depression, will have its greatest altitude or depth at one particular place, but of course will be felt over a more or less considerable area around that place, and the degree in which it will be felt will be less as the length of the radius from the centre is increased. And that this is not altogether a fanciful idea is apparent on a reference being made to the smoothed curves, when it will be observed, for instance, that in July, 1880, and also in June, 1881, the upward movements were much greater at Bombay, the most northern of the three stations, than at Belgaum, a more southerly one; and at this, again, they were much greater than at Zanzibar, the most southern.

Mr. Archibald brings forward another objection. He asks: "If, as Mr. Chambers thinks, the waves of pressure travel slowly round the earth, why they do not reappear at the place where they started, after an interval of about one year and eight months (calculated from the lags given in Mr. Chambers's paper). At present there does not appear to be the slightest evidence that they reappear at all, and if they do not, when and where do they disappear?" One answer to this question is that they must, in the course of their eastward journey, get completely masked by other simultaneous movements of the atmosphere that are constantly taking place. Another answer to this question, and the one not requiring the supposition of the simultaneous movements, is that, as the travelling waves get further away from the place of their origin, and consequently widen out, their amplitude gets constantly less, until at last, like the waves caused by dropping a stone in a pond, they become imperceptible. If it were possible to eliminate the effect of the simultaneous movements, and examine only the curve produced by the travelling waves, one might then see this gradual decrease in their amplitude as they proceeded along their journey. It is impossible, however, at present to separate the effects of the two movements. An alternative method, however, to eliminating the effect of the first-mentioned movements is to pick out a period during which they were small or imperceptible. If such a period can be found, it will then doubtless be possible in some degree to trace the comparatively undisturbed action of the travelling movements. Such a period occurred from March to August, 1882, during which time the simultaneous abnormal movements were not easily traceable. And it is then seen how the amplitude of the double oscillation D′ (1 and 2) of the Zanzibar curve has diminished at D′ and D (1 and 2) of the Belgaum and Bombay curves.

Another question which may be raised with regard to the matter, and a question which is not so easily answered is, why these waves should travel in an easterly direction and not in a westerly? It would be imagined that they should be transmitted equally in both directions, or if they are transmitted in one direction rather than in the other, it should have been a westerly one; in which case their motion might have been accounted for readily enough by supposing the atmosphere to lay behind in equatorial regions in a westerly direction due to the influx of air of a lower velocity from the polar regions; and perhaps also by supposing the sun to exercise an influence in the matter. The fact is, however, that the motion is in the same direction as, and ahead of, the earth's rotation. It would be interesting, however, to see if there is any evidence of a westward motion, and referring to the curves with this object in view, such evidence is perhaps discoverable. For instance, the simultaneous movement in July, 1880, causes a very marked upward bend of the Bombay and Belgaum curves; if, then, there is any motion westwards, this upward bend should make its appearance in some succeeding month in the Zanzibar curve; and, as a matter of fact, there is an upward movement shown by the dotted line in the month of September. It is difficult to find many instances of this westward transmission, owing to the somewhat intricate mixture of movements presented by the curves; but the following instances may be adduced as lending some support to the hypothesis: there is a simultaneous downward movement in May, 1880, and there is an independent downward movement at Zanzibar in the month of August in the same year, that is, three months later; there is again the instance already cited of the simultaneous upward movement of July, 1880, recurring at Zanzibar in September, that is, two months later. It may be that the excessive downward movement at Zanzibar in the month of March, 1881, was in part due to the recurrence there of the simultaneous movement which occurred, especially developed at Bombay, in January of the same year; that is, two months before. Again, the very large downward movement at Zanzibar in October and November, 1881, may have been in part due to the arrival there from Bombay and Belgaum of the wave produced by the simultaneous downward movement which occurred in August, two and a half months earlier. And lastly, two instances less difficult to trace, owing to the absence of any marked simultaneous movements during the period of their occurrence, are the upward and downward movements at Zanzibar of the months April and May, 1882, which may be regarded as due to the arrival there from the west of India of the waves resulting from the simultaneous impulses received at all stations in January and February of the same year; that is, at periods of three months for each.

And here may be given the explanation previously referred to of the apparent acceleration in the rate of movement of the wave A, A′, and A″. It is possible that A and A′ may not be due to the arrival at Bombay and Belgaum of the maximum A″, but of the wave caused by the simultaneous movement which occurred in July six months before, a period much nearer the normal than are the periods three and three and a half months; in which case the maximum A″ would be due to the arrival at Zanzibar from Bombay and Belgaum of the wave caused by the

simultaneous movement in July, 1880, together with the simultaneous movement of October, 1880.

If this be a correct analysis of the curves, then there is the remarkable fact to be noted, that the motion of these waves in a westward direction takes place at an average rate of two and a half months, that is to say, twice as rapidly as in the eastward direction. And this fact would readily accord with the supposed westward lagging of the atmosphere due to its inertia; and also with any supposed influence of the sun. The presence of this westward transmission is not so apparent, however, as that of the eastward. And whether it be present or not, there still remains the difficulty, substantially the same as at the outset, that the motion eastwards is by far the most defined and most readily traceable; a difficulty for which I cannot even guess at any solution. Facts, however, should not be overlooked because they cannot be explained, but rather an explanation sought; and in the explanation of this fact theoretical matters of considerable interest may perhaps be involved. The only hints at any facts which might by any possibility suggest an explanation are to be found in Mr. Chambers's summary of his discovery, where he speaks of the direction eastwards being like that of "the cyclones of extra-tropical latitudes"; and in the very interesting and more suggestive statement of Dr. Balfour Stewart (*vide* NATURE, vol. xxii. p. 151), in which he says, speaking of terrestrial magnetism, "that we have some evidence which leads us to suspect that particular states of declination range, like particular states of weather have a motion from west to east, the magnetical moving faster than the meteorological."

