THURSDAY, FEBRUARY 19, 1880

MADAGASCAR

The Great African Island. Chapters on Madagascar. By the Rev. James Sibree, Jun., F.R.G.S., of the London Missionary Society. (London: Trübner and Co., 1880.)

MR. SIBREE'S book is described on the title-page as a popular account of recent researches in the physical geography, geology, and exploration of the country, and its natural history and botany; and in its origin and divisions, customs and language, superstitions, folk-lore, and religious beliefs and practices of the different tribes. Together with illustrations of scripture and early church history, from native statists and missionary experience. The book commences with an interesting summary of ancient notices and accounts of the island of Madagascar, with a continuation of the history of its discovery and exploration down to the present time. The author identifies Madagascar, as has been done by some former writers, with Menuthias of Ptolemy, but there seems little doubt that Menuthias, which is described in the "Periplus Maris Erythræi," is, as considered by Bunsen, Karl Müller, and others, the island of Zanzibar. The author admits in a note that there is some doubt about the matter. In his account of the early Arab names of the island he is not quite clear. The Arabian voyagers named the island, the home of the roc (Æpyornis), the Island of the Moon, possibly from the neighbourhood of the Mountains of the Moon. They wrote the name either Kamar or Komr, which latter name survives in the modern title of the small outlying group, the Comoro Islands, which the Arabs called Komäir or the lesser Komr. The name, as applied to the main island, survived until the arrival of the Portuguese, for on one of the oldest maps, the Charta Marina Portugalensium, of the first decade of the sixteenth century, the name Komortina occurs for the island in addition to those of Madagascar and San Lourenço.

The author attributes the discovery of the east coast of Madagascar to Don Francisco de Almeida in 1506, whereas Antão Gonçalves is given by Peschel as the discoverer and also as the giver of the name San Lourenço, which is attributed by the author to João Gomez d'Abreu. It seems, however, probable that a still earlier voyager may have discovered the east coast of the island, a certain Diogo Dias, commander of a ship of Cabral's fleet, and brother of Bartholomew Dias.

The best map of Madagascar is that published last year by the late Rev. Dr. Mullens, which is partly based on M. Grandidier's sketch-map, published in 1871. The island is nearly 1,000 miles long and 350 miles broad at its greatest extent, and being the third island in size in the world, is nearly four times as large as England and Wales. It consists of an elevated interior region from 3,000 to 5,000 feet in elevation, and a comparatively level surrounding country raised from 400 to 500 feet above sea-level, extending also over a vast area to the west and south, into which region the more elevated land does not extend. All around the coast is a belt of virgin forest with an average breadth of from fifteen to twenty miles, much of which is still unexplored. A good deal of the elevated interior is bare and somewhat dreary-looking. "The long rolling moor-like hills are only covered with a coarse grass, which becomes very brown and dry towards the end of the seven months' rainy season." The largest river is 300 miles long, and could be ascended by steamers of light draught for about ninety miles. The central plateau consists of primary and igneous rocks, and is plainly, as might have been foretold from the nature of the fauna of the island, of great antiquity. There are secondary and recent deposits on the lower region, and in the latter M. Grandidier discovered the fossil remains of a hippopotamus. With the hippopotamus occur the bones of *Æpyornis maximus*, the gigantic fossil eggs of which probably gave rise to the fabulous stories of the roc. The bones of two other species of Æpyornis have now been discovered, one was as big as a cassowary, the other only as large as a bustard.

To naturalists accustomed to think of Madagascar as full of the most interesting of animals, it seems strange to learn that "a stranger crossing the forest is always struck with the general stillness of the woods and apparent scarcity of birds seen on the route;" but after all, stillness is more or less characteristic of all forests. The lemurs, at all events, make themselves heard. "In travelling from the coast to the elevated plateaux of the interior one is sure frequently to hear their loud wailing cries, which sometimes make the woods resound for some minutes together and have a most startling effect when heard for the first time." One lemur (*L. catta*) is not arboreal like the remainder, but lives amongst the rock, having feet specially modified to suit this kind of existence. The natives have a superstitious dread of the Aye-aye (Cheiromys), believing that a person who kills one will die within a year. The hedgehogs (Centetidæ), of which there are five genera and nine species in the island, are used as food, having much the taste of pork. They seem to be very abundant in the woods, in low scattered brushwood. "We frequently met with three or four varieties whilst rambling in the outskirts of the woods." They do not roll themselves up into a ball like our hedgehogs, but put their head between their fore-paws when in attitude of defence.

We must pass over the further account of the fauna and flora, and turn to the later and more important portion of the work which treats of the ethnology of the island, and which is especially valuable. A part of it has already been published in the *Proceedings* of the Anthropological Institute and of the Folk-Lore Society, as well as in NATURE. The population of Madagascar is a very mixed one, and the exact history of its development is extremely difficult to trace. There are, possibly, traces still remaining of an aboriginal stock, that is to say, of races which existed in the island before later African colonisation and very long before the Malayan incursion. There are numerous indications of the occupation of the country now held by the Hovas, which are the race of the island which at present exhibit the purest Malay blood, by an earlier people called Vazimba. Superstition unfortunately prevents the opening of the graves of this extinct race. They are said to have been ignorant of the use of iron, and to have been of low stature. There are also vague accounts of another

dwarf race with woolly hair, the Kimos; and of still another, the Béhòsy. There seems to be great uncertainty as to the reality of these three races, and as to whether any of them yet exist, as they are said by some to do in the part of Madagascar as yet unexplored by Europeans. It is quite possible that some people allied to the Bushmen may have occupied the island in early times. The main mass of the population is made up of the lighter coloured more distinctly Malay races, and of a much darker skinned race with frizzly hair, and of all gradations between these two. The latter stock are regarded by most ethnologists as of African affinity, whereas the author thinks they may be Melanesians, and have reached the island from the same source as the Malays, a supposition which we can hardly regard as probable. The Rev. W. E. Cousins concludes from his researches that the Malagasy language represents an ancient stage in the Malay tongue, now so widely spread over the Indian and Pacific Oceans, and thus, as far as philology is concerned, it is probable that the emigration of the Malagasy tribes from the east took place at a remote era. The author speculates from the obscure evidence of certain lists of Hova kings as to the date at which the Hovas arrived at the island, and concludes that probably not much, if at all later than the Norman conquest, perhaps much earlier, but he seems unaware of a fact of some importance, namely, that in an Arab account of the middle of the thirteenth century, the inhabitants of Komr are spoken of as the "Brothers of the Chinese," *i.e.*, evidently Malays, whilst a town in the island is mentioned by name as "Malay" both in this later account and a century earlier by Edrisi.

But the problem of the Madagascar population is still further complicated; Arabs visited the island from very early times from the mainland, and constantly imported African slaves by hundreds in their dhows, and continued to do so until up to a very short time ago. They settled in the country and mixed with the population, and their influence is still in active operation on the north-west of the island. On the eastern coast there is a strong European mixture in the population, partly ancient, partly modern, due to Creole settlers, and planters, and sailors of all nationalities. There is, further, much Indian blood in the country, derived mostly from Bombay.

The influence of the missionaries has had the usual effect upon the Malagasy language, numerous English words connected with religious belief have been imported into it wonderfully spelled. For example, "Jesosy Kraisty." It is, perhaps, rather a pity, than a matter of congratulation, as the author considers it, that the poor Malagasys have learnt the English words "demon" and "devil," which are in the list he gives. The account of the language is full of interest. The names of villages show many parallels to English names of places. There are, for example, Oxfords, Holytowns, Kingstowns, Princetowns, and Stonebridges. Divorce is delightfully easy in Madagascar; a tired or angry husband merely sends for his wife and gives her a piece of money before witnesses saying, "I thank you, madam," and the thing is done. Divorce is hence termed "thanking a wife." Like the New Zealanders, the Malagasys are beginning to give up nose rubbing as a salutation, and are taking to our important improvement on this ancient practice, kissing. In old times they used to lick the foot of a superior as a salutation, a form which survives with us only in the case of the adoration of the pope.

The Hova girls plaster their faces with a white paste, and thus make themselves fairer when it is removed; this is a novel suggestion for possible adoption in Europe, a sort of putting the complexion in curl-papers. The girls also wear black spots on their faces, corresponding with our patches. The young men grow long nails on their little fingers with great care, thus curiously imitating the Chinese. Curiously enough, no stone implements or weapons have as yet been discovered in Madagascar. It must be almost the only inhabited place in the world where they have not been found. Probably they will yet be discovered. Their absence would be strong evidence against the former existence of the dwarf aboriginal race in the island.

In Chapter XVI., headed "New Light on Old Texts; Illustrations of Scripture from Malagasy Customs," the author draws so many parallels between Malagasy customs and those of ancient Semitic and other races as recorded in the Bible, that we feared greatly he was going to discover the lost tribes; but he is not a man to do anything so foolish. Very likely, however, some one will be found before long to do it for him with his data. Madagascar is about the only place remaining in which the discovery has not been made, now that Mr. McLeod has published his "Japan and the Lost Tribes of Israel,"[1] and identified Jin Mu Tenno's Samurai with these "wandering Jews."

In the concluding chapter of the book, on "Malagasy Church Life as Illustrative of the History of the Apostolic and Early Churches," some most interesting information is given. It appears that the Malagasy people have spontaneously developed by a process of reasoning nearly all those brilliant innovations which it is the pride of our own most advanced Ritualists to have copied from others. Thus a story is told of a terrible case of suspense in which baptism had been performed with water in a sacramental cup in lack of some other suitable vessel. What was to be done with the holy water? It would never do to throw it away; so at last a good deacon drank it. Stranger still, amongst Mr. Sibree's own people at Ambohimanga, he found a notion springing up that they ought to fast before communicating, and they appealed to him as to whether he did not do so and whether it was not improper to allow the elements to mix with common food. They also had a strong feeling that the ceremony should take place only in the forenoon and only on the first Sunday in the month. Further, some natives employed to make the bread used in the Eucharist did so in secret after various ceremonial ablutions, and explained that their reason was that "they did not want unbelievers to know how the bread was made for fear they should despise it." Any bread left over they took to the Government House, and ate there only after prayer. All these ideas have, according to Mr. Sibree, been developed quite independently of the Malagasys, though we cannot help suspecting them as due, partly at least, to French Roman Catholic influence. Only in the matter of vestments apparently do the Mala-

[1] "Japan and the Lost Tribes of Israel. Epitome of the Ancient History of Japan." By G. N. McLeod. (Rising Sun Office, Nagasaki, Japan, 1879.)

gasys seem not to have developed Ritualistic tendencies; but they have advanced notions concerning ornament, bright colours look especially well on a brown skin, and possibly before long a Malagasy bishop may appear in full Ritualistic fig, evolved out of his inner consciousness. If so, may we be there to see.

We have only been able to touch here and there on the many interesting subjects discussed by Mr. Sibree. This book is a most valuable addition to knowledge and very entertaining. It contains several full-page illustrations (not all new) and two maps.

CLAUSIUS'S "MECHANICAL THEORY OF HEAT"

The Mechanical Theory of Heat. By R. Clausius. Translated by W. R. Browne, M.A. (London: Macmillan and Co.)

THIS translation satisfies a real want of a tolerably large class of students of science. It furnishes in a volume of reasonable size a clear and readable account of a subject, an acquaintance with which has until lately been only obtainable by an English reader at the cost of a great deal of research through the transactions and memoirs of various societies. The name of its author furnishes a sufficient guarantee of the accuracy of the substance matter of the book, treating as it does of a subject specially his own. The method of treatment leaves hardly anything to be desired, even from the point of view of a student previously ignorant of the subject. The reader is nowhere perplexed by uncouth symbols or analytical operations beyond those which are familiar to all acquainted with the principles of the differential and integral calculus. At the same time, and perhaps partly in consequence of this avoidance of complicated analysis, the reader is never allowed to lose sight of the essential meaning of the symbols employed. Some of the chapters in the book will furnish a valuable exercise in the meaning and value of partial differential coefficients, even to a student who is not specially interested in the physical questions discussed. The same remark applies to some of the explanations given in the mathematical introduction, on the nature of the integral of a total differential in the case when the condition of being an exact differential is not fulfilled, explanations originally inserted, as the author tells us, in consequence of objections made to his theory by Prof. Decher.

Any one wishing to gain a general acquaintance, thorough as far as it goes, with the subject, can scarcely do so with the expenditure of less time and labour than are required for the perusal of this book. As a mathematical study the book may replace some of the luxuriant growths of modern geometry and analysis with great advantage to the brains of the student.

The translation is admirably done. It is hardly possible in reading it to recognise any traces of foreign idiom. Occasionally we find some little confusion of phraseology, probably arising from loose translation; as on page 210, where a rather curious description is given of the ordinary process of changing the independent variables from x, y, to ξ, η, and this process is apparently referred to, a little lower down, as an "artifice." It is a pity, too, and a little surprising, considering the array of scientific talent mentioned in the preface as having been applied to the correction of first proofs, that the book should be disfigured by so many misprints. Not to speak of great uncertainty as to the insertion or omission of a comma between the two variables inside a bracket after a functional symbol, and the sign × between two factors of a product, there are many serious errors. Thus, for instance, on page 69 we have "volumes" for "values:" on pages 117 and 124 we have the sign + for ×; on page 187 we have dT for T. In equations (19) and (20) of page 190 we have $\frac{dQ}{dT}$ written instead of $\frac{dQ}{dP}$, and the error is repeated twice lower down on the same page. The figure of the steam-engine on page 237, described as an "imaginary one," certainly strikes one as decidedly imaginary. The insertion of a few valves in the figure at suitable places would render it more satisfactory, at any rate to an unimaginative reader. It may be hoped that these blemishes will be removed when a second edition is reached of what, in spite of them, is an exceedingly valuable addition to our English mathematical literature. W. S. A.

OUR BOOK SHELF

Noxious and Beneficial Insects of the State of Illinois. Third Annual Report. By Cyrus Thomas, State Entomologist. Pp. 1–212. 8vo. (Springfield, 1879)

IF we might be permitted to propose another title for this book, we would suggest that of "An Essay towards a Monograph of North American *Aphides*." But we fancy such a title would be too much opposed to that borne on the cover. We fear the Report is too profound to be of service to agriculturists and horticulturists, otherwise than on the same grounds that an intelligent mother of a family is enabled, from the study of a medical dictionary (intended for the use of the profesion only), to diagnose the symptoms of measles, croup, and other ills that infantine humanity is heir to. We might make the same objection to the titles of a multitude of American *scientific* publications. The axiom that "the end justifies the means" scarcely needs being called into requisition in a notice of this Report; yet some uncertainty exists in our mind as to the end aimed at. Does it consist in enabling unscientific, but intelligent, farmers and horticulturists to identify their plant-lice foes? or is it intended as a prominent contribution towards a knowledge of these insects, to be made use of by scientific workers principally? We do not attempt to solve the problem, but prefer to regard the Report more especially in the last-named light.

Looking, then, at the scientific side of the question, we see here a most valuable contribution to a natural history of American *Aphides*, and in some respects we think it would have been better had the author not been hampered with the necessity of producing a popular report at the same time. It is impossible to give an analysis of the author's views on the many vexed questions in the life-cycles of these noxious atoms. Much of the introductory remarks on habits has been of necessity (and advisedly) compiled, and the suggestions as to dimorphism (p. 31) have, we think, been somewhat fully anticipated; still there remain some very potent suggestions made by Dr. Thomas; not the least of which is in what form those species that appear habitually to attack *annual* plants only, pass the winter months?

A multitude of new species are described, and others already noticed have been more fully investigated and the details given. Naturally, many European species occur also in America. For these the author has mainly (as is acknowledged) made use of Mr. Buckton's yet incomplete monograph of the British species, adopting also the latter author's somewhat unscientific form of bibliographical and synonymic quotation. Some very glaring typographical errors are corrected, but only in the place where they first occur, although constantly recurring; others almost equally important are not noticed.

Zur Kenntniss der Fauna des untersten Lias in den Nordalpen. Von Dr. Neumayer. (Vienna, 1879.)