As to the cause of these widely-distributed simultaneous movements of the barometer, movements which I consider to be in the main the initial impulses of the complication of abnormal movements visible in the curves, I have no evidence of any value. The most natural idea is that a connection, direct or indirect, may be traced between them and changes in the state of solar energy; the downward movements perhaps being due to an excess of energy, and the upward movements to a deficiency. In some points, perhaps, they may bear analogy to magnetic storms. I have not a sun-spot curve for the years under consideration, and cannot therefore make the necessary comparisons.

As a working hypothesis to serve as a guide in further investigating the matter, I should be inclined to suppose that the atmosphere, if it could, without stopping the earth's motion, be divested of its regular diurnal and seasonal movements, and the eddies and storms resulting therefrom, would present to observation a somewhat intricate mixture of motions consisting of the following elements:—

1. Certain initial movements, resulting mediately or immediately from changes in the state of the sun's energy, and affecting very wide areas, and being of the form of heapings up or drawings away of the atmosphere over these areas, the movements attaining their maximum height or depth at the centre of these areas. The centres of these areas would be immediately under the sun, that is to say, within the tropical latitudes.[1]

2. Waves resulting from the propagation in eastward and westward (and perhaps, though in a less marked degree northward and southward) directions of the impulses given by the first movements; the waves which travel eastward being for some unexplained reason more pronounced than those travelling westward, but their rate of motion over the earth's surface being, on account of the rotation of the earth and the atmosphere's inertia, slower in the eastward direction than in the westward.

3. Small local movements over more limited areas resulting from the chance conjunction and interference of any two or more of the first and second movements.

An extensive and detailed examination of the barometric records of stations scattered over the globe will bring to light facts either favourable or unfavourable to this hypothesis; and after this examination has been made, it will then be time to decide whether or not it is worth while undertaking the labour of dealing with the subject mathematically.

The matter seems important even theoretically, for in it and investigations of a like kind are to be found attempts at a rational arrangement of the very complex collection of facts contained in the various records of barometric abnormal movements; and practically also, for on the results of further investigation into it depends the confirmation or dismissal of a hypothesis which has given promise of furnishing a useful method of weather forecasting.

A. N. PEARSON,
Acg. Meteorological Reporter for Western India

Bombay, January 10

[1] Mr. H. F. Blanford's discovery of "a barometric see-saw between Russia and India in the sun-spot cycle" (*vide* NATURE, vol. xxi. p. 477) seems to support this hypothesis.

SCIENCE IN RUSSIA

THE Kieff Society of Naturalists was opened in 1869, and soon had more than a hundred members, mostly belonging to the University. Like other Societies of Naturalists at the Russian Universities, its chief aim has been the exploration of Russian natural history in the neighbouring provinces, these explorations proving that though the region around the Dnieper was not quite unknown in its geological, botanical, and zoological aspects, still there were wide lacunæ to be filled up before arriving at a thorough knowledge of it. Prof. Feofilaktoff, who had already published a geological map of the province of Kieff, assisted by several young geologists, busily explored, therefore, the surrounding provinces, especially on the right bank of the Dnieper, and published in the *Memoirs of the Kieff Society* a series of valuable papers on the Cretaceous, Tertiary, and post-Tertiary of the region, as well as on brown coal on the Dnieper. The Phanerogamic flora of the Dnieper region being sufficiently well known from the former works of Professors Andrzeiovski, Trautvetter, Rogowicz, and several others, the chief attention of the Society has been devoted to the Cryptogamic flora; and numerous papers by MM. Borschoff, Plutenko, Wältz, Rishavi, Timofeeff, Ryndovsky, Moshinsky, and Sovinsky, on the algæ, mosses, lichens, and fungi of the Dnieper region, as well as of Caucasus, appeared in the *Memoirs*. In zoology the chief researches were directed towards the exploration of the invertebrate fauna of the Black Sea, and whilst M. Bobretzky thoroughly studied the Annelids of the Black Sea, M. Krichagain carried out special studies of the Copepoda, and M. Paulson studied the Crustaceans of the Red Sea, in order to compare them with those of the great interior sea of Russia and Turkey. Several valuable papers were published at the same time on the anatomy and physiology of animals and plants, whilst the researches in chemistry and physics which were made at the Kieff University were mostly sent for publication to the *Journal of the Russian Chemical and Physical Society* at St. Petersburg.

Finally, the Kieff Society has undertaken, since 1873, the yearly publication of a most valuable systematic catalogue of papers in mathematics, in natural science, pure and applied, and in medicine, published throughout Russia in the numerous scientific publications which have grown up during the last ten years. These catalogues, which have reached during the last few years the size of large octavo volumes two hundred pages in extent for natural sciences and the same for medicine, are most valuable, as the number of provincial publications rapidly increases in Russia, and scientific papers of great value are virtually buried among the publications of the statistical committees, provincial assemblies, local scientific societies, and so on. The last (tenth) volume of this catalogue contains an index for the whole series of ten volumes.

The two last volumes of the *Memoirs* (*Zapiski*) *of the Kieff Society of Naturalists* (vols. v. and vi. 1879–1882) contains, like the preceding ones, a good many valuable papers. In geology we find several papers by Prof. Feofilaktoff and Schmalhausen. According to the former, the Eocene formation of the region has its central parts in the Government of Kieff, on the banks of the Dnieper. It consists of two series of deposits, the sandstones and sands of Traktemiroff, which only contain remains of Mollusks; and the Spondylus deposits which cover the former, and consist of sands, Spondylus clay, and greenish sands with plants (vol. v. fasc. 2). These plants, according to M. Schmalhausen's researches, which will soon be published by the Society, are the Alga *Chondrites*, similar to the Eocene *Chondrites Targionii*; a Conifer similar to the *Araucarites Duchartrei*; fruits of *Nipadites*, similar to those of the London clay; and pieces of Coniferæ and Palms and of a Bromelite (*Br. Dolinskii*, Schmalh.), fruits of tropical Leguminosæ (*Leguminosites Rogowiczi* and *L. Feofilaktowi*), and leaves of *Ficus prisca*. All these plants have been found in the upper parts of the clay, whilst in the sands that cover it M. Schmalhausen found a great number of stems and leaves of marine Monocotyledons, such as *Caulinites Rogowiczi* (a new species akin to the *Caulinites parisiensis*), and a new species of *Zorterites*, as well as parts of a new species of Graminea, *Polocapyrum inzertum* (vol. vi. *Pro-*