ENGLISH geologists who are interested in the study of the Infralias, will welcome this latest contribution to science by the indefatigable palæontologist of Vienna. The fossils described have been obtained principally from three localities — Pfonsjoch, in the Northern Tyrol, Breitenberg, in the Osterhorn group, and Zlambach in the Traunthale. Among the sixty-six forms here noticed, a large proportion are either identical with species which have been described in Western Europe or present such slight points of difference that Dr. Neumayer has not felt himself warranted in giving them distinct names. It is very interesting to find how close is the agreement in the general characters of the fossils of these Infralias beds in the Mediterranean province with the fauna of the strata on the same horizon in England, France, and Swabia. As in Western Europe, so in the Alpine province, we find the numerous varieties of *Ammonites* (*Aegoceras*) *angulatus* and *planorbis*, especially characterising the zone by their great abundance; while *Ostrea arietis*, *Lima punctata*, *L. gigantea*, *L. succincta*, *Modiola psilonoti*, *Myoconcha psilonoti*, and *Unicardium cardioides*, are associated with these ammonites in both areas. Besides these familiar forms there occur, however, some others which are quite unknown in Western Europe. Dr. Neumayer's monograph is illustrated with seven well-executed lithographic plates, and is a very valuable contribution to our knowledge of the Jurassic formation in the Alps.

J. W. J.

Africa Past and Present. By an Old Resident. (London: Hodder and Stoughton, 1879.)

IN "Africa Past and Present" the writer carries us back to the time when Herodotus, collecting material for his history, in the absence of written documents, travelled to Africa. Then follow chapters on enterprising Arabs, who penetrated into the interior of the country at a far distant period, and on the Portuguese early English and French discoveries. Accounts are given of the travellers who were sent out by the African Association to explore the interior of the country, prominent among whom were Mungo Park, "whose melancholy fate did not damp the ardent desire of the British public for further information concerning the interior of the great continent." Then follow descriptions of the more recent adventures and discoveries of Speke, Grant, Baker, Livingstone, and others, though the author makes no reference to the important work done by recent German explorers. The latter half of the book is devoted to the history and physical geography of the country, the author taking each division and giving topographical details of it, and speaking of its climate, resources, productions, and character, manners, and social condition of its inhabitants. The book is intended as a handbook for missionaries, merchants, travellers, and emigrants who wish for information about Africa. As such it will be useful. The book has many illustrations and a map of the country. It has also the advantage of being cheap and portable.

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 ensure the appearance even of communications containing interesting and novel facts.*]

Ice-Crystals

I HAVE been prevented by other work from thanking your correspondents who offered explanations of the peculiar forms taken by ice-crystals upon rotten ligneous fibre.

Will you, however, allow me to say that the explanation offered is one respecting which I am very sceptical.

That explanation is that the long filaments, like spun glass, are merely the result of the internal freezing of the moisture in the substance of the wood and of the expansive force of that freezing pressing the ice thus formed through the pores of the wood.

My impression is that if this were the cause the expansive force would be sufficient to destroy the ligneous fibre altogether, and break it up. I question also whether there are any pores or tubes of the kind and size required by this theory running in the direction of the medullary rays. Lastly, as upright arborescent forms of ice-crystal are formed upon dry wood and upon other substances, which cannot possibly be due to any such cause, I am inclined to think that this particular form is determined by some other cause than the one suggested. The filaments are much too long and much too crystalline in structure to be the mere result of extrusion from an internal mass of ice.

Argyll Lodge, Kensington, February 14 ARGYLL

Kœnig's Collection at the Philadelphia Exhibition

MY attention has just been drawn to the fact that a report has recently been circulated in London to the effect that the splendid collection of acoustic apparatus exhibited by Kœnig, of Paris, at the Centennial Exhibition of 1876, had been retained in this country for the Stevens Institute of Technology, under promise of payment, and that nothing had been paid for it.

As regards the Stevens Institute, I have to say that the report is utterly without foundation.

We have never had one of the instruments in our charge, nor has a word ever been said about purchasing it for our use.

The collection was, in fact, removed from the Centennial building to the University of Pennsylvania at Philadelphia, which is about one hundred miles from here, where it now remains, and it has been currently reported that a gentleman in Philadelphia had presented it to the said University. As to that part of the story I know nothing, but I do know absolutely that the Stevens Institute of Technology has never had anything directly or indirectly to do with the matter.

HENRY MORTON

Stevens Institute of Technology, Hoboken, New Jersey, February 4

"Scientific Jokes"

I DO not know who your correspondent "G. H." may be, but I should surmise from the tone of his letter that he is somewhat of a beginner in science, and that he is so proud of his acquaintance with certain elementary propositions in thermodynamics, that he is on the *qui vive* to detect in others an ignorance of them. In my opinion the fair meaning of the passage objected to, when read with its context, is that the author is drawing a parallel between temperature in heat and potential in electricity (between which there are striking analogies), and that the words to which your correspondent refers are purposely employed to prevent any one imagining (as "G. H." seems to have done) that it was intended to represent the energy of heat as the *product* of heat and temperature in the same manner as that of electricity is the product of quantity and potential. Temperature is treated as inseparable from heat and nothing more, just as potential is inseparable from electricity, and this is not an unscientific view of the matter.

The latter part of the letter relating to the theory of terrestrial magnetism, propounded by Professors Ayrton and Perry, is, I

think, still less creditable to the writer. Whatever be one's own views on the subject, the question of the tenability of the theory is still *sub judice*, and it is not becoming in "G.H." to speak so contemptuously of the author of the address for not taking the same view as he does of the merits of the controversy.

74, Onslow Gardens, S.W. J. FLETCHER MOULTON

On the Mode of the Transverse Propagation of Light

IN NATURE, vol. xxi. p. 301, is a letter by Mr. W. M. Hicks containing some critical remarks on a paper of mine, "On a Mode of explaining the Transverse Vibrations of Light" (NATURE, vol. xxi. p. 256), which I shall be glad to notice here.

Firstly, it is, no doubt, understood that the theory proposed by me cannot be regarded as *in opposition* to any existing theory, from the simple fact that no theory or clear conception of the constitution of the ether (in regard to the mode of propagation of the transverse vibrations of light) appears really to exist. The notion of the ether resembling a "solid" or an "infinitely thin jelly," cannot, of course, be regarded otherwise than as a resource in the face of a difficulty, which, however, we think must appear to any impartial inquirer to increase rather than diminish the difficulty; and therefore the inference would seem a not unreasonable one that any *true* theory of the constitution of the ether would be something totally different from "statical" theories of this kind. As it has been one of my objects to prove, after considerable attention given to the subject, that but *one* view of the constitution of the ether is in principle conceivable (or that one solution to the problem already exhausts the limits of the conceivable), I may therefore be excused for having some confidence in the fundamental groundwork (at least) of the view adopted, and am therefore all the more ready to reply to any criticisms on the subject, though no doubt (as in the case of any theory possessing points of novelty) difficulties may be expected at first to arise that may entail considerable thought to remove them. It need not be premised that the attainment of truth is the ultimate object of all.

In the first place, in regard to the remarkable means of correcting and adjusting their own motions that atoms moving freely among each other have been proved to possess, I may at once withdraw the expression "instantly," in regard to the rate at which this self-adjustment takes place. The expression is at best a vague one, and the idea arose from the known fact of the practically instantaneous adjustment that takes place in the case of an ordinary gas. The mean velocity of the ether atoms would, of course, be necessarily equal to that of light, and all that is essential is that the adjustment should be rapid enough to maintain adequately the equilibrium of the ether.

In regard to the second difficulty mentioned; I do not see that the fact of some of the atoms of ether moving at a greater or less velocity than the *mean* velocity (which is equal to that of light) should put a difficulty in the way of accounting for the regularity of the waves of light. For it has been proved in connection with the kinetic theory that the number of atoms whose velocities differ by any great proportion from the mean velocity is relatively very small. These atoms would no doubt distribute the energy irregularly over the beam of light, but the total effect would in this way neutralise itself. The great majority of the atoms would still be moving at the mean velocity and distributing the energy in regular waves, and producing that sequence of energy that we call light. I may note that in a paper on "The Mode of the Propagation of Sound on the Basis of the Kinetic Theory of Gases," published by me in the *Phil. Mag.* for June, 1877, and where a mathematical determination of the velocity of the wave was appended by the late Prof. Clerk Maxwell—the same considerations regarding the varying velocities of the atoms would be involved as above; and yet we know that as a fact the sequence of the waves of sound is in perfect regularity.

In reference to the third difficulty mentioned by Mr. W. M. Hicks, regarding the explanation of refraction and reflection. This leads me more strongly to return to a detail in regard to the constitution of the ether I had before adopted, but had not fully grounded, probably from the absence of the requisite encouragement to devote an adequate amount of thought to the subject. I quote the following in substance from a paper already written. I am led to regard the ether atoms as of *two* grades of dimensions. Of course there is no *à priori* reason why they should be all of one size, and the fact of their being of two sizes does not alter the principle of the theory in the least. They may therefore be assumed, if facts require it, to be of two grades of dimensions. The one set of atoms (specially concerned in the effects of gravity) are to be considered as enormously smaller than the atoms propagating light, and consequently their velocity (which will adjust itself automatically in the inverse ratio of the square root of their mass) very much greater. It might perfectly well be assumed (for example), that the mass of the atoms producing gravity is such that their velocity equals, say 10,000 times the velocity of light. I would just remark, in connection with this, that the expression "wonderful" sometimes applied to the velocity of light is, I think, to be deprecated. I would submit that there is nothing really "wonderful" in any velocity, because, however great a velocity is, it is always indefinitely small compared with that which it might be conceived to be, as one has in strict logic no power to limit arbitrarily the conceptions in this respect. If, therefore, there be reason for inferring a certain velocity to exist (no consequence what its value), it seems to me there is no ground for assuming it to be "wonderful." If a body or atom moves in free space without obstruction, there is nothing to curb its velocity, and its energy may even become immeasurably small at this velocity, provided the atom itself be small; and, in the same way, we have nothing to limit our conceptions as to the smallness of atoms. There can be no difficulty whatever in these conceptions, as mechanical principles are admittedly independent of *scale*, and therefore there is nothing mysterious whatever in the subject. The real mystery surely attaches to the spiritualistic assumptions about "forces" which spoil the interest of physical inquiries, and have involved that magnificent physical agent, the ether, in such a labyrinth of spurious mystery as to repel the inquirer. I cannot avoid the inference that any one who reflects seriously and impartially on the subject, will be disposed to admit that there really cannot be *two* methods in physical science, but only *one* method (the dynamical), the so-called "statical" speculations about "forces" leading nowhere. It has been proved again and again in connection with science that the so-called spiritualistic "method" is utterly barren, and only involves one in an inextricable maze of speculation from which there is no escape. I have thought these few remarks necessary in view of the special subject with which I am dealing.

It will be observed that the whole of the dynamical effects above referred to are automatic. The correction of the motion of the atoms so as to move in the right way to produce gravity and light is automatic; the adjustment of the relative velocities of the atoms between the two sets is automatic, or we make no arbitrary postulate at all. The effect of an adequate velocity for the smaller set of atoms would necessarily (from well-known dynamical principles) cause them to oppose no measurable resistance to the molecules of gross matter vibrating in them, and consequently they could take no measurable part in the propagation of the energy of light. They would, on the other hand, produce an enormous pressure (adequate for gravity) on the molecules of gross matter—the pressure being as the *square* of the velocity.[1]

The main reasons for assuming that the atoms producing gravity and those producing light are separate, are first the great pressure requisite for gravity, and the consequent necessity for an adequately high velocity to produce this pressure, and secondly (as Mr. W. M. Hicks points out), there would appear to be a difficulty in explaining the reflection of light from some bodies, and also the phenomena of refraction, if we assumed the atoms propagating light to pass through all bodies with perfect facility, as is necessary in the case of the atoms which produce gravity. As this letter has already grown to some length, I will at present confine myself to this inference, reserving some ideas relative to polarisation (in connection with the present theory) to a subsequent letter.

To prevent misconception, the fact may be cited that the above kinetic theory of the ether does not represent an *emission* theory of light. The motion of translation (which the ether atoms would possess if there were no light) merely serves as the carrier of the energy impressed upon them by the vibrations of the molecules of gross matter. On the other hand, the fact of the theory resembling (in the translation of the atoms) *one* of the ideas of Newton may possibly be regarded as rather a recommendation than otherwise. If, however (as I have certainly set

[1] If observation shows light to suffer no (sensible) diminution of velocity at reflection, it would follow that the luminiferous atoms do not suffer a (sensible) diminution of their translatory motion at rebound from gross matter, and consequently these particular atoms could not be appreciably concerned in the effects of gravity.

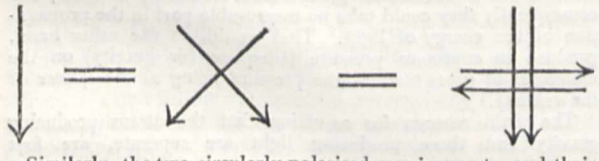
myself the task to prove) there is not really more than *one* explanation of the constitution of the ether in principle conceivable [excluding, of course, the essentially endless vagaries about "forces"], then on this ground alone the hope may be entertained by those who look to the existence of an *explanation* for every physical fact, that difficulties that may naturally present themselves at first will not prove insurmountable by a due amount of thought and careful analysis. S. TOLVER PRESTON

The Transverse Vibrations of Light

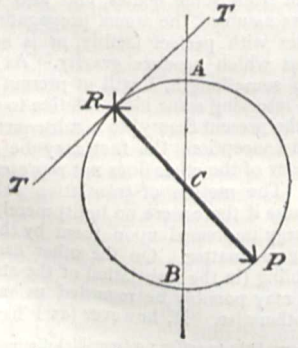
FEW are probably likely to underrate the vast benefits which have accrued to physical science since the time of Poisson, from the application of mathematical analysis to physical problems; but it seems to me we are at present rather in danger of forgetting that such mathematical reasoning can only lead to useful results when founded upon definite physical conceptions. It was upon such a basis that the triumphs of Young, Fresnel, and Airy were won; and it is for want of such a basis that I fear we shall get little aid from Mr. Tolver Preston's ingenious speculation. Mr. Hicks has taken some exceptions to them, which seem sound if he has correctly read the theory, though I am not quite sure he has, or that I should go quite with him in regard to what Mr. Preston *may* mean. But I wish to point out, with your permission, objections of a more simple and definite physical nature.

The only transverse movements capable of being communicated to an ether-molecule by transverse vibrations of matter, which do not involve translation through a measurable though minute distance in space, appear to be rotation on an axis, or (if we conceive the molecule as an annulus) alternate contraction and expansion—"vibration" Mr. Preston calls it—within its own limits. In the case of a gaseous constitution, transverse translation in space with the assumed long free path, must continue, and result in a free path different from the assumed direction of the ray. The particles of sand employed to illustrate the subject thus acquire a continuous transverse *motion* in passing through the sieve, and do not "vibrate" or come back in an orbit. Such true vibratory motion is the main characteristic of solid bodies, and is the best known reason for conceiving the ether as of a "solid" constitution.

What I wish to point out is, that large classes of phenomena appear to demand such actual transverse *motion* in orbits of the entire ether particles, and cannot at present be explained without. I confine myself to two of the simplest examples from polarisation. It is well known that the production of complementary colours from a plane polarised ray by a doubly-refracting film and analyser, may be simply represented to the eye and the mind by the following diagram equation, which shows the resolution of actual *motions*.



Similarly, the two circularly-polarised rays in quartz, and their conversion on emergence into a plane ray rotated on its axis by the angular value of the difference in velocity, may be represented thus:—



Here actual motions in the plane AB are resolved into two opposite circular motions represented by the doubly-barbed circle, which meet on their emergence at the point R, to which their respective velocities from the common departure A have brought them. There they are again resolved, the two tangential forces TR destroying each other, and the two radial forces, RC, uniting in the rotated plane wave, RP. Here again we have throughout actual motions, through definite distances. And I am at a loss to see how whole classes of phenomena of which these are typical can be explained in any other way, or by any but a true "vibration" bodily to and fro in space. If it be so, then it is not enough for some vague physico-mathematical notion to satisfy abstract mathematical conditions; we must ask for the definite physical conception which is to account for the physical phenomena. Until we have this we have made no real advance in comprehending the physics of the ether.

At the same time I cordially agree with Mr. Preston in his regret at the comparative distaste for the study of this subject; and I may, perhaps, add a suggestion on my own part, though not really new. To my own mind it seems as easy to conceive of "matter" without gravity as with it, and of infinite elasticity as of elasticity at all (which is not easy). In ponderable matter, again, the most highly elastic solid bodies are as "solid" as the least; the greater mobility of their atoms by no means interferes with that peculiarity of vibrating *in orbits* and preserving a *locus* which distinguishes solids from fluids, and which so far we have been obliged by the phenomena to attribute to the ether also. Granted that to account for elasticity we have to conceive atoms not in contact, and are confronted by the old mystery of how they can act upon each other across a vacuum. Still, does this confront us any *more* in the ether than in ponderable matter; and, so far as they do go, are not our conceptions of the one sufficient for and equally applicable to the other?

LEWIS WRIGHT

Wellfield, Ashley Road, Crouch Hill, N.

Diffusion of Copper in the Animal Kingdom

JE lis dans la NATURE, vol. xxi. p. 305, un article intitulé "Diffusion of Copper in the Animal Kingdom," se terminant par ces mots: *it is to be hoped that more extended observations will inform us of the exact nature of the rôle played by cupric compounds in the animal economy.* Je crois pouvoir satisfaire en partie au moins à ce vœu. Dans plusieurs communications insérées dans les publications des Académies des Sciences de Paris et de Bruxelles (1878 et 1879), j'ai montré que chez certains mollusques céphalopodes et gastéropodes et chez les crustacés décapodes, le cuivre joue dans le sang le même rôle physiologique que le fer dans notre sang.

Le sang veineux dû poulpe (*Octopus vulgaris*), du homard (*Homarus*), etc., contient une substance albuminoïde incolore, cuprifère, à laquelle j'ai donné le nom *d'hémocyanine*, terme rappelant sa parenté avec l'hémoglobine. *L'hémocyanine* forme dans la branchie une combinaison peu stable avec l'oxygène; cette combinaison *l'oxy-hémocyanine* est d'un beau bleu. Elle se décolore en se dissociant sous l'influence du vide ou du contact avec les tissus vivants. Aussi le sang artériel du poulpe est d'un beau bleu tant que l'animal respire une eau bien aérée. Il suffit de comprimer la branchie, de gêner la respiration, pour voir le sang artériel se décolorer.

L'hémocyanine paraît avoir une constitution chimique analogue à celle de l'hémoglobine. Comme cette dernière elle est susceptible de se dédoubler en une substance albuminoïde ne contenant pas de métal et en une substance cuprifère qui paraît former des sels cristallisables analogues aux sels d'hématine.

LÉON FREDERICQ

Liége, le 11 février, rue du parc, 25

Lines of Force due to a Small Magnet

I HAVE been recommended by Sir William Thomson to send you the following construction for the lines of force due to a very small magnet.

The equation to the lines of force due to a very small magnet placed at the origin of co-ordinates and lying along the axis of x is—

$$\frac{y^2}{(x^2+y^2)^{\frac{3}{2}}} = \frac{1}{C} \quad \ldots\ldots\ldots \quad (1)$$

By varying C we obtain a series of similar curves.

Transforming to polar co-ordinates by putting $x = r\cos\theta$, $y = r\sin\theta$, we get for the equation (1)

$$r = C\sin^2\theta.$$

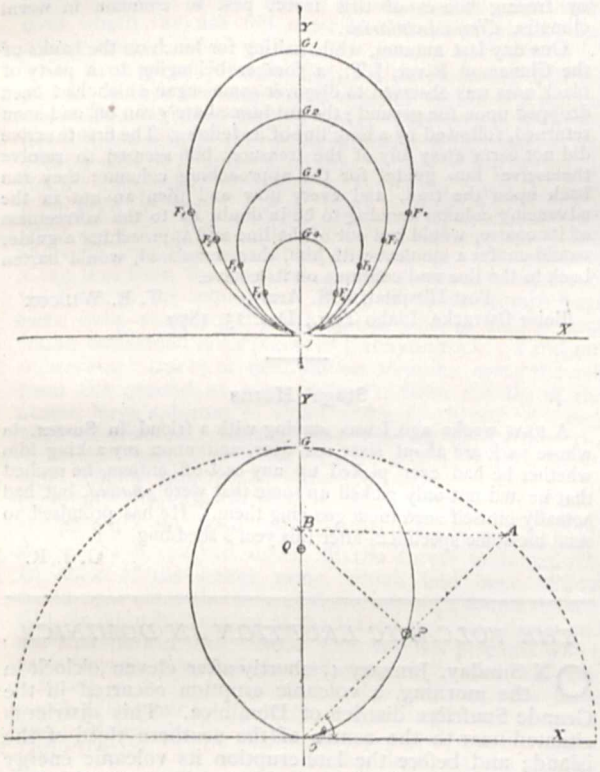
This immediately suggests the following construction:—

Take $OG = C$, and with this as radius, describe a semicircle. Draw any radius OA, then take AB perpendicular to OY, and BP perpendicular to OA: then P is a point on the required curve. Because

$$OB = OA.\cos OAB$$
$$= OA \sin\theta, \qquad \text{where } \theta = \text{angle } AOX.$$

Also $OP = OB \sin\theta$
$= OA \sin^2\theta$.

Therefore P is a point on the curve.



In a similar manner any number of points on the curve may be obtained; and by varying the length OG, we get different curves of the same class.

Near to the point G in the figure, the points on the curve cannot be constructed accurately by the method just given; but if the radius of curvature for the point ($x = 0$) be calculated, it will be found that for the point G it is $\frac{OG}{3}$. Q is the centre of curvature. And a large arc of the circle described about Q with radius QG coincides with the curve. Thus the whole curve may be constructed with great accuracy.

From equation (1) radius of curvature at any point (xy) is given by

$$\rho = \frac{C.y(4x^2 + y^2)^{\frac{3}{2}}}{3(2x^2 + y^2)(x^2 + y^2)}$$

or, with x eliminated by (1),

$$\rho = \frac{C^{\frac{1}{3}}.y^{\frac{1}{3}}.(4C^{\frac{2}{3}} - 3y^{\frac{2}{3}})^{\frac{3}{2}}}{3(2C^{\frac{2}{3}} - y^{\frac{2}{3}})}.$$

Thus $y = .432\,C$ gives the point of maximum radius of curvature.

Lines of force—

$$\frac{y^2}{(x^2+y^2)^{\frac{1}{2}}} = \frac{1}{C}.$$

These curves may be obtained by giving to C the values

$$C = OG_1,$$
$$C = OG_2,$$
$$C = OG_3,$$
$$C = OG_4.$$

The points (F) are points of minimum curvature.

Glasgow, January 29 JOHN BUCHANAN

Prehistoric Man in Japan

IN an article on this subject (NATURE, vol. xxi. p. 350) by Mr. F. V. Dickins, there is a mistake in dates. He says: "The 'adzuma' or eastern region of the main island was probably peopled chiefly by an Aino race, up to the fourteenth or fifteenth centuries." He hesitates to assign a higher antiquity to the Omori heaps (which were discovered by Prof. Morse) than the thirteenth or fourteenth century, and yet thinks it probable that they were the works of an Aino race. But the fact is that this part of the island was already inhabited by the present race, who had expelled the Ainos long before those periods. Consequently if, as he thinks, the heaps were the remains of the thirteenth or fourteenth century, they cannot be the works of the Ainos; if, on the other hand, they were the works of the Ainos, a much higher antiquity ought to be assigned to them. Such being the case, either one of his conclusions must be incorrect.

London S. SUGIURA

Monkeys in the West Indies

IN NATURE, vol. xxi. p. 131, there is a letter from Mr. Edmund Watt, of Dominica, calling in question the correctness of Prof. Mivart's statement in his paper on "Tails," regarding the non-existence of monkeys in the West Indies.

If by this statement Prof. Mivart means that monkeys are not to be found wild at the present time in any of the West India islands, it is certainly incorrect, as they abound in St. Christopher and Nevis.

If, on the contrary, and what is much more probable, he means that monkeys are not *native* in any of these islands, then he has made no mistake, as I think I shall be able to show.

It certainly does appear remarkable that no species of monkey should exist in the wild state in any of these islands along the whole range from Grenada to Jamaica, with the exception of St. Christopher and Nevis, and the question that naturally presents itself is, Have they been introduced? I am not aware that there is any tradition to this effect in either of these colonies.

It appeared to me that the most likely mode of obtaining information on this point would be to examine all the old West India histories in my possession, as those writers who treated of the natural history of the islands could not fail to notice so singular a fact as the existence of monkeys in two neighbouring islands and in none of the others. The first history examined was that of Rochefort, "Histoire Naturelle et Morale des Antilles, 1665." He names and describes all the mammalia in the West Indies known to him, but no mention whatever is made of monkeys. The next work examined was the "Histoire Générale des Antilles," by Père Du Tertre, 1667, a most interesting book, but little known. Du Tertre was a man of keen observation, and he has devoted a large portion of his work to natural history. He gives a very clear description of all the mammalia with which he was acquainted, but there is not a word about monkeys. This is the more notable from the fact that St. Christopher was considered the mother colony of the other French settlements, and Du Tertre lived there for several years, and visited the island frequently. From the negative evidence afforded by Rochefort and Du Tertre, it may be concluded that monkeys did not then exist in these islands, and, in consequence, must have been subsequently introduced.

On examining a third historical work on the West Indies, that of Père Labat, "Nouveau Voyage aux Antilles, 1744," conclusive evidence was discovered of the *when* and the *how* of the importation of the monkey family into St. Christopher.

Father Labat says that he paid a visit to St. Christopher in the year 1700. He describes the French quarter, the island being inhabited at the time by French and English, and gives a very amusing account of a monkey hunt (*chasse des singes*). He makes the following statement regarding the introduction of monkeys into the island, which I give in the original. "Pendant que les Anglais étoient demeurez maîtres des terres des Francois, dont la plus grande partie resterent en friche, les singes qui s'étoient échapez des maisons des Francois pendant la guerre, multiplierent tellement que quand on reprit possession de l'Isle on les voyoit par grosses troupes. Ils venoient voler jusques dans les maisons, & lorsqu'on plantoit des cannes, des patates ou autres choses, il falloit y faire sentinelle jour and nuit, si on vouloit que ces animaux n'emportassent pas tout ce qu'on avoit mis en terre."

It is thus made clear that the existence of monkeys in St.

Kitts (in the wild state) dates from about ten years previous to the visit of Labat, in 1700—so that they have been denizens of the island close upon two centuries now. The manner of their introduction may not even have been known to the English settlers of the colony.

It was on this occasion, the good Father informs us, that he first ate monkey. "It is true," he says, "I was a good deal shocked when I saw four heads in the soup, very much resembling infants' heads, but when I tasted of the dish I had no difficulty in overcoming my scruples, and continued to eat with pleasure," for, he adds, "C'est une chaire tendre, délicate, blanche, pleine d'un bon suc, & qui est également bonne à quelque sorte de sauce qu'on la mette."

The worthy Father feelingly dwells upon the admirable qualities of young monkeys in the form of soup or otherwise. The people of St. Christopher and Nevis might benefit by the experience and example of good Father Labat. Why not try young monkey as an article of diet generally? The planters would thus receive some compensation for the destruction of their canes and provisions by this pestilent mammal.

Trinidad, in a natural history point of view, may be considered more as a portion of South America than as belonging to the West India Islands proper. The two kinds of monkeys found in Trinidad are, I believe, met with in the opposite mainland. There is, therefore, no mystery as regards their existence in that island. The same remark applies to Nevis with respect to St. Christopher.

An example of almost exactly the same nature as that above related regarding the monkeys of St. Christopher has taken place in Dominica within the last half-century, and in like manner might pass out of remembrance unless placed on record.

About forty years ago a planter of this island visited his friends in Martinique: in returning from thence he brought with him two opossums, male and female. Shortly after they unfortunately escaped from their cage, and made their way into the woods. This was the current belief at the time and afterwards. The fact, however, is certain of the importation of the animal about that period. Their numbers increased rapidly, and not many years had passed when one of the results of their presence in the forests was the disappearance of the large frog, or crapaud, of the island, upon which the *Manicere* (as called by our people) preyed. The southern district of the island, where the pair escaped, was first nearly cleared of crapauds; but as the opossums multiplied they gradually extended over the whole island, with the exception of a part of the northern district, and as they spread, the frogs for most part were destroyed, and it was feared might be finally exterminated; but lately it would seem that their numbers have somewhat increased, and the opossums are probably not so numerous.

Fortunately our peasantry eat the opossum with great satisfaction, and set traps in the woods to catch them and hunt them on all occasions.

The large frog, or crapaud, of this island, *Cystignothus ocelatus*, I believe, is a part of the dietary of the people of all classes in the colony. It is very wholesome and much relished. Its extensive destruction by the mischievous opossum has been a great evil to the country, but its extermination would be a serious loss. Happily, however, it appears to be gaining ground of late, though it can never abound as formerly while the "Manicere" exists in our woods.

JOHN IMRAY

Dominica, January 10

Intellect in Brutes

I SEND the following notes on the habits of the red or agricultural and the small black ant, which may be of interest to the readers of NATURE:—

I have been stationed for several years where the red or agricultural as well as the small black ant are common, and have observed with much interest their habits. The burrows of the red ant are said to be very deep, always extending to water, and it is stated that one has been followed for a depth of twenty feet.

I have never seen any evidences of the sowing of seeds, but have frequently seen them carrying leaves of grasses and grass-seeds into their burrows.

The mounds are usually from two to three feet in diameter at base and one foot in height, are made of gravel, and frequently ornamented with bits of crockery, beads, or pins, as opportunity may offer. The warriors are very bold, attacking anything which may trespass upon their grounds; I have often placed a centipede or scorpion upon the mound, and observed them attack and destroy it.

The fighting is all done by the warriors, who, on being called upon by the sentries, sally out in great numbers, and rush to the attack; some seize and hold the victim, while others attack it on every side; as soon as it ceases struggling, the warriors return to their burrows, leaving to the workers the labour of cutting up and carrying in.

Hospital-Steward Smith, U.S. Army, states that in Arizona and Idaho he has observed that these ants render much service by freeing houses of that insect pest so common in warm climates, *Cimex lectularius*.

One day last autumn, while halting for lunch on the banks of the Cinnamon River, I.T., a forager belonging to a party of black ants was observed to discover some sugar which had been dropped upon the ground; the ant immediately ran off, and soon returned, followed by a long line of its fellows. The first to arrive did not carry away any of the treasure, but seemed to resolve themselves into guides for the approaching column; they ran back upon the trail, and every now and then an ant in the advancing column seeming to be in doubt as to the correctness of its course, would run out of the line and approaching a guide, would confer a moment with him, then, reassured, would hasten back to the line and continue on its course.

Post Hospital, U.S. Army, T. E. WILCOX

Boise Barracks, Idaho Terr., Dec. 23, 1879

Stags' Horns

A FEW weeks ago I was staying with a friend in Sussex, in whose park are about sixty red deer, and upon my asking him whether he had ever picked up any cast-off antlers, he replied that he had not only picked up some that were *gnawed*, but had actually himself seen them gnawing them. He has promised to send me some specimens after this year's shedding.

G. J. R.

THE VOLCANIC ERUPTION IN DOMINICA

ON Sunday, January 4, shortly after eleven o'clock in the morning, a volcanic eruption occurred in the Grande Soufrière district of Dominica. This district is situated near to the centre of the southern third of the island; and before the late eruption its volcanic energy was manifested by the action of four solfataras and by the Boiling Lake. During the morning of January 4, the weather in the town of Roseau—the capital of the island, was cool and showery; but shortly before eleven o'clock the sky became overcast and heavy rain began to fall, accompanied with thunder and lightning. Soon afterwards the sky darkened, the rain poured in torrents; a powerful odour of sulphuretted hydrogen pervaded the atmosphere; the lightning increased in vividness; and thunder of a peculiar sound, and without the usual reverberation, crashed for several minutes with intermissions of so short a duration as to be scarcely recognisable. After the lapse of about five minutes the darkness began to lift, and it was then seen that the rain was bringing down volcanic ash of a light greyish colour and metallic lustre. The ash fell for about nine minutes, covering the ground to the extent of a quarter of an inch, and during the time everything had a dull leaden aspect, whilst the mud rolled off the houses and the leaves of the trees like big globules of partially oxidised mercury. During the time the ash was falling I noted that the barometer indicated a pressure of 30·10 inches, and a few hours afterwards the mercury fell to 29·96 inches. The Roseau River, which rises near to the volcanic district, became a raging torrent, flooding the land through which it passed and creating great destruction; its water became of an opaque white colour, and even now, more than three weeks after the eruption, the white colour remains, though in a lesser degree. It is worthy of notice that the greater body of water came from the vicinity of the eruption, for the

lower tributaries of the Roseau River were very little swollen.