ceedings). In another paper Prof. Feofilaktoff gives a description of the diluvium of Poltava (vol. vi. fasc. 1). It consists of three different series of deposits, namely, the lower boulder clay, the loess, and the upper boulder deposits. The yellow loess of Poltava is a quite characteristic loess, and contains the usual *Helix hispida*, *Pupa muscorum*, and *Succinea oblonga*, but it is well stratified at certain places, as it contains intermediate deposits of sandy clay. The upper boulder clay reaches a thickness of forty to fifty feet, and contains boulders five to ten feet in diameter. It consists of materials brought from the north, with a mixture of local materials—chiefly of the underlying loess—without any kind of stratification of the different elements of which it consists. M. Schmalhausen gives a description, with a plate, of the stem of the *Protopteris punctata*, Sternb., from the Government of Volhynia. This sample seems to be the best known up to the present time, and M. Schmalhausen doubts whether this cretaceous fern has been found anywhere in Western Europe in so well-preserved a state. The incomplete samples which were often found in Western Europe led to its being described under the names of *Filicites punctatus*, *Sigillaria punctata*, *Caulopteris punctata*, and *Protopteris Sternbergi*. A note by Prof. Borschoff, on the downs of the Kyzyl-Koum Steppe, has been previously noticed in these columns. We notice also several analyses of Caucasian mineral waters.

The zoological papers are numerous and important. M. Krichaguin gives an account of his dredgings on the north-eastern coast of the Black Sea, and describes the following new species of Copepoda: *Monstrilla intermedia*, *Monstrilla pontica*, *Longipedia pontica*, *Tachidius Abrau*, *Canthocampus æguipes* and *longicaudatus*, *Liljeborgia pontica*, *Cleta brevirostris armata*, *C. Thalestris*, and *C. Liljeborgia*, *Westwoodia pontica*, *Thalestris filifera*, and *Oithona minuta*. His conclusions are: that the fauna of the Black Sea has great originality, owing to the large number of original genera it contains; that the cosmopolite forms either appear as original species, or have a resemblance to the Mediterranean ones, and that those species which are common to the Black Sea and northern seas have undergone important modifications (vol. v. fasc. 1). M. Sovinsky's paper on the Amphipods of the Bay of Sebastopol (vol. vi. fasc. 1) contains a complete monograph of the twenty-seven species he has found in this bay, and a description of four new species of *Sunamphitoë*, *Dexamine*, and *Microdeutopus*. Another paper by the same author (vol. vi. fasc. 2) contains a comparison, with plates, of the Red Sea species *Virbius proteus*, as well as the genera *Nikoides* and *Alpheodes*, established by M. Paulson, with the Black Sea forms *Virbius gracilis*, Hell., *Nikoides pontica*, and the Mediterranean *Alpheus dentipes*, which are nearly akin to the above. M. Bobretzky, who published, in 1870, in the *Memoirs of the Kieff Society of Naturalists*, a systematic description of forty-three species of *Annelida Polychæta*, has recently revised his determinations on the ground of new observations, as well as of the researches by MM. Claparède and Marion; and, without seeking to establish new species, he has preferred to establish a comparison between the Black Sea and Mediterranean forms, and to maintain only the three following new species: *Polynoë incerta*, *Ophelia taurica*, and *Terebellides carnea*.

In the department of comparative anatomy we notice an elaborate paper by M. Rumshewich, on the development of the eye among Vertebrates, accompanied by numerous plates; on the internal muscles of the eye of Reptiles (*Lacerta agilis*, *L. viridis*, *L. Stirpium*, *Chelonia fluviatilis*, and *Ch. midas*), by the same; on the reproductive organs in Annelids, and on the origin of the blastoderm in insects, by M. Bobretzky; and on the structure of the brain in man, by M. Betz.

Botany is represented in volumes v. and vi., only by lists of Phanerogams and of Algæ in the district of Radomysl, on the Teterev River, by M. Sovinsky; and chemistry by an elaborate paper, by M. Barzilovsky, on the nitrotoluols.

After having largely contributed during the years 1855 to 1865 to the purely geographical exploration of the unknown parts of Siberia and the adjacent countries, the East Siberian branch of the Russian Geographical Society entered upon a period of more thorough scientific exploration of Siberia itself. The merely geographical expeditions, such as that of MM. Czekanovski and Müller to the land of the Chuckches, became few and rare, and we now find the members of the Society engaged in a complete exploration of the natural history of Siberia, so that the two last volumes of the *Izvestia*[1] of the East Siberian branch bring us a series of researches into the geology and anthropology of Siberia. The first rank among these undoubtedly belongs to the geological explorations around Lake Baikal, by M. Chersky. The young geologist of Irkutsk publishes for the first time a most interesting geological map of the coasts of Lake Baikal. It appears from this map that the great mass of the mountains on the western shore of the lake consists of Laurentian crystalline slates, mostly chloritic schists and gneisses, overlying the aphanite schists and amphibolitic slates, with intercalations of granites, granito-syenites, and porphyries. The upper horizon of the same formation consists of the same slates and gneisses, with thick intermediate deposits of limestones. The whole is covered to the west with Silurian deposits, a large Jurassic freshwater basin occupying the depression of Irkutsk. Smaller depressions are occupied by freshwater Miocene deposits. The most important result of M. Chersky's researches is that (as was foreseen on the ground of orographic and architectonic data) the depression of Lake Baikal is not a longitudinal valley, as might be supposed at the first aspect. The chains of mountains we see on its western shore reappear on the eastern shore, maintaining the same direction from south-west to north-east, and *crossing* the lake in the shape of submerged low ridges. On the south-eastern shore of Lake Baikal M. Chersky found the continuation of the high plateau of Eastern Siberia consisting of the same two parts of the Laurentian formation, and covered with lower Silurian deposits, the depressions of which were occupied during the Tertiary period with freshwater lakes; there are also numerous traces of great lakes which covered wide tracts during the Post-Glacial period. As to the glacial period, the number of accurate observations published by the East Siberian geologists is unfortunately not in proportion to the amount of theoretical discussion, the only sure and new facts we have to mention being the presence of *roches moutonnées*, due to glaciation, on the northern shore of Lake Kossogol, that is, on the high plateau at the foot of its border-ridge, the Sayan Mountains (they were described by the late M. Czekanovski); traces of glaciation in the higher parts of this ridge; polished *roches moutonnées* at several places of the high plateau in the basin of Selenga, requiring, however, a more careful examination; and glacial deposits in the valley of the Irkut, due to local glaciers, whose extremities reached a height of less than 2000 feet above the present sea-level.