The scene of the eruption is about eight miles east from Roseau, and the volcanic ash was blown to the west, by the trade wind, in a narrow belt about one and a half miles wide. There is, unfortunately, no means of ascertaining the extreme limit of this belt; but a small vessel, which was about four miles out at sea at the time of the eruption, experienced a shower of ash similar in every respect to that which fell in Roseau. The area, then, over which the ash fell must have been at least twenty square miles.

On the 12th of January, I visited the Soufrière district, and found that a volcano had opened up about a mile to the south-west of the Boiling Lake. The Grande Soufrière lies in the depth of the primeval forest which covers the greater part of Dominica, so that no loss of life occurred; but for a considerable distance beyond the crater the trees have been destroyed, and the earth is covered several feet deep in some places, with volcanic *débris*. Here and there, stumps of blasted trees sticking up a few inches or a few feet from the gray ash give a striking evidence of the force of the explosion. Most of these stumps have been quite shattered by the ejecta, and in many were found embedded large pieces of trachytic rock. I did not observe any traces of fire, but on scraping away the ash from the ground at some distance from the lip of the crater, large splinters of wood and a few bleached leaves were discovered. Beyond this zone of desolation, the forest has been destroyed to a great extent by a whirlwind which appears to have occurred just before the eruption. Branches of trees, broken and twisted off from the parent stem, have fallen to the ground, and by their weight have crushed down all the forest undergrowth. In spite of the heavy rains, which had been almost continuous since the time of the eruption, I found the ash still tenaciously clinging to the leaves and the trunks and the branches of the trees. The swollen streams which run through the ravines radiating from the volcanic district, were in many places dammed up with large pieces of sulphur and pumice, and with splinters of wood. On reaching the lip of the crater, which was a work of some difficulty on account of the depth of the ash, the bottom was seen about 600 feet below. This appeared to be cooling down, for although commotions were observed in several places there was no flame or glow visible. Here and there, columns of aqueous vapour ascended and widened out into clouds before reaching the lip, so that the bottom of the crater could only be seen at intervals. The crater is ovoid, with its long axis running in a direction from west-south-west to east-north-east and the lowest part of the lip, as measured by the aneroid barometer, is 2,615 feet above the level of the sea. At the north-eastern extremity there is a break in the side of the crater, and through this a quantity of volcanic mud poured into the Point Mulatre river, which flows towards the eastern side of the island; it would appear that an enormous quantity of the gray mud was thrown out, for it is stated that at one time the bed of the river was nearly filled up, but since the eruption most of the mud has been carried out to sea.

Large masses of pumice and sulphur are seen in the vicinity of the crater; and I picked up, near to the lip, pieces of felspar and porphyry. Rocks containing augite are found in abundance, and the solid ejecta lying about in all directions are composed for the most part of grey trachyte, containing a large proportion of iron pyrites. Were these trachytic rocks pulverised they would form, with the addition of sulphur, a sand similar in appearance to that which fell in Roseau at the time of the eruption.

Strictly speaking, a new crater has not formed, for the eruption was only the breaking into activity of an old volcano. The Grande Soufrière district formerly included four solfataras and the Boiling Lake, and the most active of these solfataras was situated in the crater of the volcano which has again become active. With the exception of a part of the bottom and southern side occupied by the soufrière—as a solfatara is called in the West Indies—the crater was clothed with trees, many of which were of large size and considerable age; and a stream of strongly ferruginous water rising at its south-western extremity, ran through the ovoid basin and found an exit at the break in the north-eastern side. The path to the Boiling Lake passed through the crater, and the north bank of the chalybeate stream—which has now entirely disappeared—was the usual place selected for an encampment by those visiting the lake. No earthquake was experienced at the time of the eruption; and beyond the peculiar thunder there were no sounds, similar to the booming of cannon, which are usually mentioned as concomitants of all manifestations of volcanic energy. It is also to be noticed that there was no flow of lava, and on my visit to the volcano, I found no trace of this usual educt of an eruption. It may be that the resistance to the volcanic force, was too small to cause much tremulation except in the immediate vicinity; and the surrounding country is of so rugged and broken a nature—dislocated rocks, and sharp ridges alternating with deep ravines—that a seismic wave would be propagated with difficulty.

The ash and sand which fell in Roseau, was similar in many respects to that ejected from Tomboro in April, 1815, for on that occasion the Commander of the H.E.I.C. cruiser *Benares*, reported concerning the ash which fell at Macassar, "though an impalpable powder or dust when it fell, it was, when compressed, of considerable weight; a pint measure of it weighed twelve ounces and three-quarters, it was perfectly tasteless, and did not affect the eyes with painful sensation, had a faint burnt smell, but nothing like sulphur; when mixed with water it formed a tenacious mud, difficult to be washed off."[1] The ash which fell in Roseau was heavier, for a pint measure of it without compression weighed twenty-one ounces and fifteen drachms; this heaviness may however, be accounted for by the large proportion of iron pyrites, and the presence of this mineral was the cause of the metallic glistening first noticed when the ash fell.

M. Bert, a resident in Roseau, has made a qualitative analysis of the ash, and he informs me that he found the following bodies:—ferric sulphide, magnesia, potash, soda, silicon, sulphur, carbon, oxides of iron, lead, and alumina. M. Bert also found traces of other bodies, but their proportion was so small that he was unable to determine their exact nature with the means at his disposal.

H. A. ALFORD NICHOLLS

JUNGLE LIFE IN INDIA[2]

OF the many volumes published about the British possessions in Asia not one of them appears to us to go over the same ground as Mr. Ball's "Jungle Life in India." For nearly fifteen years the author, as one of the staff of the Geological Survey of India, was engaged in the work of the survey in parts of the Central Provinces and of Western Bengal far out of the ordinary tracks. Fond of sport, an excellent ornithologist, and a good botanist, there was much to engage his attention outside the ordinary routine of his daily duties—duties indeed which by their very nature brought him into everyday contact with all sorts of natural objects, both great and small. A specialist, it is true, has the proud satisfaction of knowing the subject he works at perhaps better than any one else, but he too often acquires the knowledge by the sacrifice, dismal to contemplate, of his love for almost all other subjects, and he can look for sympathy with his

[1] Memoir of Sir Thomas Stamford Raffles, F.R.S. London, 1830, p. 246.

[2] "Jungle Life in India; or, The Journeys and Journals of an Indian Geologist," by Valentine Ball, M.A., of the Geological Survey of India. London: Thos. De la Rue and Co., 1880.

labours to a very select few. Not so with our Indian geologist; his special work is but little touched on in this volume, though a glance at its 702nd page (Appendix G) shows the amount of that work accomplished, in the form of Memoirs, Records, and Reports published from time to time by the Geological Survey of India, to have been both important and great. One great charm of this journal lies in its many touches of nature. One feels as one reads it that for the moment they are with the journalist as he travels through some jungle, wanders along the bed of some mountain torrent, or explores some new coal-field big with promise. As a personal narrative it is full of life, and what it may want in precision is more than made up by the vivid pictures it presents.

The volume opens with an account of the Ranigunj coal-field, the largest and most important of those in which coal is worked in India :—

"The Ranigunj coal-field is the largest and most important of the areas in which coal is worked in India. Its proximity to the main line of railway, and also to the port of Calcutta, tends to give it pre-eminence over other less favourably situated localities. In the year 1774 coal was known to occur there, and so long ago as 1777 was actually worked. In 1830 several collieries of considerable extent had been opened out, and were, we have reason to believe, in a flourishing condition. The total area of coal-bearing rocks which is exposed is about 500 square miles; but it is possible that the real area may be even double that, since on the east the rocks dip under and are completely concealed by alluvium. Throughout this area a central zone includes the principal mines, and the chimneys which dot this tract constitute it the black country of India. At the present time (1879) there are about six principal European companies engaged in the extraction of coal, while many minor firms and native associations contribute to swell the total amount raised.

"Formerly a large proportion of the coal was obtained by open workings and quarries: but at the present day most of the seams which were accessible in this way have been exhausted, and regular mining is now carried on with more or less system. The miners are, however, individually, in some cases, allowed a degree of freedom, or rather licence, which would never be permitted in European mines. They chiefly belong to two races, the Bhowries and the Sontals; the former using the pick, while the latter cannot be induced to work with any other tool than a crowbar, with which they produce an altogether disproportionate amount of small coal and dust. The pillar and stall is generally practised in preference to the long wall system of 'getting' the coal. None of the mines are of great depth, and a perfect freedom from fire and choke-damp renders it possible to carry on the work without its being necessary to adopt the precautions which in England only too often fail to secure the object aimed at. Many of the seams are of considerable thickness; one which is worked contains nearly forty feet of coal. As a rule, however, the thick seams, especially those in the lower measures, do not contain the best coal. Compared with ordinary English coal, the Ranigunj coals, and Indian coals generally, are very much inferior in working power, still they are capable of generating steam in both locomotive and other engines, and for this purpose several hundred thousand tons are raised annually from Indian mines."

The many details in reference to articles of commercial value to be found scattered through this volume may be well illustrated by the following extracts, the first relating to "cutch," the second to shell-lac :—

"At this season a particular class of the natives were engaged in preparing the substance called *Koir*, which bears the commercial name of cutch, and is otherwise known as catechu. The chopped heart-wood of *Acacia catechu*, Willd., is boiled down in earthen vessels, and the resultant red liquid is subjected to further boiling, and, on arriving at a treacly consistency, is poured into clay moulds or wooden troughs. In some places I have been told that the finer qualities are improved by being buried for some months in the earth. It is an article of great value, and the right to manufacture is farmed out by the Zemindars. It is exported to Europe for dyeing and tanning, and in India it forms one of the constituents of pawn for chewing. It is also employed for various other purposes."

In these countries the consumption of cutch is very considerable; it is chiefly in use for tanning manufactured articles, such as the nets used in the herring and mackerel fisheries. Our next extract relates to an important production called shell-lac. Why is this term sometimes, and in standard works, spelled with but two ll's?

"This morning, before leaving the station, we visited a shell-lac manufactory, and as the method by which that useful article of commerce is prepared, and the source from which it is derived are not generally known, I shall endeavour to convey what I know of the subject as briefly as possible.

"Lac (or as it is called in Hindustani, *lah*) is secreted by an insect (*Coccus lacca*) on the branches and twigs of certain jungle trees. The principal of these are the khusum (*Schleichera jujuga*), plas (*Butea frondosa*), and bier (*Zizyphus jujuba*). The lac from the first-mentioned, the khusum, is more highly esteemed than that from the others. To some extent the lac is found occurring, so to speak, spontaneously, and is collected by the forest tribes, and brought by them to the fairs and bazaars for sale. Where, however, there is a regular trade in stick-lac, propagation of the insect is systematically carried on by those who wish for a certain and abundant crop. This propagation is effected by tying small twigs, on which are crowded the eggs or larvæ of the insect, to the branches of the above-named species of trees. These larvæ are technically called 'seed.' The larvæ shortly after sowing spread themselves over the branches, and, taking up positions, secrete round themselves a hard crust of lac which gradually spreads till it nearly completes the circle round the twig. At the proper season the twigs are broken off, and we must suppose them to have passed through several hands, or to have been purchased directly from the collectors by the agents of the manufacturer. On arrival at the factory, they are first placed between two powerful rollers, which, by a simple arrangement, admit of any degree of approximation. The lac is then crushed off and is separated from the woody portions by screening; it is next placed in large tubs half-full of water and is washed by coolies, male or female, who, standing in the tubs, and holding a bar above with their hands, stamp and pivot about on their heels and toes until, after a succession of changes, the resulting liquor comes off clear. Of the disposal of the liquor drawn off at the successive washings I shall speak presently. The lac having been dried is placed in long cylindrical bags of cotton cloth of medium texture, and which are about ten feet long and two inches in diameter. These bags when filled have somewhat the appearance of an enormous Bologna sausage. They are taken to an apartment where there are a number of open charcoal-furnaces. Before each of these there is one principal operator and two assistants. The former grasps one end of the long sausage in his left hand, and slowly revolves it in front of the fire; at the same time one of the assistants, seated as far off as the sausage is long, twists it in the opposite direction. The roasting before the glowing charcoal, soon melts the lac in the portion of the bag nearest the operator's hand, and the twisting of the cloth causes it to exude and drop into a trough placed below. The troughs which I saw in use were simply leaves of the American aloe (*Agave americana*). When a sufficient quantity, in a molten condition, is ready in the trough, the operator takes it up in a wooden spoon and places it on a wooden

cylinder some eight or ten inches in diameter, the upper half of which is covered with sheet brass. The stand which supports this cylinder gives it a sloping direction away from the operator. The other assistant, generally a woman, now steps forward holding a strip of the agave or aloe between her hands, and with a rapid and dexterous draw of this the lac is spread at once into a sheet of uniform thickness which covers the upper portion of the cylinder. The operator now cuts off the upper edge with a pair of scissors, and the sheet is then lifted up by the assistant who waves it about for a moment or two in the air till it becomes quite crisp. It is then held up to the light, and any impurities, technically 'grit,' are simply punched out of the brittle sheet by the finger. The sheets are laid upon one another and the tale, at the end of the day, is taken, and the chief operator paid accordingly, —the assistants receiving fixed wages. The sheets are placed in packing-cases, and when subjected to pressure break into numbers of fragments. In this fresh state the finest quality is a very beautiful object having a rich golden lustre. On seeing it thus, one cannot help feeling regret that it is not nice to eat—the best Everton toffee never looked more tempting. The above is the history of shell-lac, from its birth in the jungle to its appearance in the world as the commercial article. From the manufacturer it passes through the broker's hands to the merchant, and from him again to the manufacturers of varnishes, sealing-wax, and other commodities of which it is an ingredient.

"The dark red liquor resulting from the washing above described, is strained, in order to remove all portions of woody fibre and other foreign materials. It is then passed into large vats, where it is allowed to settle; the sediment is subjected to various washings, and at last allowed to settle finally, the supernatant liquor being drawn off. The sediment, when it is of the proper consistency, is placed in presses, from which it is taken out in the form of hard dark purple cakes, with the manufacturer's trade-mark impressed upon them. This constitutes what is known as lac-dye. By the addition of mordants, this dark purple substance yields the most brilliant scarlet dyes, which are not inferior, I believe, to those produced by cochineal. The dye which is thus separated from the lac by washing is said to be the body of the insect, not a separate secretion."

One more extract we venture to make, which gives a description of the uses made of the flowers of the *Bassia latifolia*, Roxb. Not only are the fruits of this tree used as an article of food, but "the fleshy deciduous corollas are likewise largely employed for the same purpose, and, in point of fact, constitute a staple and sometimes almost the only article of diet available to the poorer classes during several months of each year. Towards the end of February or the beginning of March, as the crop of mhowa flowers approaches ripeness, the corollas, becoming fleshy and turgid with secreted juices, gradually loosen their adhesion to the calyx, and fall to the ground in a snowy shower. The duty of collecting the fallen blossoms is chiefly performed by women and children; at dawn they may be seen leaving their villages with baskets and a supply of water for the day's use. Before the crop has begun to fall they take the precaution to burn away the grass and leaves at the foot of the trees, so that none of the blossoms may be hidden when they fall. The gleaners generally remain under the trees all day, alternately sleeping and collecting the crop, and the male members of the family visit the trees once or twice during the day, in order to carry away what has been collected. At night bears, deer, and other animals visit the trees to take their share of the crop. In the early mornings, and late in the evenings, the less frequented trees, on the borders of the jungles, attract numbers of jungle and pea fowl. Cattle also are very fond of the flowers, and cow's milk has in consequence, at this season, a strong flavour of mhowa.

"It often happens that the people who collect come from a considerable distance, in which case they erect with the branches of the sál a temporary encampment of huts, in which they live until the crop is all gathered in. In front of each of these huts a piece of ground is made quite smooth and hard, for the purpose of spreading out the flowers to dry in the sun. When perfectly dry they have a reddish-brown colour, and in size they have lost three-fourths of their original dimensions, and about half their original weight. It is the custom with some of the natives, before spreading them out to dry, to pull off the ring of minute foliaceous lobes which crowns the fleshy corolla. It is very difficult to obtain any trustworthy statements as to the yield of the mhowa trees. A first-class tree, I have been told, will continue to shed its blossoms for fifteen days, at the rate of 120 pounds a day; but this estimate is, I believe, at least double what it ought to be. The rent of the trees varies with the abundance of them in the district, the quality of the previous rice harvest, and various other circumstances affecting the demand and supply. Twopence to four shillings were the extremes of prices which, in various places, had, I ascertained, been actually paid for permission to collect. As does the rent of the trees, so the saved crop varies much in price—the limits being from 120 to 480 pounds for the rupee or two shillings, but when, as is most frequently the case, the exchange is in kind, the merchants only give a small quantity of salt and six or eight pounds of rice for a maund (80 lbs.) of mhowa. During the famine in Manbhum the price of mhowa averaged about 24 lbs. for the rupee.

"Two maunds of mhowa are stated by some to furnish a month's food to a family consisting of a father, mother, and three children. It is, however, seldom eaten alone, being mixed with the seeds of the sál, or with the leaves of jungle plants; sometimes a small quantity of rice is added. It is the custom to cook but once a day, and each member of the family helps himself whenever he feels hungry.

"When fresh the mhowa has a sweet taste, with an odour somewhat suggestive of mice; when dried it presents some resemblance to the inferior kinds of figs. Cooking renders it vapid, and utterly devoid of flavour. On distillation the newly dried flowers yield a highly intoxicating spirit called *daru;* this is generally diluted with from five to ten times its bulk of water, and is then sold at about the rate of a penny for a quart. Its odour is most offensive to Europeans, but British soldiers have been known to secure for themselves the pleasures of intoxication by drinking it with held noses, as a child takes a nauseous draught. By careful distillation it is possible to get rid of the essential oil which causes the unpleasant flavour. From the seeds a sort of oil is expressed, which is used for cooking purposes and to adulterate ghi. Although the natives protect such mhowa trees as exist I am not aware that they do anything to increase the number.

Some of the most interesting parts of the work are those describing two trips made in 1869 and 1873 to the Andaman and Nicobar Islands. These trips served the purpose of bracing up our author for a renewed jungle life. As an example of the excellent illustrations, we give one showing a group of Nicobarese at Nankowri Island. The origin of these people "is still shrouded in much obscurity. According to themselves they all came from the Great Nicobar. They are said to possess two traditions as to their primary origin: the first being that they are sprung from ants, and the second that they are descended from a man and a dog, the sole survivors of a great inundation. This latter, however, may very possibly be a comparatively modern idea, derived from some jumbled account of the Noachian deluge taught them by the earliest missionaries. To what I have already said as to the probable affinities of the Nicobarese with the Malays and Burmese, I would here add that I have

noticed among them certain traits which seem to me to point to an affinity between them and two tribes of Dravidians, with whom I have some acquaintance; these are the Malés, or Rajmehal Paharias, and the Sowras, or Savaras, of the tributary states of Orissa. The grounds for this identification are not, it is true, very definite; but when visiting the villages of the Malés, many little things, such as the erection of ornamental bamboos to ward off evil spirits, and the store-houses raised on posts, recalled to my mind similar objects in the Nicobars. In order to test this supposition I have compared lists of Nicobarese and Dravidian words, and the result is that some few have proved to be identical, or nearly so."

The following curious phenomenon is worthy of being noted. Presumably the lime must be taken up in solution by the roots in large quantities, and then deposited in the manner described.

"Some white marks on the cut stump of an Asan tree (*Terminalia tomentosa*, W. and A.) caught my eye, and these on examination proved to be the sections of laminæ of calcareous matter, which alternated with the ordinary rings of woody growth. How this calcareous matter found its way into such a position it is difficult to say; but its occurrence is perhaps not more singular than that of silica in the joints of bamboos, where, as is well known, it sometimes forms what is called 'tabasheer.' The rocks about were gneisses and schists, and I could discover nothing in the soil to account for the peculiarity.

"About a year previously, or in April, 1870, the fact of the occurrence of calcareous masses in timber had been brought to the notice of the Asiatic Society of Bengal by Mr. R. V. Stoney, who stated that many trees in the Orissa Tributary Mehals have pieces of limestone (or calcareous tufa) in fissures in them, but principally Asan

Group of Nicobarese, Nankowri Island.

(*Terminalia tomentosa*, W. and A.), Swarm (*Zizyphus rugosa*, Lam. ?), Sissu (*Dalbergia sissu*, Roxb.), and Abnus (*Diospyros melanoxylon*, Roxb.). In some cases, irregular-shaped pieces, seven inches long by two inches thick, were met with in the trunks at a height of about six feet from the ground. By the natives the lime is burnt, and used for chewing with pawn. On examination it was found that there was no structure in these masses which would justify a conclusion that they had been formed by insects. Some included portions of decayed wood seemed to be cemented together by the lime. Though I have not had an opportunity of consulting many botanists on the subject, I believe it to be the case that the occurrence of deposits of carbonate of lime in timber has not been met with elsewhere. Oxalate of lime is sometimes met with in vegetable tissues, but in the form of carbonate, I am informed, however, that there is no recorded case of lime having been found, and such also appears to have been the opinion of the late Dr. Kurz."

We had marked for further extracts some passages from the author's account of his second trip to the Andamans and Nicobars, made in 1873, and from his account of the district about Orissa, and of his visit to Afghanistan, but for these and many other such we must refer the reader to the volume, feeling assured it will be found very pleasant reading. In it there is much about the economic resources of a great country, and very many interesting details of several of the native races.

The Survey is happy in having on its staff one who by this volume has proved the good use he has made of his small amount of leisure time. We wish we could add that such zeal and such knowledge had met with or were sure to meet with a proper reward from those in whose hands the destinies of India now lie.

NATURE, February 19th, 1880.

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously. Series commencing October, 1877.

No. V.

PREVAILING WINDS.

Arrows shows the direction of, and fly with, the wind. Force is shown as follows:

Symbols.	Force.	Velocity.	
		Miles per hour.	Metres per second.
→	1, 2	0 to 9	0 to 4.0
→	3, 4	9.1 to 22.5	4.1 to 10.1
→	5, 6	22.6 to 40.5	10.1 to 18.1
→	7, 8	40.6 to 67.5	18.1 to 30.2
→	9, 10	67.6 up	30.2 & over.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

BRIG. GEN. (BVT ASSG'D) CHIEF SIGNAL OFFICER, U. S. A.

ISOBARS AND ISOTHERMS.

Isobars in *blue*; detached barometer means in English inches.

Isotherms in *red*; detached temperature means in degrees Fahrenheit.

INTERNATIONAL MONTHLY CHART.

Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of May, 1878, based on the daily charts of the International Bulletin.

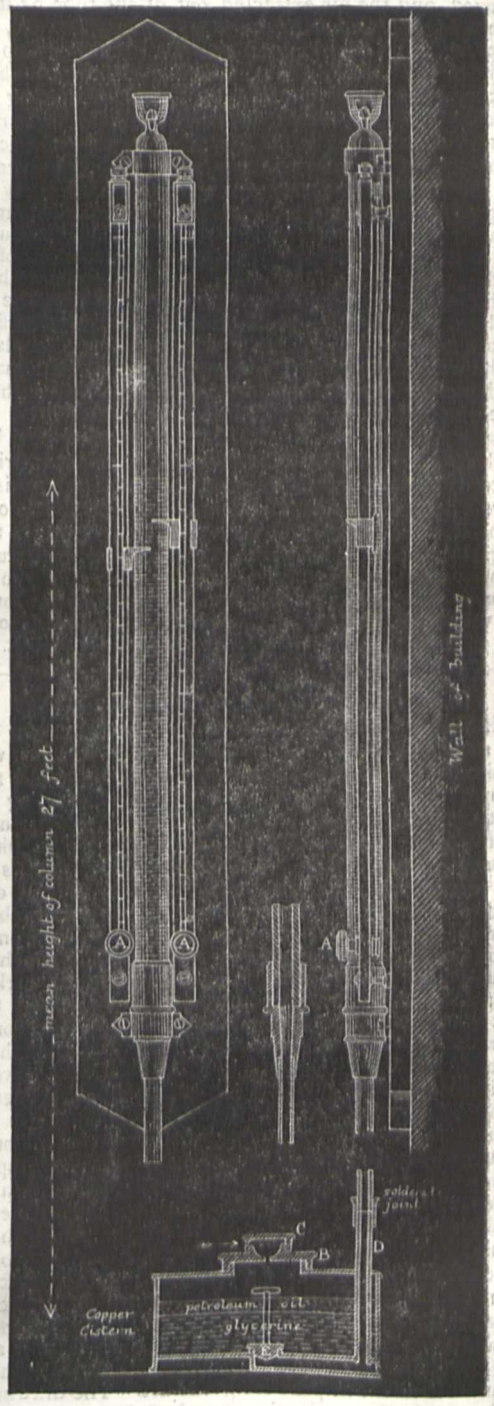
ON THE CONSTRUCTION OF A NEW GLYCERINE BAROMETER

THE direct influence of changes of atmospheric pressure on the occurrence of many of our colliery accidents, so clearly demonstrated by the investigations of Messrs. Scott and Galloway, has naturally led to the consideration of barometers affording a wide range of movement, thereby rendering small atmospheric changes at once apparent, and clearly noticeable to the uneducated eyes of those engaged in such situations as collieries, storm stations, and other places where it is important to note rapid movements without the careful observation which is requisite for the correct reading of an ordinary mercurial barometer.

Among the various attempts which have been made from time to time to construct long range barometers, may be mentioned the celebrated water barometer, constructed at great cost for the Royal Society in 1830, by Prof. Daniel, but a water column is found to be unreliable in its action, the effects of pressure being so often masked by variations due to changes of temperature on the aqueous vapour existing in the Torricellian vacuum. Mr. Jas. B. Jordan, of the *Mining Record Office*, has for some years been devoting much attention to this subject, believing that if precise instruments of this class could be made, they would prove of scientific value in showing the character of the more minute vibrations of pressure, and of practical use for the purpose above referred to. The fluid which has shown the most successful results appears to be glycerine—and a glycerine barometer was constructed by Mr. Jordan in the year 1870, which is still in operation. The purest glycerine, as manufactured by Messrs. Price and Co., has a specific gravity of 1·26; from its high boiling-point, 440° Fah., it has a very low tension of vapour at the ordinary temperatures of the atmosphere, and a very low temperature is required to freeze it. The mean height of a column of glycerine is 27 feet, and a variation of one-tenth of an inch, in the height of a mercurial column is shown by a change of more than an inch in the glycerine column. The glycerine absorbs moisture freely when exposed to the atmosphere, but this is prevented by covering the exposed surface of the liquid in the cistern with a layer of heavy petroleum oil prepared especially for the purpose. Barometers of this character have also been constructed by Mr. Jordan at the South Kensington and Jermyn Street Museums with good results. Still further to test the scientific value of the new instrument, application was made to the Government Grant Committe of the Royal Society for a small grant of money to construct an experimental barometer, and an instrument was erected therewith at the Kew Observatory, by the permission of the Kew Committee.

A detailed description of the instrument has recently been read at the Royal Society by the inventor. The accompanying figure explains its construction: the cistern is a cylindrical vessel of copper tinned inside, 5 inches deep and 10 inches diameter, fitted with a screwed cover, B, the air having access through a small hole in the cap, C, attached to the cover, which has a recess, holding cotton wool for filtering out the dust. The main tube is connected with the cistern by attachment (with a soldered joint) to a projecting piece of tube D, which enters the cistern through the bottom, and is fitted at its opening with a screwed plug, E. The tube is an ordinary composition metal gas-pipe, five-eighths of an inch in diameter, furnished at the top with a gun-metal socket, into which is cemented a glass tube 4 feet in length, with an inside diameter of 1 inch, terminating in an open cup, and fitted with an india-rubber stopper.

The fluctuations of the level of the column of glycerine are observed and read off on brass scales placed on either side of the tube, fitted with indices and verniers, moved by milled heads, A A, at the bottom of the scales. The right-hand scale gives inches and tenths of absolute measure from the level of the liquid in the cistern; the left-hand scale the equivalent value in a column of mercury, divided into tenths and hundredths, the hundredth division being equal to about one-tenth of an actual inch.



The observing part of the barometer is attached to an oak back fixed to the wall of an upper room in the Observatory, the main tube being carried down through the entrance hall to the barograph room below, a distance of 27 feet, where the cistern is placed on a bracket on the

north wall, the distance being accurately measured with a tape, the error of which was found by comparison with the standard yard preserved in the Observatory.

The cistern was filled with three-fourths of a gallon of glycerine, coloured red by aniline, first heated to a temperature of 100° F. to render it more limpid, so as to disengage the air more freely; the plug, E, was then removed, and the air extracted out of the tube by means of an air-pump connected at the top of the glass tube, when the pressure of the atmosphere forced the liquid up to a height of 323·571 inches, being equivalent to 30 inches of mercury, the Kew standard at the time reading 30·3 inches. The plug was then screwed in to support the column, air admitted at the top, the air-pump connections removed, and the tube filled up to the top with glycerine, and the india-rubber stopper inserted. The screw plug being removed for a few seconds to allow the column to fall an inch or two, was then replaced, and the instrument left, until the liquid was completely exhausted of air, which slowly rose to the surface, into the vacuum above; the india-rubber stopper was again withdrawn, the tube filled up, the stopper replaced, and the cistern plug finally removed, when the column gradually fell until balanced by the weight of the atmosphere, leaving a small quantity of glycerine in the cup above the stopper, over which a plate-glass cover was placed to keep out the dust.

Daily observations of this instrument are now being regularly taken at Kew Observatory, under the superintendence of Mr. Whipple, the Director, which will decisively prove whether the instrument is to be regarded as one of scientific precision, but in any case the inventor is to be congratulated on having reduced to a simple construction an instrument forming a large scale weather-glass, suitable for ordinary observation, which cannot fail to be of interest and value at our museums and other public institutions.

C. E. R.

THE HISTORY OF WRITING[1]

I HAVE promised to speak to you to-night on a large subject, one which, to be treated adequately, would require, not a single lecture or a single hour, but many lectures and many days. The history of writing is in great measure the history of the human mind; just as anything like real abstract thought is impossible without language of some kind, so, too, without writing it is difficult to conceive of a progressive civilisation or a developed culture. The trained memory is no doubt able to accomplish marvellous feats, as we may learn from the Hindus, who have preserved by means of it, through long centuries, not only poems, but even scientific works as well; nevertheless, the memory has a limit, and I think most of us would be sorry to trust to it alone for the record of our own thoughts and discoveries, much less those of others. If language gave man the power of continuous thought, writing has enabled him to develop and make use of it.

There is a striking analogy between the history of language and the history of writing. Both have sprung from a humble origin. Language began with a few sounds and cries which symbolised and expressed an equally small number of ideas; writing began with pictures of such objects as fell within the experience of the first draughtsmen. How early this was in the history of our race has recently been disclosed to us by archæological research. Like the child, primitive man amused himself by drawing pictures of the things he saw about him, and like precocious children sometimes showed remarkable talent in practising the art. The drawings of reindeer and other animals, scratched by means of rude flint implements on reindeer-horns or mammoth-tusks, which have been found in the caves of France and our own country, are frequently of high merit, and prove that considerable skill in the art of drawing may coexist with the lowest savagery in other respects. It is a lesson that we might already have learnt from the Eskimo, whose etchings on whalebone are not unworthy of European artists, or from the Bushmen of Southern Africa, who have long excelled in painting animal forms on the smooth surfaces of rocks. But these contemporaries of the reindeer and the mammoth, who belonged to what is termed the age of polished stone tools, when England and France were still enfolded for six months of the year in a garment of glaciers and solid ice, were not the first in the West who practised the art of drawing. A remarkable discovery, made during the past year in the region of the Pyrenees, has shown that long before then, in the days when the cave-bear and hyæna and other extinct monsters of the old world still existed, and when the geography of Europe differed widely from that of our own time, there were men who employed their leisure in depicting the animals about them as well as themselves. A number of teeth belonging to the cave-bear have been discovered in a cave of the palæolithic or "old-stone" period, adorned with drawings, some of which represent human beings, covered, let it be observed, with long hair like the mammoth. I have sometimes fancied that language itself may have owed its first start and progress to pictorial aid. It is said that two Chinamen, in despair of understanding each other through the help of a language which has to denote so many different ideas by the same sound, have been known to have recourse to writing; and most of us remember when our own efforts to learn to read, and in some cases to increase our acquaintance with our mother-tongue, were assisted by the use of pictures. An appeal to the eye is surer and more impressive than an appeal to the ear, and we recognise objects more readily by their pictures than by their names. After all, therefore, it may not be a paradox to imagine that the beginnings of writing may be older than the beginnings of language, that men drew pictures before they uttered articulate sounds.