The Siberian branch of the Geographical Society has taken, during the last few years, a lively interest in anthropology and archæology, and we notice in the two last volumes of its *Izvestia* a series of papers on this subject. M. Vitkovsky's excavations of grave-mounds of the Stone period on the left bank of the Angara, at the mouth of the Kitoy, and also of the sand-hills which were inhabited by prehistoric man, have yielded a very rich collection of bones and implements. No less than twenty complete skeletons were dug out, twenty-five nephrite hatchets, numerous nephrite, jade, and quartzite arrow-points, bone needles, and implements for fishing. The most interesting feature of these implements is the presence in very great numbers of carved pieces of slate, pretty well polished, and representing seals. They occur in large quantities (160 in M. Vitkovsky's collection), and are of all sizes, from 150 millimetres to 15 millimetres long. These carvings of seals, as well as other implements, are illustrated in the plates which accompany M. Vitkovsky's paper. The skulls testify that the inhabitants of the Downs were a mixture of dolichocephals and brachiocephals, the former seeming to have predominated. The jade of which the hatchets were made was probably taken from the jade boulders which are found in the valley of the Byelaya River in the Government of Irkutsk. We notice, also, most valuable papers by M. Agapitoff on the hieroglyphics on cliffs on the western shore of Lake Baikal; and on the remains of prehistoric man in the province of Irkutsk, and on Olkhon Island. The hieroglyphic inscriptions on cliffs which are so numerous in the district of Minusinsk (they were lately figured in the St. Petersburg *Izvestia* of the Geographical Society) were supposed to be very rare towards the east; but simply because they remained unknown. Those on Lake Baikal (reproduced in the Siberian *Izvestia*) represent several men, of two different sizes, reindeer, deer, birds, and, most probably, a horse with a man upon it. The old graves are very numerous, too, on Olkhon Island, and they belong (according to the measurements of the skull) to Mongolians, as well as the remains of stone walls which were discovered on the shore of Lake Baikal. They contain iron implements, as well as glass globules and amber pearls.

The Siberian branch of the Geographical Society has also,

[1] *Izvestia* of the East Siberian branch of the Russian Geographical Society, vols. xii. and xiii. Irkutsk, 1881 to 1883.

during the last few years, devoted much attention to the meteorology of Siberia, and, besides the meteorological observations made at its stations, it has collected materials for ascertaining the dates of the freezing and breaking up of the ice in Siberian rivers. The list of these dates for the rivers of Siberia for the years 1874 to 1880 will certainly be consulted with profit, as also several brief notes on amber in Siberia, on chemical analyses of salt from various salt lakes, and of coral from the Nerchinsk district, and from the banks of the Amur, as also other smaller notes.

EXPERIMENTAL RESEARCHES ON THE ELECTRIC DISCHARGE WITH THE CHLORIDE OF SILVER BATTERY[1]

THE authors recall that at the conclusion of the third part of their researches (*Phil. Trans.* for June 11, Part I. vol. clxxi.) they stated that they intended to make an investigation on the dark discharge, and the special conditions of the negative discharge; this paper contains a number of experiments, more especially on the latter subject, and also others intended to throw light on the general nature of the electric discharge through gases.

The first part of the paper describes some experiments made with vessels of different forms in order to ascertain whether the dimensions and shape of the vessel have any effect on the pressure of minimum resistance to the electric discharge. This was found to be the case; for example, with a residual air charge in a spheroidal vessel 7 inches (17·8 centims.) long, and 5 inches (12·7 centims.) diameter (Fig. 1), the pressure of minimum resistance was as high as 3 millims., 3947 M; while in a tube 22·5 inches (57 centims.) long, and 1·625 inches (4·1 centims.) diameter, it was only 0·69 millim., 908 M; again in a smaller tube 23 inches (58·4 centims.) long, and 0·75 inch (1·9 centims.) diameter, it was 1 millim., 1316 M. It is evident, therefore, that not only the dimensions of the tube, but possibly also the shape of the terminals, have an influence on the pressure of least resistance, and it is very probable that in the atmosphere, where lateral expansion is practically unlimited, the conditions of minimum resistance are different from those which exist even

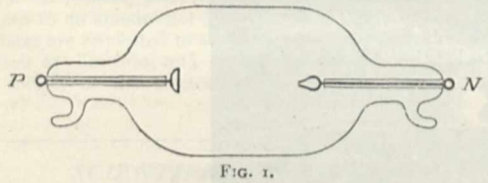


FIG. 1.

in very large tubes, and that this may influence the height of the aurora.

The paper next deals with the discharge in miniature tubes $\frac{7}{8}$ inch (2·2 centims.) long, and $\frac{1}{4}$ inch (0·63 centim.) diameter, with terminals nearly touching; at first it required 2400 cells to pass, then a single cell would do so, but after standing a short time it required 4800 cells to reproduce a discharge. In another tube $1\frac{3}{4}$ inch (4·4 centims.) long and $\frac{3}{8}$ inch (0·95 centim.) diameter), with the terminals distant 0·00104 inch (0·0264 millim.), it required 2240 cells to produce a discharge, then the potential had to be increased to 11,240 cells to do so. Ultimately even this number failed, but after the tube had lain by for some days 600 cells could pass. It is very possible that the strong discharge in the first instance volatilised a portion of the terminals which were of platinum, and that this volatilised metal condensed afterwards, or else that the terminals absorbed the gas so completely as to produce a vacuum too perfect to admit of a discharge taking place; and that ultimately sufficient of the occluded gas was again given off to render it again possible.

In connection with the occlusion of gas by terminals a case is described in which the terminals are of palladium and the charge hydrogen (Fig. 2). After a few discharges the terminals occluded some of the gas, and when a fresh one was produced a volatile compound of hydrogen and palladium was given off, especially from the negative, and produced a dense, mirror-like coating on the inside of the tube (Fig. 3); this was reoccluded by standing for a couple of days, leaving the tube free, and again given off to form a new mirror-like coating with a fresh discharge; this property has continued since March, 1875.

The paper next describes experiments to ascertain the length of the spark in dry air and in air saturated with moisture. It was found to be practically the same in both cases. With 10,860 cells the mean length of the spark between two paraboloidal points was found to be in dry air 0·45 inch (1·1 centims.), in moist air 0·447 inch (1·1 centims.).

The next subject taken up is the discharge in a tube from two batteries, first in the same and then in contrary directions. In the tube are two terminals at each end, one pair at opposite ends being inclosed in two short pieces of tube 9 inches (22·8 centims.) long and $\frac{1}{2}$ inch (1·27 centims.) diameter; the main tube being 31 inches (95·2 centims.) long and $1\frac{3}{4}$ inch (4·4 centims.) diameter. The various phases of the stratified discharge are represented in an engraved mezzotint steel plate copied from photographs, and show the effect of the one stratified discharge on another stratified discharge produced by a second battery. It is seen that two discharges in contrary directions may take place in the same tube, and that the one modifies the aspect of the other.

Experiments are also described in a tube in the form of a cross with four arms at right angles (Fig. 4), with two separate batteries connected in various ways with the different members.

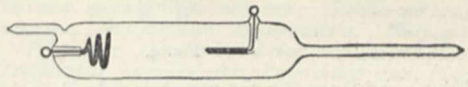


FIG. 2.

The experiments were made both in air and in hydrogen. By the introduction of external resistance of one of the batteries, the discharge could be readily identified as belonging to that battery by the effect of the resistance on the character of the stratification. In one of the mezzotint plates are several figures copied from photographs which show clearly the phenomena produced. Calling the poles P and N of one battery, A, and P′ and N′ of the other, B, it is shown in one case when two currents were equal 0·0083 ampere, that a discharge from A battery goes from P in the direction of N only so far as the junction at the cross, and then turns off to N′, the negative of the other battery B; while, on the other hand, the discharge of the B battery goes from P′ to N of the A battery. The case is different if an external resistance is introduced in one of the discharges, reducing it to 0·00087 ampere, then the discharge of the A battery goes from P to N, and that of the B battery from P′ to N′. There is a bending down, however, of the strata of the weaker discharge of the cross junction, in consequence of the action of the stronger one.

The authors remark that one cannot but be impressed, from the experiments described in the paper, and others in their former papers, by the apparent plasticity of the aggregate assem-

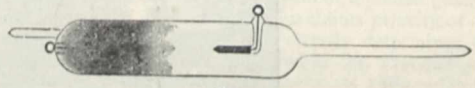


FIG. 3.

blage of molecules constituting a stratum which yields to external influences that modify its form.

The authors describe and figure a case of complex strata in the form of an outer bracket convex towards the negative (Fig. 5), and close to it an inner chord; also discharges in various gases in tubes of large dimensions, 37 inches (94 centims.) long, and $5\frac{1}{16}$ inches (14·8 centims.) diameter. In these the stratification, which is comparatively narrow at the terminals, extends in a conical form from the terminals to the full diameter of the tube.

They have found that the dark space in the discharge in vacuum tubes is only relatively actinically dark in comparison with a stratum, and they succeeded in obtaining a photograph of the dark space in thirty-five minutes as strong as that from a stratum in two and a half seconds; consequently they conclude that the dark space is 840 times less actinically bright than a stratum.

The authors next describe a number of experiments, by means of a Thomas-Becker electrometer used on a method, to avoid leakage, proposed to them by Prof. Stokes, to ascertain the difference of potential in different parts of a vacuum tube having a number of rings sealed within it, also in other tubes of special construction. These bring out instructive information, in reference not only to the relative resistances of different lengths of a

[1] Abstract of a paper read at the Royal Society on June 14, by Warren De La Rue, M.A., D.C.L., F.R.S., and Hugo W. Müller, Ph.D., F.R.S.

column of gas at various pressures, but also forcibly to the impediment presented by the terminals themselves to the passage of a discharge from gas to terminal and terminal to gas.

It is shown that, at moderate exhausts, the resistance to the passage of the discharge is uniform along the length of the column of gas, and that at high exhausts it is not so, and that the total resistance increases but slightly with an additional length of the column; moreover, that, at these low pressures, the main impediment is in the passage of electricity between gas and terminal or terminal and gas; this is much greater at the negative than at the positive terminal.

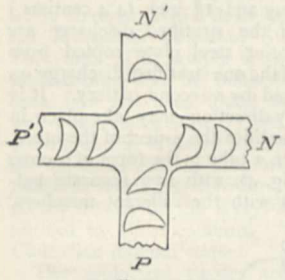


FIG. 4.

FIG. 5.