However this may be, the development of writing was soon far outstripped by that of language. Language enabled man to create and record *ideas;* the pictures he made were pictures of objects only. Until he could represent to the eye ideas as well as objects, his writing was a very poor affair indeed. It is only by courtesy that it can be called writing at all. But a time came when a great step forward was made. The ideas that had to be supplied when combining the pictures of several objects into a story gradually came to be read into the pictures themselves. A pair of legs, for instance, came to signify not only a man's legs but the idea of walking as well. Writing began to pass out of its infantile stage; to cease to be merely pictorial and to become ideographic.

This is the point at which the development of writing has stopped among some races of men. Thus certain of the North American Indians have long possessed a means of communicating with one another, and of inscribing magical charms and exorcisms on rocks or the bark of trees, by means of pictures and ideographs. When these hieroglyphs, as we may term them, are painted, the system of writing is called Kekinowin, and some of the pictorial symbols employed in it are curious enough. A warrior, for example, is represented by the picture of the sun, with eyes, and nose, and two pendant lines, because he ought to be as bold and strong as the great luminary of day. A hand held upwards with the fingers extended denotes death, and a series of circles one within the other signifies time. This system of writing has been developed to such an extent among the Mikmaks, that a religious work has been published at Vienna entirely written in it, and containing no less than 5,701 different signs.

As soon as writing advances to the ideographic stage, the exact delineation of outward objects naturally ceases to be necessary. When once it has been determined that

[1] Lecture at the London Institution, February 12, by Prof. A. H. Sayce.

a pair of legs should express the idea of walking, the accurate drawing of the legs is no longer a matter of consequence. The two lines of an angle could represent the idea just as effectually as a carefully drawn pair of legs. The memory and intelligence have been appealed to as well as the eye, and we can as easily remember that the idea of walking is denoted by two lines as by two legs. Consequently we shall find that as soon as the ideographic stage of writing is reached, the forms of its symbols begin to degenerate. Just as the sounds of which words are composed are worn away in time by phonetic decay without any necessary impairment of their meaning, so, too, the forms of characters grow changed and modified without injury to their significance. It takes less trouble to represent the human figure by a couple of crossed lines than by an elaborate picture, and if the symbol remains intelligible, the less troublesome representation inevitably supersedes the older one. Pictures pass into ideographs not only as regards their inner sense, but also in their outward form.

The great discovery has thus been made. Ideas can be rendered intelligible to the eye not by calling up pictures of objects but by arbitrarily determining that a particular sign shall stand for a particular idea. The pictures of primitive man have become characters. It is no longer the outward senses but the memory that is appealed to. In short, a system of writing has been invented which can be learned like a language. All that now remains is to perfect the invention, to discover how the whole realm of human ideas can be expressed by the fewest and simplest signs.

But the development and perfecting of the invention was a slow and gradual process. When we look back upon past ages it seems strange to us that the characters were not at once reduced to an alphabet, the letters of which denoted mere sounds. We may ask why it was that men were so long in finding out that it is quite as easy to symbolise sounds as to symbolise what is still more impalpable, namely, ideas. What seems obvious to us, however, was by no means obvious before the knowledge and experience which we inherit was slowly and laboriously acquired. No great discovery is ever made at once, by a leap as it were. It must be prepared for and led up to; the time, as we say, must be ripe for it. And the history of writing is the same as that of all other great discoveries. It was a long time before men began to realise that our system of writing may be intelligible to others even if we do not try to represent ideas at all. As ideas multiplied it was found impossible to find separate characters for each of them, much less to remember them all. At first the difficulty was evaded by combining two or more ideographs together in order to express a new idea, which was analysed into others already known and represented in writing.

Thus the ancient Babylonians had separate characters to denote "water" and "eye;" by combining these they succeeded in suggesting to the mind of the reader the notion of a "tear." So, again, as the sun was symbolised by a circle, a month was readily represented by writing within the circle the numeral thirty, which signified the 30 days of the lunar month.

This mode of expressing ideas may be termed classificatory. Ideas were arranged in classes, one under the other, and just as we define an idea by making it a species of some other or more comprehensive idea, new ideographs were formed by setting two or more side by side, one to denote the genus, the other the species. Thus, as Dr. Legge has shown, "a wife" is represented in the ancient Chinese writing by the two ideographs of "woman" and "broom," the Chinese conception of a careful housewife being that of one who keeps the house clean by constant sweeping. So, too, in the hieroglyphic system out of which the cuneiform characters of Babylonia and Assyria sprang, the ideographs of "great" and "man" stood for "a king," who was regarded as a special member of the genus "man." The idea of "father," again, was picturesquely expressed as "the maker of the nest," and that of "prison" as "house of darkness."

But after all there was a limit to the number of ideas which could be represented ideographically. As civilisation and culture progressed, pictorial writing found it difficult to keep pace with the new ideas which were being continually called into existence. And even if means were discovered for representing them all, the burden upon the memory became excessive and intolerable, a lifetime was required to learn a system of writing which attempted to denote by separate pictures or groups of pictures the manifold conceptions of civilised life. A civilised people, moreover, is necessarily brought into contact with its neighbours. It may try to shut itself up in silent isolation, like the Egyptians of the Old Empire or the Japanese of a more modern day, but sooner or later the nations which surround it will force themselves upon its attention, if not in the way of peace, at all events by war. Then comes the question, how to express in writing foreign proper names which have no meaning in the language of those who would record them? There is only one answer to the question, only one solution of the difficulty. We must cease trying to represent objects and ideas, and must represent words, that is, sounds instead. The day on which this fact dawned upon the human intelligence was one of the most important in the history of our race. An alphabet became possible, and with it the almost unlimited power of expressing the thoughts and needs of mankind.

But it took some time yet before the possibility was realised. Great discoveries, as I have before said, are not made all at once; simple as they seem when once made, they must be led up to slowly and step by step. An alphabet was preceded by a syllabary, that is, by a system of characters each of which denoted not a single sound but a syllable. It was almost inevitable that it should have been so. We do not naturally divide our words into individual sounds but into syllables, and a syllable often stands for a word. This was especially the case with the languages of the three leading inventors of writing, the Chinese, the Egyptians, and the Accadian population of primitive Chaldea. Many of the ideographs, therefore, used by these nations represented not only ideas but also single syllables, and it was obvious that they might be employed to express both. In Accadian, for instance, the word *bat* signified "to die," and was represented by a picture of a corpse; but *bat* also meant "fortress," and so what was originally the picture of a corpse came to be inserted in the picture of "an enclosure" when the latter was intended to denote a fortress or citadel.

As soon as the fashion had been set of assigning to characters as phonetic values their pronunciation as ideographs, it rapidly spread until every character came to have a purely phonetic value attached to it, as well as an ideographic one. The process was, no doubt, much aided by the decay and decomposition of the old pictures; it was easier to treat a character which had lost its original pictorial form as a mere representative of a syllable than one which still remained a faithful image of some natural object. But the process was attended by one great drawback. Ideographs, as we have seen, might stand for more than one idea, or the same idea might be known under different names; when, therefore, the old system of ideographs was changed into a syllabary, each ideograph represented more than one syllable. The polyphony or power possessed by each character of denoting several phonetic values, which resulted from this, has been a great stumbling-block to the decipherers of the inscriptions of Egypt and Assyria, and has only gradually been removed. It was also a stumbling-block to the Egyptians and Assyrians themselves, and various devices were

adopted for avoiding it. Why it was never determined to take it out of the way altogether by restricting each character to the expression of a single syllable, was probably due to the same cause as that which makes ourselves cling so tenaciously to our own polyphonous alphabet, the innate conservatism, I mean, of the human mind. At any rate, it was left to a later age and to the foreign borrowers of the Assyrian syllabary to make an improvement which seems to us at once so obvious and so necessary. Up to the last, therefore, an Assyrian character could not only be used ideographically, but also as the representative of several distinct and different sounds. Take, for instance, the character which, as we have seen, meant originally a corpse. As the usual word in Accadian for "a corpse" was *bat*, *bat* remained the usual phonetic value of the character, but besides denoting *bat* it also denoted the syllables *til*, *mit*, and *be*, and might be used to express any one of these sounds whenever the writer willed.

In the eighth century before our era, the Assyrian mode of writing was adopted by the tribes which at that time occupied Armenia on the north, and Media on the east, and the first great reform was introduced into it by restricting each character to the expression of a single syllable. In order to express syllables, however, a good many characters were required; by the side of *ba*, for example, it was necessary to have a *bi*, a *be*, and a *bu*, and accordingly, every one who wished to learn to read and write was obliged to have a good memory. It was reserved for the Persians to make the last improvement in the cuneiform system of writing by ingeniously extracting an alphabet out of it. And the way in which they went to work was this. A certain number of characters was taken, their signification as ideographs translated into Persian, and the particular sound with which each of these Persian words began was assigned to the character as its alphabetic value.

What it required the combined labours of several different races and nations to effect in the case of the cuneiform characters of Assyria and Babylonia was effected unaided and alone by the wonderful people of ancient Egypt. The Ashmolean Museum at Oxford contains one of the oldest monuments of civilisation in the world, if indeed it is not the very oldest. This is the lintel-stone of a tomb which formed the last resting-place of an official who lived in the time of King Sent, of the second dynasty, whose date is placed by M. Mariette more than 6,000 years ago. The stone is covered with that delicate and finished sculpture which distinguished the earliest period of Egyptian history, and was immeasurably superior to the stiff and conventional art of the later ages of Egypt which we are accustomed to see in our European museums. But it is also covered with something more precious still than sculpture, with hieroglyphics which show that even at that remote epoch Egyptian writing was a complete and finished art, with long ages of previous development lying behind it. The hieroglyphic characters are already used not only pictorially and ideographically, but also to express syllables and alphabetic letters, the name of the king, for instance, being spelled alphabetically. In the hands of the Egyptian scribes, however, Egyptian writing never made any further progress. With the fall of what is called the Old Empire (about B.C. 3500) the freshness and expansive force of the people passed away. Egyptian life and thought became fossilised, and through the long series of centuries that followed, Egypt resembled one of its own mummies, faithfully preserving the form and features of a past age and of a life which had ceased to beat in its veins. Until the introduction of Christianity the only change undergone by Egyptian writing was the invention of a running-hand, which in its earlier and simpler form is called hieratic, and in its later form demotic.

But what the Egyptians themselves failed to do was done by a body of enterprising and inquisitive strangers. For some centuries after the fall of the Old Empire Egypt was given over to decay and intestine troubles, and when it again emerges into the light of history it is under the princes of hundred-gated Thebes in the period known as that of the Middle Empire. It was while these princes were adorning Thebes with temples and granite colossi, and excavating tombs for themselves in the rocks of Beni-Hassan, that a small party of immigrants, only thirty-seven in all, arrived in the Delta about 2,700 years before the Christian era. They were shepherds and cowherds from the coast of Phœnicia or Palestine, and as it were with an instinctive realisation of the great part their kinsfolk were afterwards to play in the history of Egypt, their arrival was commemorated in painting and hieroglyphics on the walls of one of the tombs at Beni-Hassan. There we may still see them pourtrayed in vermilion and ochre, and trace in their hooked noses and black hair the features of the shepherd-kings who subsequently held Northern Egypt under their sway for 600 years, as well as of the Children of Israel and the later population of the Delta. For a time came when the Egyptians were driven out of the rich and fertile lands of the Delta, the first seat of their power and civilisation, and their places taken by the traders of Tyre and Sidon and the agricultural tribes of Southern Canaan. Henceforward the Delta received a new name among the subjects of the Pharaohs; it was called Caphtor or "Greater Phœnicia," since here the Phœnician Semites found a richer territory and broader lands in which to expand than in their own narrow coast-line at home.

It is to these Phœnician settlers that we owe our present alphabet. They were, as I have said, an enterprising people, and their commercial business soon taught them the value of the writing of which their Egyptian neighbours were possessed. But as became men of business they were a practical people as well as an enterprising one; they felt none of that conservative reverence for the past which prevented change and innovation among the Egyptians, and so when they went to school in Egyptian learning they carried back with them not the whole cumbrous hieroglyphic system with its ideographs, its syllabic values, and its polyphony, but its alphabet only. All else was discarded; they found twenty-two characters sufficient to express all their thoughts and speech, and twenty-two characters only they accordingly kept. These twenty-two characters constitute the so-called Phœnician alphabet, which was handed on by the Phœnicians on the one side to the Hebrews, and on the other side to the Greeks, from whom it has descended through the Romans to ourselves. The Egyptian characters were borrowed by the Phœnicians of the Delta, not in their hieroglyphic but in their hieratic forms, as two or three examples will make self-evident.

(*To be continued.*)

RECENT PROGRESS IN ANTHROPOLOGY

AT the annual meeting of the Anthropological Institute on January 27, the president, Dr. E. B. Tylor, delivered the anniversary address. He compared the present state of the science with that of a generation ago, as shown in the addresses of 1847-8 delivered by Dr. Prichard to the newly-formed Ethnological Society. In those days it was still commonly believed that the broad-skulled tribes, whose remains are found in our early stone-age burial-mounds, were of the Keltic race; in fact, the so-called Ancient Britons. How backward comparative philology then was is shown by the fact that so eminent a scholar as Colebrooke fancied that Tamil and other Dravidian languages of South India were mere degraded dialects of Sanskrit. Prichard was the founder of English anthropology, but between his time and ours lie two events which have transformed it, namely, the development-

theory, which has rationalised the study of the races of mankind, and the discovery of quaternary man, which has extended human antiquity to a period long enough for the development-theory to work in. Dr. Tylor next proceeded to give an account of the Anthropological Society of Berlin, which, founded ten years ago, has, under the presidencies of Professors Virchow and Bastian, steadily risen to over 400 members, and has done admirable work. Its financial arrangements differ much from those of the English Society, it being housed by the State, and receiving an annual grant from the Minister of Public Worship, through which aid the members receive publications exceeding in value their moderate subscription. Among the contents of its publications for the last few years, special mention was made of the accounts of anthropoid apes in the Zoological Gardens of Germany. The life of Mafuka, who lived some time at Dresden, is among the most instructive of ape-biographies, as illustrating the approach of the anthropoid to the human mind. Knowing how to unlock her cage with the key, she stole and hid it for future use; she took the carpenter's bradawl and bored holes with it through her own table; when pouring drink from a jug into her cup, she would carefully stop short of overfilling it. Her death had an almost human pathos: she threw her arms round the neck of the director, Herr Schöpf, kissed him, and then putting her hand in his, lay down and died. Mention was made of Dr. Kulischer's paper on sexual selection in primitive times, which collects more fully than has been done by previous writers, the evidence that a pairing-time like that of the lower animals prevailed in rude human society, taking effect especially in festivals held in spring and autumn, as the times of returning warmth and plenty. On these occasions the great feature is the courting-dance, the often-unrestrained proceedings of which are not to be looked on as abnormal orgies, but as simply and undisguisedly natural, forming, indeed, part and parcel of the marriage-system of rude communal society. The courting-dance, though becoming more decorous with advancing culture, has held on with extraordinary tenacity through the history of society. In the middle ages it fully kept its connection with the season-festivals to which it especially belonged, curious relics of which still remain in European villages, for instance, the Ascension-Day festival near Gotha, where the dance under the linden-tree still marks the union of the peasant couples. Dr. Tylor added that the dances of the modern ball-room, however refined and ceremonious, show clear traces of descent from these ruder performances, not only in form, but in actual purpose.

Among matters of pre-historic archæology which of late have attracted attention in Germany are the "high-fields," or "heathen-fields," where the marks of ancient tillage are traced on ground now waste or forest-grown. These resemble the well-known "elf-furrows" of Scotland, but in neither country has the old agricultural race been identified. It is much the same with the "vitrified forts" once supposed to be peculiar to Scotland, but which are now found to be common in Central Europe. In a concluding general survey of the past year's work of the Anthropological Institute itself, particular stress was laid by Dr. Tylor on the contribution of new evidence for the Asiatic origin of the Polynesians, by Mr. Keane and Col. Yule; the minute examination of the Andaman islanders by Prof. Flower tending to prove them representatives of the primitive negro type; the Rev. J. Sibree's account of Malagasy relationships, where the indefinite use of such terms as father and mother points to an early stage of the idea of kinship; Dr. Tuke's investigation of De Rochas' theory that the Cagots of France and Spain owe their exclusion from society, not to being descendants of heretics, but of lepers, real or supposed; and Mr. Worthington Smith's collections increasing the area in England over which palæolithic man is now proved to have lived.