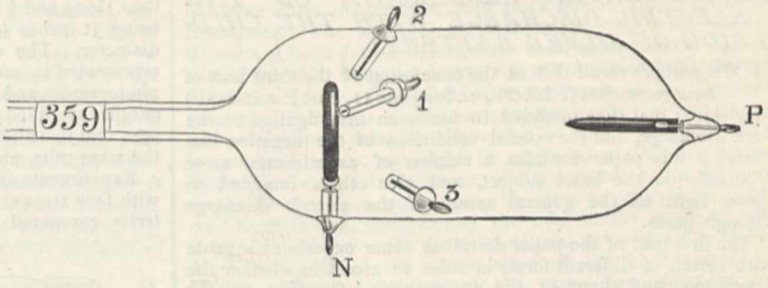


FIG. 6.

The authors have next studied the electrical condition of a gas in the immediate vicinity of the negative terminal. In order to do this they constructed a tube $4\frac{1}{2}$ inches (11·4 centims.) long and $1\frac{7}{8}$ inches (4·8 centims.) diameter. One terminal is in the form of a point, the other in the form of a ring. The positive pole of the battery was connected with the point, and the negative either to the ring alone or to earth as well; the ring terminal of the tube was, when the battery was insulated, connected with earth either by means of a stout wire or 3 feet (91·4 centims.) of fine platinum wire, 0·002 inch (0·005 centim.) diameter, and offering a resistance of 81 ohms, or a moistened cork offering a resistance of 4,300,000 ohms. In the tube were sealed three idle wires, 1, 2, 3, covered with the exception of their extremities with fine glass tubing (Fig. 6). No. 1 idle wire is 0·002 inch (0·005 centim.); No. 2 0·2 inch (0·5 centim.); and No. 3 0·6 inch (1·5 centims.) from the ring. The ring terminal, when connected to earth, was found to be always at zero potential; notwithstanding this there was frequently observed, more especially as the exhaust was increased, a negative potential when the idle wires were connected successively with the electrometer, amounting in one case with an air charge, pressure 0·01 millim., at wire No. 2, to 1068 cells, at wires 1 and 3 to 912 cells. At other times a plus potential was observed. Many experiments were made to determine the precise conditions which developed a negative potential or a positive potential, but unsuccessfully, and it was inferred that this depended on the condition of the discharge itself within the tube. It is certainly very remarkable that, while the potential of the negative ring was absolutely zero, a high negative potential should be developed in its near vicinity.

The authors remark that every one familiar with the appearance of a stratified discharge will have noticed when the negative terminal is a ring, that as the exhaust proceeds a spindle of light approaches and at last protrudes through the interior of it (Fig. 7, 1, 2, 3, 4, 5); this spindle they regard as a visible exponent of strong action among the molecules of gas composing it. In order to probe its electrical condition they prepared a tube with a central idle wire surrounded by a minute glass tube, except its extremity, and projecting to a distance of $\frac{3}{8}$ inch (0·95 centim.) from the plane of the ring, which was made negative. Another idle wire was sealed in the tube 0·15 inch (0·38 centim.) from the periphery of the ring. As the exhaust proceeded with a charge of carbonic anhydride, the spindle approached the ring and ultimately protruded through it. It was found that the potential of the central idle wire increased with the exhaust, until it nearly or quite equalled that of the whole tube; while that of the external idle wire was only 0·054 that of the tube.

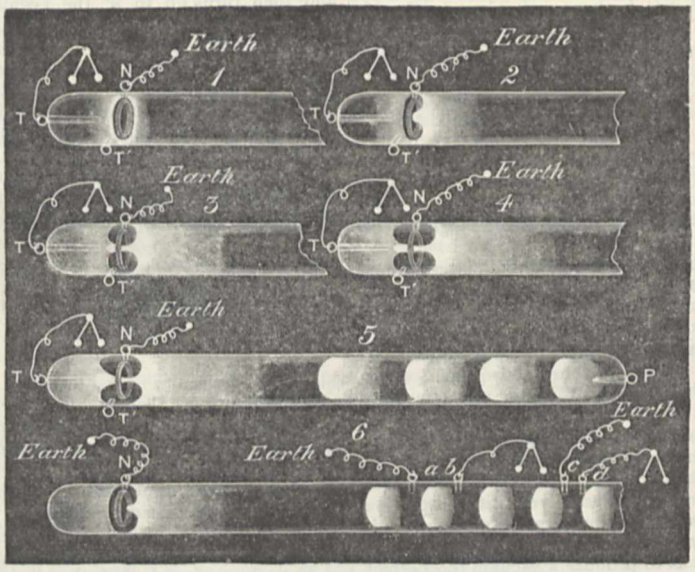


FIG. 7.

A great number of experiments were made to test the potential across a stratum *a*, *b*, and across a dark space *c*, *d*, respectively, by two idle wires sealed in suitable positions in a tube, one of which was connected with earth, the other with the electrometer (Fig. 7, 6). The gases used were carbonic anhydride and hydrogen respectively. As a mean of a great number of experiments it was found that when a dark space was straddled,

the potential being reckoned 1, then when a stratum was straddled the potential was 1·243, 1·229.

On testing two idle wires distant ⅛ inch (1·6 centims.) apart with a Thomson-Becker galvanometer, the current in this fractional part of a tube was found to go frequently in the reverse direction to that of the main current, and when the galvanometer was connected to two idle wires diametrically opposite, currents

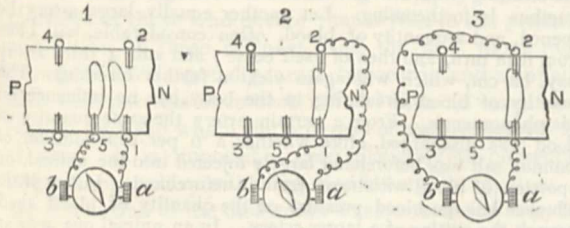


FIG. 8.

were indicated sometimes in one direction, sometimes in another across the tube (Fig. 8). These experiments seem to indicate that there are eddies in the gas during a discharge, as if the motion of the molecules conveying an electric discharge was of an epicycloidal character. The authors conclude by saying that it is possible that the eddies may be connected with the production of strata.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—We are requested to announce that the Savilian Professorship of Geometry is vacant, and an election to the office will be held before the end of Michaelmas Term (December 17). A Fellowship in New College is now annexed to the Professorship. The duty of the Professor is to lecture and give instruction in Pure and Analytical Geometry.

The combined emoluments of the office from both sources will be, for the present, 700*l.* a year, but may possibly hereafter be increased to an amount not exceeding 900*l.* a year.

Candidates are requested to send to the Registrar of the University their applications, and any documents which they may wish to submit to the electors, on or before Wednesday, October 31.

SCIENTIFIC SERIALS

Bulletin of the Belgian Royal Academy of Sciences, June.—On the action of amygdaline during the germination of bitter almonds, by M. A. Jorissen.—Determination of the specific heat of some organic bodies; variations experienced by this quantity through change of temperature, by M. de Heen. Of the eleven substances examined, three only—the formic salts of sodium, calcium, and barium—maintained a perceptibly constant specific heat within the limits of a temperature ranging from 10° to 93° C. A considerable increase of specific heat was shown by most of the other bodies tested.—Note on a double series of equations, by M. E. Catelan.—Anatomical study of the Æschnines (*Æ. grandis* and *heros*), by Baron Edm. de Selys Longchamps. Appended is a complete tabulated classification of the Æschnideæ (Æschna of Fabricius and Latreille).—On a deposit of *Oldhamia radiata* (Forbes) recently discovered in Tubize, Brabant, by M. C. Malaise. From its position in the Brabant schistose system the author is induced to refer this rock to the Lower Cambrian formations.—Attempted determination of the relation $\frac{C}{A}$ of the principal momenta of inertia in the terrestial spheroid, by M. E. Ronkar. In this paper a twofold series of calculations are made, based respectively on the hypotheses of Lipschitz and Laplace regarding the mean density of the crust of the earth.—Note by the editor on the explanation of the prevailing blue colour in large volumes of pure water advanced by M. Montigny.

Annalen der Physik und Chemie, July.—Electrical researches, by G. Quincke.—Researches on the slow discharge, by Heinrich Hertz, with six diagrams.—On the difference in the discharge from the positive and negative electrodes, by H. Hellman of Riga.—New observations on the thermo- and actino-electricity of rock crystal as a reply to a memoir of C. Freidel and J. Curie, by W. Haukel.—On the variation of the magnetic coefficient with the hardness of steel, by Hugo Meyer.—On the coefficient of friction of mercury and its variation with the temperature, by Synesius Koch, with three diagrams.—Theory of light for perfectly transparent light, by W. Voigt.—Concerning the theory of light, by E. Lommel.—On the sound of impinging flames, by K. Noack (three diagrams).—A new apparatus for showing Foucault's streams, by Dr. A. von Waltenhofen.—On the relation between the fundamental note and overtones of transverse vibrations in open metal cylinders, by Hugo Feukner.—On the reciprocal of the strain of closely-tuned elastic bodies, by Dr. G. Krebs.

SOCIETIES AND ACADEMIES

SYDNEY

Linnean Society of New South Wales, June 27.—Prof. W. J. Stephens, M.A., in the chair.—The following papers were read:—Descriptions of new genera and species of fishes by Charles W. De Vis, B.A. Two genera are described, *Dactylophora* of the family *Cirrhitidæ*, and *Leme* of the family *Amblyopina*. The new species described are: *Girella carbonaria*, *Girella neuralis*, *Dactylophora semimaculata*, *Platycephalus semermis*, *Polynemus speculatis*, *Leme mordax*, *Sphyræna strenua*, *Trochocopus sanguinolentus*, *Labrichthys dux*, *Plagusia notata*, *Synaptura cinerea*, and *Crossorhinus ornatus*.—A fourth paper on plants indigenous in the immediate neighbourhood of Sydney, by Mr. E. Haviland.—Localities of some species of Polynesian recent mollusca, by John Brazier, C.M.Z.S., &c.

PARIS

Academy of Sciences, August 6.—M. Blanchard, president, in the chair.—Preliminary reports on the transit of Venus, December 2, 1882, at the Transit Stations of Haiti, by MM. D'Abbadie, Callandreau, and Chapuis; of Mexico, by MM. Bouquet de la Grye, Héraud, and Arago; of Martinique, by MM. Tisserand, Bigourdan, and Puiseux; of Florida, by M. Perrier; of Patagonia, by M. Fleuriais; of Chili, by MM. de Bernardières, Barnaud, and Favereau; of Chubut, by M. Hatt; of Monte Video, by M. de Penfentenyo; of Rio-Negro, by M. Perrotin; of Cape Horn, by M. Courcelle-Seneuil; of Bragado, by M. Perrin. These reports, deposited with the Secretary of the Academy on the return of the several expeditions, are here collected together for the convenience of astronomical students.—Active or dynamic resistance of solids. Graphic representation of the laws of longitudinal thrust applied to one end of a prismatic rod, the other end of which is fixed (concluded), by MM. de Saint-Venant and Flamant.—In reply to a recent communication by M. Jamin on the critical point of liquefied gases, a letter was read from Mr. W. Ramsay, who claims priority of discovery, and points out that he had already determined the critical point in a memoir which appeared in the *Proceedings of the Royal Society* for April 22 and December 16, 1880.—On the application of Ampère's method to the investigation of the elementary law of electric induction by variation of intensity, by M. Quet.—On boron, by M. A. Joly. In this paper the author determines the existence of a combination of boron and carbon, reserving for a future communication a study of the various compounds containing these two elements.—On the blood plaquettes of M. Bizzozero, and on Norris's third or invisible blood corpuscle, by M. G. Hayem. It is shown that the so-called "plaquettes," claimed by Bizzozero as a new discovery in the Italian *Archives of Biology* for January, 1882, *et seq.*, are simply the "hæmatoblasts" already described by M. Hayem. On the other hand Norris's "third or invisible corpuscle," which had been identified with the hæmatoblasts, appears not to be a new element at all, but merely an artificial product resulting from the various manipulations to which the blood had been subjected by the English observer.—Experimental researches on some phenomena relative to the absorption of animal fats, by M. A. Lebedeff.—On the true character of the ophthalmic affection known as astigmatic keratite, by M. G. Martin.—New researches on the curve of the muscular shock in various affections of the nervo-muscular system, with three illustrations, by M. Maurice Mendelssohn.—Influence of sea water on freshwater animals, and of fresh water on marine fauna, by M. Felix Plateau.—On barometric pressure in connection with igneous eruptions, by M. Fr. Laur. It is argued that gaseous and other eruptions are due exclusively to rapid variations of atmospheric pressure.