NOTES

We are again enabled, by the courtesy of General Myer, to present our readers with one of those monthly weather maps for the northern hemisphere, of the value of which we have spoken on several occasions. The present map is for May, 1878, representing the mean pressure, mean temperature, mean force, and prevailing direction of wind, for that month. Our readers will find it both instructive and interesting, as is indicated in our Meteorological Notes this week, to compare it with the corresponding map for April of the same year, which we published in our number for January 29.

An extraordinary prize of 3,000 francs has been awarded by the French Academy of Sciences to Mr. Crookes, F.R.S., in recognition of his recent discoveries in Molecular Physics and Radiant Matter.

We are glad to learn that it is intended to commemorate, by a permanent memorial, the distinguished services rendered to science and education by Dr. Thomas Andrews, during the thirty years that he was occupant of the Chair of Chemistry in the Queen's College, Belfast. At a meeting of a highly distinguished character which was held in the Queen's College, it was resolved that the memorial should consist—"Firstly, of a portrait or bust to be placed in the College, and of a replica to be presented to Dr. Andrews's family. Secondly, of a prize or scholarship to be founded in the Queen's College, Belfast, and awarded for high attainment in those sciences in which Dr. Andrews has achieved his distinction." We think that the form which the proposed memorial is to take will commend itself not only to Dr. Andrews's personal friends, but to the wider circle who appreciate his scientific work, and who desire to encourage the studies to which his life has been devoted. Subscriptions to the memorial are invited by the Executive Committee, and will be received by the treasurers, Mr. E. H. Clarke, Belfast Bank, and Mr. W. C. J. Allen, Ulster Bank, Belfast.

It is announced as certain that M. Krantz, the director of the 1878 Universal Exhibition, will be appointed director of the Conservatoire des Arts et Métiers, and that many improvements will take place on the occasion of his appointment.

News has reached Kew of the arrival of Prof. Bayley Balfour at Aden on January 24. In compliance with instructions from the Admiralty, Capt. Heron, of H.M.S. *Seagull*, arranged to convey Prof. Balfour to Socotra, and the latter hoped to start on February 1 or 2.

The veteran French chemist, Sainte-Claire Deville, has resigned the professorship at the École Normale of Paris, after having filled it in the most brilliant manner for twenty-nine years. Of his manifold and classical investigations during this period, the most noteworthy were those on aluminium, which, supported by Napoleon III., led to the creation of the aluminium industry; the adaptation and application of the same metallurgical processes to magnesium which created likewise the industry of this metal, and the extensive researches on platinum and its allied metals in company with Debray, in the course of which platinum was fused for the first time. Although, perhaps, of less financial value, still the results obtained by Deville in inorganic chemistry may fairly be placed at the side of the remarkable contributions of his fellow *savant* Pasteur, in the biological department of the same science. His successor is Prof. Troost, whose career as an investigator dates back some twenty-five years. He has likewise confined his attention almost exclusively to the problems of inorganic chemistry, and is best known by long-continued and exhaustive studies on the phenomena of heat connected with chemical reactions.

THE *American Naturalist* states that the report of the Curator of the Harvard University Museum of Zoology, where geology is also taught, shows that facilities are extended to those desirous of studying lithology. The instruction given by Mr. M. E. Wadsworth during the past year consisted of lectures on the macroscopic and microscopic characters of the rocks and their constituent minerals, and also of field and laboratory work. Besides the study of the laboratory collections, each student had assigned to him a separate district, which he was to map, studying the characters and relations of the rocks, and collecting the necessary specimens. Of the rocks thus collected the student was required to make thin sections and to examine them microscopically, writing a thesis upon the whole work. It was intended that the course should be sufficiently thorough to fit the student for practical field and laboratory research.

THE prospectus is issued of a proposed *Botanisches Centralblatt*, to be published weekly by Fischer, of Cassel, under the editorship of Dr. O. Uhlworm, of Leipzig. The object of the publication is to supply brief abstracts (without criticism) weekly of every important new independent publication or paper in a scientific journal, in all the various branches of botanical science; a complete index to titles of recent botanical literature in all countries; short original communications; reports of museums, gardens, botanical explorations, &c.; personal news, &c., &c. The editor has secured the co-operation for this purpose of correspondents in the various towns of Germany and France, England, Switzerland, Sweden, Servia, Denmark, Greece, Russia, Belgium, Holland, &c., &c. All communications should be addressed to Dr. O. Uhlworm, Südstrasse, 82, Leipzig, who invites the assistance of botanists in all countries to render the publication as complete and useful as possible.

A FEW alterations have been made in this year's curriculum of the École d'Anthropologie at Paris, which is now divided into a winter and summer session. Dr. Paul Broca is delivering a course of comparative anatomy, while Dr. Paul Topinard is conducting the biological section of the class for anthropology, and M. Gabriel de Mortillet that of human palæontology. The summer session will begin in April, with lectures on ethnology by Dr. Dally, on language in relation to anthropology by Dr. Hovelacque, and on demography by Dr. Bertillon.

HERR LISSAUER, in exploring the so-called "Reihengräber" near Culm, on the Weser, has found about seventy graves, not previously opened. In these the bodies were found lying in rows on the bare ground, and besides bronze and iron knives, amber, agate, and other beads, rings of an oval form, varying in diameter from 30 to 80 millim., were discovered on either side of each skull. These singular objects, to which the name of "Hackenringe" has been given from their hooked form, have never before been found at any but a purely Slave-station. In Poland there is evidence that their use was continued till the middle of the eleventh century, but hitherto no light has been thrown on the purpose for which they were intended. The crania found in these graves differed from the brachiocephalic type of the Slaves, and approached more closely to that of the mesaticephalic ancient inhabitants of Western Prussia.

A SMALL crater is stated to have appeared near Paterno, on the west side of Etna, and the other craters are again issuing a saltish oily fluid, which has formed a small lake and is injuring the neighbouring fields. Numerous slight shocks of earthquake have also been felt to the north-north-east and south-south-west of Etna; jets of steam have issued from the new craters, and steam, mixed with ashes, from the central one.

THE principles of sanitary science appear to have received but small attention in the Riviera, for, according to the sanitary commissioner of the *Morning Post*, who has just concluded a series of articles on the result of his examination of the condition of the part between Cannes and San Remo, they are everywhere disregarded. The more important facts he gives are these: As there are nowhere any sewers, the cesspool system is all but universal, and cesspools are often under the houses and have faulty ventilating pipes. There are but few public water supplies, and even where these are available they are not always used, wells, even in suspicious positions being used instead. There are two distinct sets of dangers which must be regarded quite apart. There are the dangers to villas and hotels, wherever situated, from defective cesspools, internal arrangements, and wells, and there are especial dangers in towns from the *égouts*. The dangers of villas and hotels are not under inspection, and people occupying them have no other assurance of safety than having them examined for themselves. The examination should be extended to the overflows from buildings on higher ground, which it appears the law does not prohibit. Many even of the best hotels are in a very unsatisfactory state. The ventilating pipes of cesspools frequently end by bed-room windows; wells are situated in places liable to pollution, while internal arrangements are dangerously faulty. The greatest dangers of all, however, are the *égouts* in towns. Originally intended only as drains for rain-water and waste house-water, they in reality receive the overflows of cesspools, and as they are never flushed and have but a very slight gradient, the matter hangs about in them and ferments, thus becoming a source of grave danger, as the air from the *égouts* rises into the streets through untrapped openings. The commissioner states that he has arrived at the real facts regarding the *égouts*, in spite of much official misinformation, and that he was three times laid up from working out the facts for himself. Although told at official bureaux that overflows did not exist because they were forbidden by law, he had some cesspool covers opened, saw the overflows, and then, from extended inquiries, found that the law was habitually disregarded, as the fine for an overflow was never enforced. English visitors thus know for the first time that *égouts* are not mere drains, as officially stated, but are worse than sewers. The beaches and promenades near the sea are especially dangerous, as the sands are becoming sodden with sewage matter, and the almost tideless bays are getting choked up with it. There are numberless private *égouts*, while the larger public *égouts* open on to the shores without any flaps or doors to them, so that the fouled air is wafted back to the public gardens and the favourite shore promenades. The one piece of advice offered to visitors is that they should select hotels or villas away from the shore and away from *égouts*.

AN International Meteorological Conference has been held in Sydney, at which it has been arranged to establish a uniform system of weather telegraphy for the different Australian colonies.

PROF. MILNE, of Tokio, Japan, has devised an ingenious method of detecting the least seismic trembling. In an article in the *Japan Gazette* for December 13, 1879, he thus describes his method:—"Besides endeavouring to obtain the true motion of any earth particle, I have, for special reasons, been endeavouring to obtain records of the smaller shakings. By the use of a special form of microphone when it is properly placed it is not difficult to detect any movement, however slight, of the earth's crust. My microphones are buried in pits round about the house. Precautions have been taken to keep out insects, otherwise the tramping of a beetle would register as an earthquake. The pits must also be dug at a distance from a roadway or path, otherwise every step of persons passing, even if six yards distant, will be indicated to the recorder. Excluding beetles, thieves, and unexpected visitors, it would seem that for some time before the occurrence of a 'shock' the telephone gives signs that the earth

is crackling as if under an increasing strain; these indications continue for uncertain periods, but they have been distinctly noticeable before the last few earthquakes. It would seem that the power of resistance of the earth before any surface movement is felt is very great, but, at last, like a bending stick, it suddenly breaks, and the jar gives the vibrations which we call an earthquake. If these 'crackles' can be detected we shall then have the means of approximately foretelling when the consequent crash is at hand. The observations of these 'crackles' which, so far as I am aware, have hitherto been studiously avoided or else unfortunately neglected, would also tell us something definite about periodicity. From my observations I feel certain that there are many small earthquakes which ordinary instruments pass by unnoticed. The consequence is that, when we attempt to correlate earth motions with those of, say, for instance, the moon, we do not find the accordance we should expect; the attraction of the moon has not been sufficiently great to overcome the elasticity of the earth's crust, and to cause shocks great enough to be recorded upon the usual instruments. If, however, instruments still more delicate are used, we shall find little earthquakes, or what I prefer to call earth tremors recorded in those places where we have been unsuccessfully looking for big ones. We shall, in fact, detect the little straws which are being piled up in regular order and which will eventually break the camel's back."

In his just published report H.M.'s Consul at Yokohama states that the experiment made during the two previous years of manufacturing black teas for the English market has been attended with such disappointing results to all concerned that the industry is not likely to be persevered in for the future.

The Birmingham Philosophical Society, at a meeting on February 12, did themselves the honour of electing Mr. Charles Darwin an honorary member and presenting him with an address on the occasion of his seventy-first birthday, the day of meeting.

Capt. Oliver desires us to state that in his letter in Nature, vol. xxi. p. 348, he wrote by mistake, in referring to Halley's work, *official* for *optical*.

We have on our table the following books:—"A Rule of Proportion," Dr. John Marshall (Smith, Elder); "Anatomy for Artists," Dr. John Marshall (Smith, Elder); "Der Realismus der modernen Naturwissenschaft," Dr. Anton von Leclair (Williams and Norgate); "Wave and Vortex Motion," Thomas Craig (van Nostrand); "Scotch Live Stock," James Bruce, (Edmonston and Co.); "Géologie Expérimentale," A. Daubrée; "Primer of the Industrial Geography of Great Britain and Ireland," G. P. Bevan (Sonnenschein and Allen); "Nile Gleanings," Villiers Stuart (John Murray); "Memoirs of Dr. P. P. Carpenter," Russell L. Carpenter (C. Kegan Paul); "Rural Bird Life," Charles Dixon (Longmans); "Hot Air," Richard Metcalf; "Ceylon Coffee Planters' Association," John Hughes; "Lethæa Geognostica," F. Roemer (E. Koch); "Biological Atlas," D. and A. N. M'Alpine (W. and A. K. Johnston); "Physical Geography," E. W. Lewis (Moffatt and Paige); "The Unity of Matter," A. S. Wilson (Samuel Highley); "The Art of Perfumery," G. W. S. Piesse (Longmans); "Who are the Irish?" James Bonwick (Bogue); "Das Protoplasma," Dr. Johannes v. Haustein (Carl Winter); "The Spectroscope in Medicine," C. A. McMunn (Churchill); "Zoology," A. S. Packard (H. Holt and Co.); "The Comstock Lode, its Formation and History," J. A. Church (J. Wiley and Son); "Handbuch der Botanik," Dr. N. J. C. Müller (Carl Winter); "River of Golden Sand," 2 vols., Capt. Gill (John Murray); "Chapters from the Physical History of the Earth," A. Nicols (Kegan Paul); "Medicinal Plants," parts 38, 39, 40, and 41, Robert Bentley and H. Trimen (Churchill); "Lange's History of Materialism," vol. 2, E. C. Thomas (Trübner); "Linkages," J. D. C. de Roos (van Nostrand); "Theory of Solid and Braced Elastic Arches," William Cain (van Nostrand); "On the Motion of Solid in a Fluid," Thomas Craig (van Nostrand); "Lucernariæ and their Allies," H. J. Clark (Washington).

The additions to the Zoological Society's Gardens during the past week include a White-fronted Lemur (*Lemur albifrons*) from Madagascar, presented by Mr. W. C. Gordon; a Macaque Monkey (*Macacus cynomolgus*), a Rhesus Monkey (*Macacus erythræus*) from India, presented by Mr. J. Snowden Henry, F.Z.S.; two Hawk-headed Caiques (*Deroptyus accipitrinus*) from Brazil, presented by Mr. Chas. Frieke; a Spur-winged Goose (*Plectropterus gambensis*) from West Africa, presented by Mr. R. B. Dobree; a Peregrine Falcon (*Falco peregrinus*) from Newfoundland, presented by Mr. F. R. Haynes; a Robben Island Snake (*Coronella phocarum*) from South Africa, presented by Mr. W. Porter; a Bewick's Swan (*Cygnus bewicki*), North European, two Sharp-nosed Crocodiles (*Crocodilus acutus*) from Jamaica, deposited; a Serval (*Felis serval*) from West Africa, purchased.

OUR ASTRONOMICAL COLUMN

The Comet of 1577.—For more reasons than one the comet which was observed at the end of 1577 and beginning of 1578 deserves prominent mention in the history of these bodies. It must have been the brightest comet of the sixteenth century, visible even in full sunshine, as we know from the testimony of Tycho Brahe, and it was from his careful observations of it, made at a critical time in the discussion as to the nature and distance of comets, that he proved it to have a much smaller parallax than the moon, and hence to be situated far beyond our satellite. Tycho's observations formed part of a work which, though it appears to have been completed so far as it referred to the comet in 1588, and copies distributed by Tycho to his friends in that year, was not published in the full sense of the term until 1603, when it was brought out at Prague after his death, under the care of his son-in-law. The work is entitled "Tychonis Brahe, Dani, De mundi ætheri recentioribus phænomenis liber secundus, qui est de illustri stella caudatâ anno 1577 conspectâ." In 1648 it was reprinted at Frankfort in the collective edition of Tycho's works. Pingré refers to the inaccuracy with which the observations of the comet were given in this edition, which served him for his *Cometographie*, but he thought he had discovered and corrected all the errors in his transcript of the observations for that work (vol. i. pp. 513-16).