BERLIN

Physiological Society, July 20.—Prof. Kronecker reported a number of investigations recently carried out in the division of the Physiological Institute under his care: Dr. Openschewsky had continued his observations, communicated at the meeting of June 15 (NATURE, vol. xxviii. p. 264), regarding the influence of the vagus on rhythmical movements of the cardia produced by artificial anæmia. As the result of his further examination he found that the vagus sent two branches of nerves to the cardia: one causing its contraction, the other, when alone stimulated, its dilatation. In the vagus trunk the enlarging nerves were in the preponderance, and, on the whole of the vagus being stimulated, induced an interception of the contractions of the cardia. In a demonstration of the experiment it was shown that after destruction of the stimulating branch of the vagus the irritation of its trunk invariably provoked dilatations of the cardia.—Dr. Jacub had made experiments regarding the strength and rhythm of the movements of the uterus, and regarding the influence on these movements of a number of substances, such as secale, ether, chloral, strychnine.—Herr Aronsohn had instituted a long series of observations on the physiology of smell, observations which he himself communicated to the meeting. It is well known that Weber, from experiments made with eau-de-cologne, had laid down the statement hitherto universally accepted that gaseous substances were alone capable of stimulating the extremities of the olfactory nerves. In opposition, however, to this doctrine there was the fact of fishes being able to smell, a fact Herr Aronsohn conclusively established. Ants' eggs, which are greedily devoured by goldfishes, he saturated with a strong flavour of asafœtida, and on placing them within reach of a number of hungry goldfishes they all darted away from the otherwise savoury food. He therefore repeated Weber's experiment exactly in the manner prescribed, and had, like him, his sense of smell affected only during the infusion of the eau-de-cologne solution. Immediately, however, such an intense sensation of pain was experienced, that the experiment had very soon to be abandoned. It was evident that Weber's solution was much too concentrated, and that in order to achieve trustworthy results dilutions of much larger proportion would have to be made use of. Moreover, for the purpose of solution, instead of the water which produced so powerful an effect on the tissue, the common salt solution of ·6 per cent., which was of indifferent effect, would require to be employed. Finally the due temperature would have to be imparted to the fluid. Under these conditions a long series of experiments was now instituted with oil of nettles, camphor, eau-de-cologne, and other smelling substances. In far the greater number of cases these experiments yielded positive results. Granted that the solutions had the necessary degree of dilution (which among the different materials varied from ·1 to ·001 per cent.) and the due temperature (which might range from 37° to 62° C., though from 40° to 44° C. proved the most suitable), then on their application to the nostrils a decided and lasting smell was perceived. These experiments were not only carried out by Herr Aronsohn himself, but were repeated by other competent observers, the due degrees of dilution and temperature, which differed according to the different observers, producing always the same effect. The result in the one case as in the other was invariably positive, and went to refute the hitherto current notion that gaseous substances alone affected the sense of smell and that fluids had no effect on the olfactory nerves. On emptying out the fluid there was mostly always left a scent of which one remained sensible for a very considerable time. Contrary to former declarations, the breath emitted from the lungs also decidedly affected the olfactory nerves, provided the experiment were conducted in such a way that the particles to be smelled on expiration could reach the upper parts of the nostril. Herr Aronsohn finally made observations tending to establish the liability to weariness of the sense of smell, a fact of which any one might readily convince himself by the following experiment:—Let him take two roses, A and B, as like each other as possible; let him now first smell A for fifteen consecutive seconds, and then on trying B he will find it has very much less scent, or none at all. Let the olfactory sense now recover itself, and then let him, conversely, first smell B for fifteen seconds, and pass to A; he will now find the same defective or negative scent in A as formerly in B.—Dr. Kireef directed his observations towards the discovery of the conditions determining the fact that now and again, by the cutting of one carotid animals could not be bled, but in order to this end a second carotid must also be cut. In the pursuit of this problem a series of important facts came to light demanding further searching study, and which therefore can here for the present only be alluded to. In all the larger arteries it has been observed that on the cutting of a blood vessel only a certain fraction of the total blood, from about two-thirds to five-sevenths, runs away, and then without any visible cause the bleeding stops, though the wound is still gaping wide, and no trombus is forthcoming. Let another equally large artery be opened, and a quantity of blood, often considerable, will issue from it in turn, and then of itself cease; and still a third artery may be cut, which will again yield a further bleeding. The quantity of blood circulating in the body has no influence on this phenomenon. From a certain artery the same quantity of blood was discharged, alike whether a ·6 per cent solution of common salt was beforehand largely injected into the animal, or a portion of blood withdrawn from it beforehand. Just as little influence has the blood pressure on the quantity of blood shed through the cutting of a larger artery. In an animal one *arteria femoralis* was freely cleared out of its integuments for a considerable extent of its surroundings, while another was left in its natural position. The last on being cut shed a certain quantity of blood at double the speed, *i.e.* in half the time taken by the freely cleared artery. The vagus showed a very remarkable influence on the bleeding from a cut artery, an influence to be further traced and demonstrated in the continuation of the experiments.

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