The comet was seen in Peru as early as November 1, according to an historical work composed in 1589 by the Jesuit Joseph de Acosta, and about the same time, perhaps a day later, in Japan, as we learn from Kaempfer. It was seen in various parts of Europe on November 10, 11, and 12, and on November 13 Tycho observed it for the first time at Uraniburg, his observatory in the island of Huen. His experiences with regard to the comet are detailed in the work we have referred to. He thus describes his discovery of it: "Having gone out some time before sun-set, and while waiting supper, to amuse myself with witnessing the taking of fish from one of my ponds, I occupied myself while the net was being drawn, in surveying the western part of the sky, to see if the purity of the air promised for that night my usual pleasure of observing the stars. As I was least expecting it, I perceived in that direction a certain bright star, which appeared as distinct as Venus, when near to the earth and when seen before sunset or after sunrise. For the rays or *chevelure* of the star could not yet be perceived, the sun, still above the horizon, entirely obliterating the feeble brightness of its rays." Tycho then describes how he was astonished at the visibility of an unknown object of such brightness as to strike the eye while it was yet daylight; he was sure that there was no planet in that quarter of the sky excepting Saturn, which could not be seen in sunshine, and as to the fixed stars, he knew they were none of them visible under such circumstances. He asked those about him whether they saw an object in the direction he pointed out, and they replied it was perfectly distinct, and must be Venus because no other planet could be so conspicuous in daylight. Tycho, however, assured his friends that Venus was not in that part of the sky, and said it would be found as it grew darker that "aliquid insoliti admirandique" was there shining. Accordingly, as soon

as it was dusk, the star-like object was seen to be accompanied by a great train of light turned towards the east, and estimated by Tycho to be 22° in length; the head of the comet he judged to be 7′ in diameter. Generally he describes the head as round, bright, and of a yellowish light; the tail appeared to be burning or formed of red rays, brighter and more deeply coloured near the head; it was also curved, the convexity on the side of the zenith. Tycho's observations with instruments terminated on January 12, 1578, but he saw the comet for the last time on January 26, and estimated its place with respect to neighbouring stars.

The orbit of the comet of 1577 was calculated by Halley, but in 1844 a new reduction of Tycho's observations with modern star-positions was made by Dr. Woldstedt, who investigated the most probable resulting elements, in an inaugural dissertation at the University of Helsingfors.

The definitive orbit is as follows:—

Perihelion passage 1577, October 26·9476 G.M.T.

Longitude of perihelion	129	42·0	}	1578·0
,, ascending node	25	20·4		
Inclination	75	9·7		
Perihelion distance	0·1775			

Motion—retrograde.

On November 1 when the comet was first seen in Peru, its right ascension would be 230°, with 29° south declination, distance from the earth 0·75, and from the sun 0·28, so that the intensity of light, as represented by the usual formula, would be 21·8. On the first day of observation in Europe, November 10, at 6h. G.M.T., its R.A. was 266° 19′, Decl. – 19° 39′, distance from the earth 0·63, and from the sun 0·53, and hence the intensity of light was 9·1. On November 13, when Tycho detected the comet, the sun set at Uraniburg at 3h. 41m. mean time, and calculating for this time from the above elements, we find the R.A. was 276° 55′, Decl. – 14° 19′; the comet was distant from the earth 0·647, and from the sun 0·604, and the corresponding intensity of light 6·6, or only one-third of that when it was discovered in Peru, but it was then within 15° from the sun. Saturn was in about R.A. 281°, with 23° south declination. At the time of Tycho's last observation, or 7h. 30m. P.M. at Uraniburg, the comet was distant from the earth 2·65, and from the sun 2·07, the intensity of light, therefore, only 0·03. A consideration of these figures will amply bear out what we have stated, as to the conspicuous place which the comet of 1577 must claim.

THE SOUTHERN COMET.—A second telegram from Dr. Gould, received by Prof. C. A. F. Peters at Kiel the day after the first one, assigns a *southerly* motion to the great comet, or contrary to that mentioned in the previous one. Both statements may possibly be correct for the times to which they refer, as the case may be similar to that of the great comet of 1843, which sweeping round the sun with a velocity of 350 miles in a second, and almost grazing his surface, passed from ascending to descending node in two and a quarter hours.

METEOROLOGICAL NOTES

IN a "Brief Sketch of the Meteorology of the Bombay Presidency in 1878," Mr. F. Chambers opens a discussion of no little importance regarding certain relations subsisting among the meteorological phenomena of India. In that year the rainfall nearly everywhere throughout the Presidency was in excess of the normal quantity, and remarkably well distributed. No long-continued period of unusually dry weather was experienced in any district from the beginning of July to the end of the monsoon, the year being in this respect strikingly different from 1877 with its drought and terrible famine which followed in its footsteps. From a comparison of the weather phenomena of these two years, it is shown that the abnormal change of barometric pressure in July, 1878, as contrasted with July, 1877, was a fall of 0·068 inch, and the rainfall was 107 per cent. of the average fall greater in the latter than in the former month; in other words, the proportionate increase of rainfall corresponding to a fall in the pressure of 0·100 inch, was nearly 16 per cent. of the average fall. It is evident that if the extension of this inquiry to past and future years and to the whole of India, should confirm this important relation between the atmospheric pressure and the rainfall over their extensive region, or establish similar relations, the discovery will be of the utmost value in assisting towards the formation of forecasts of the probable character of coming monsoons.

IN the same report, Mr. Chambers extends this discussion over a much wider area than that of India, and from a comparison of the atmospheric pressure and rainfall of the Presidency with those at Zi-ka-wei, Manila, Batavia, and Mauritius, arrives at results which, though necessarily provisional in their character, are of the highest importance in the investigation of the great movements of the atmosphere. The general conclusion is that the special function performed by the central area of low barometric pressure in Asia during the summer months is merely that of a distributor of the monsoon vapour by the production of the successive "bursts" and "breaks" of the rainy season; but that the copiousness or scantiness of the vapour, and consequently of the rainfall, depends chiefly on the meteorological conditions previously existing in the Indian Ocean, the source whence the moisture and rainfall are drawn. The supreme value to meteorologists, in conducting such cosmopolitan inquiries, which attaches to the weather maps of the War Department of the United States, embracing the whole of the Northern Hemisphere, which we are now publishing, is very obvious. Their wide and deep significance will begin to be better seen on comparing the maps for May, 1878, about to appear in an early number of NATURE, with those for April, which have already appeared (NATURE, vol. xxi. p. 304). The shifting positions of the areas of high and low atmospheric pressure, with the consequent or accompanying changes of temperature, will throw much light on the changes of weather which occurred in the different regions of the Northern Hemisphere, and their rainfall; and the maps of subsequent months will go far in the elucidation of such large questions as the rainfall of India during the monsoon season of 1878, and the exceptional weather we have had in these islands for the past fifteen months.

ONE of the most conspicuous services that could be made to science by a simple catalogue of phenomena has just been rendered by Dr. Rubenson, director of the Central Meteorological Institute of Sweden. The work, which appears in the *Transactions* of the Royal Academy of Sciences of Sweden, is the first part of a catalogue of all the auroras observed in Sweden down to 1877. This part includes those which were observed and recorded from 1536 to 1799. The more special value of the catalogue, in addition to the length of time over which it spreads, consists in the circumstance that it is restricted to a well-defined portion of the earth's surface but of sufficient extent to afford results showing a generally close correspondence to the number of auroras which actually occurred over that part of the globe. The observations in the earlier years are fragmentary and scanty, but from 1722 the catalogue may be regarded as tolerably complete. From 1722 to 1799 auroras are recorded as having been seen on 4,245 nights. These years embrace fully seven sun-spot periods. Arranging the number of days each year on which the aurora was noted, according to the sun-spot periods, we obtain the following highly important results for the eleven years period of sun-spots: 30, 54, 63, 68, 78, 67, 62, 56, 55, 50, and 42. Hence the maximum occurred on the fifth year, there being thus three years from the minimum to the maximum, but six years from the maximum to the minimum. The following figures distribute these 4,245 auroras, in percentages, through the months of the year:—January, 9·7; February, 11·2; March, 13·8; April, 8·7; May, 1·8; June, 0·1; July, 0·5; August, 5·5; September, 13·7; October, 14·6; November, 10·4; and December, 10·0. The most rapid increase takes place on August 28, and the most rapid decrease on April 20.

MR. WILLIAM MARRIOTT examines in the *Journal of the Meteorological Society*, for October, two series of thermometric observations made for the twelve months ending with March, 1879, the one series being taken with a Stevenson's screen properly exposed on a grass-plot 17 feet square, and the other series with a pair of wall-screens fastened to the brick wall of an out-house with a northern aspect. The results show that the mean of the daily maxima for the year was 1°·0 lower in the wall-screen than in Stevenson's screen, but the mean of the daily minima was 0°·5 higher. The mean temperature by the wall-screen being thus only a quarter of a degree less than that by Stevenson's screen, it is concluded that the mean temperature may be roughly ascertained from thermometers shaded by a wall with a northern aspect. It is to be noted, however, that while Stevenson's screens placed over grass plots well exposed to

the sun give results comparable with each other, wall-screens give results which are not comparable, *inter se*, it being perhaps impossible to find two wall-screens in positions tolerably comparable. But it is in investigating the daily range and sudden changes of temperature, the humidity of the air, and others of the prime factors of climate that wall-screens as instruments of observation totally break down.

A PAPER of researches on the rainfall of Austria-Hungary has been recently presented to the Vienna Academy by Dr. Hann. His object is, while showing the main features of distribution of rain in the country, to establish a rational method of deduction of results from measurements of rainfall during short intervals of time. In the greater part of Austria-Hungary, he shows that June is the most rainy month; it is so in the whole of Bohemia and Hungary, with Siebenbürgen, in the eastern part of Galicia, and in Bukowina. In Moravia and Silesia nearly the same rain falls in June and August, with an intermediate decrease in July. West Galicia and the Tatra-region show a preponderance of July rain. Southwards from the Upper Dranthal a maximum in October becomes predominant. From about 45° lat. southwards more rain falls in the three winter than in the three summer months. The further south the more pronounced is the distinction of a dry from a wet period. The dryest months in the whole of Austria-Hungary down to 45° (where July is the driest month) are January and February; and especially notable is the little rainfall of February at the southern base of the central chain of the Alps.

PHYSICAL NOTES

MEASUREMENTS of the heat conductivity of iron hitherto have given rather discordant results. This must be due, according to Herr G. Kirchhoff and Herr Hansemann, to the fact that in most of them the quantities of heat given out or received from without by the body examined have not been sufficiently taken into account. These physicists have recently described to the Berlin Academy experiments by a method in which a cubical iron mass, after being left to itself a long time, had a strong water-spray directed against one of its side surfaces, the water being some degrees hotter (or colder) than the place of observation. At several points back from the heated surface vertical passages were made, each to receive one junction of a thermo-pile of thin German silver and copper wire, the other junction being at constant temperature. An observer, with the aid of a chronograph, marked the point of time at which certain divisions of the scale of the (mirror) galvanometer passed the vertical wire of the telescope, at the same time dictating their number to an assistant. Referring to the memoir for further details, we note the conclusion arrived at, viz., that the heat-conductivity of iron divided by the product of its specific heat and its density, at the temperature $\theta = 16{\cdot}94 - 0{\cdot}034\ (\theta - 15)$, when the temperature is measured in centigrade degrees, and the units of time and length are seconds and millimetres. With this result, that of H. Weber agrees best; he obtained the number 16·97 for 39° C. The results of F. Neumann, Ångström, and Forbes, on the other hand, are more divergent. (The substance used in the experiments here described was Dortmund puddled steel, containing 0·129 per cent. carbon and 0·080 silicium.)

HERR E. WIEDEMANN has recently made further experiments on the phosphorescent or fluorescent light produced by electric discharges (*Wied. Ann.*, No. 1). Nearly all platino-cyanide double salts show fluorescence under the discharge; but, so long as they were undecomposed, no double fluorescence was observed. When platino-barium cyanide had been traversed by a single discharge, the strong green fluorescent light showed no dichroism, but, after a series of discharges, dichroism appeared. It also occurred when the crystals of that or other platino-cyanide double salts were left a long time *in vacuo* (without electric discharge), whereby they lost water; and the more rapid appearance of dichroism under the electric discharges is attributed to heating of the crystals. Herr Wiedemann opposes Mr. Crookes's view, offering the following proof of its incorrectness:—If the positive current of a Holtz machine be sent through a very thick-walled discharge-tube, and the discharges be made to follow one another in such a rhythm that they are deflected from their course in the tube by the finger, only a weak phosphorescent light appears on the inner side of the tube, but a very bright green light appears on the *outer* side. The non-observation of this before is probably due to the thinness of the tubes commonly used. In narrow, and especially capillary tubes, too, only the inner wall becomes luminous.

WE take the following from the *New York Nation*:—"It is impossible for the unaided ear to determine with certainty the direction of a distant sound, especially when the atmosphere is foggy; hence the great utility to navigators of the instrument which its inventor, Prof. Alfred M. Mayer, of the Stevens Institute, has felicitously named the 'topophone,' or sound-placer. It consists of 'a vertical rod passing through the roof of the deck-cabin,' and bearing on the upper end 'a horizontal bar carrying two adjustable resonators,' below which a pointer is set at right angles with the bar. Rubber tubes from the resonators pass through the roof of the cabin and unite in a single pipe connected with a pair of ear-tubes. The vertical rod is turned by means of a handle in any direction. The first step is to tune the resonators accurately to the pitch of the sound under observation, and fix them 'at a distance from each other somewhat less than the length of the wave of that sound;' the next, by turning the handle, to bring them simultaneously on the wave-surface, when, as 'they both receive, at the same instant, the same phase of vibration on the planes of their mouths,' it will result that if the connecting tubes be of the same length, the sound-pulses, acting together, will be reinforced to the ear, but if the tubes differ in length by one-half the wave-length of the sound, the pulses will oppose and neutralise each other, and thus tend to produce silence. At this moment the horizontal bar is a chord in the spherical wave-surface of which say the fog-horn is the centre; and the pointer represents a radius, 'or, in other words, coincides in alignment with a line drawn from the place where the sound is produced through the place of observation.' By sailing the ship a measured distance 'at an observed angle from the radius line thus found, a second radius line may in like manner be found,' and 'the distance between the two points of observation is the base-line of a triangle, of which the two convergent radii are the sides.' From these data the distance of the fog-horn is readily computed."

GEOGRAPHICAL NOTES

THE *Vega* reached Naples at 1.30 P.M. on Saturday, the 14th. Prof. Nordenskjöld and his staff received a warm reception from representatives of the Italian and Swedish Governments. Prof. Nordenskjöld has been made Grand Officer, and Lieut. Palander Commander of the Order of the Crown of Italy. On Monday the explorers were entertained at a grand banquet. The French Institute will hold its annual meeting on March 1, under the presidency of M. Daubrée, who will deliver an inaugural address, the subject being Prof. Nordenskjöld's expedition. It is expected that the professor will land in France on that day. He will stop at Marseilles and Lyons, where he will be received by the local geographical societies and authorities. The Paris Geographical Society will send a delegation to Marseilles. Prof. Nordenskjöld will receive the gold medal of the Society at Paris, in the large hall of the Sorbonne. The several learned societies of Paris will send delegations to witness this ceremony, which will be followed by a grand banquet on the succeeding day. It is expected that Prof. Nordenskjöld will reach London in about a month's time, but his present intention is not to give a public address. He does not feel himself sufficiently master of English for this purpose, and, moreover, as might be surmised, he has an aversion to "starring." The botanists and zoologists of the expedition will go overland, visiting all the museums with Arctic collections, and will rejoin the *Vega* at Copenhagen.

AT the last promotion of the Legion of Honour M. Levasseur, vice-president of the Paris Geographical Society, was appointed to the grade of officer for his geographical and statistical works. M. Levasseur is the editor of the statistical department of the *Annuaire* of the Bureau des Longitudes, which has been so much enlarged recently.

THE French Chambers, at the instigation of M. de Freycinet, have voted a sum of 600,000 fr. for the cost of sending exploring missions into the remoter parts of Algiers and Senegal, and penetrating into the Sahara of the Western Soudan. Their immediate object is to trace the lines of future railways, but the indirect influence on the extension of our geographical knowledge is most important. Three scientific expeditions are being organised in Algiers; one is to operate in the Algerian Sahara, and will not pass El Golea; a second, comprising a corps of

engineers and an escort of natives, will advance southward from the Wargla, and, after passing the summer at the Jebel Ahaggar, will proceed by the Houssa to Sokoto, and ascending the Niger to Timbuctu, will return by way of Senegal. The Anthropological Society of Paris has availed itself of the permission granted it of sending out observers competent to undertake the ethnological study of the races with which the expeditions will come in contact, and has entrusted to Dr. Guyard the superintendence of the scientific staff which will accompany the Government explorers.

PROF. WALDHAUER, of Dorpat, has visited the northern boundaries of Courland, near the Riff of Domesnæs, in the Gulf of Riga, with a view of studying the condition of the small remnant of people living there, who are the sole representatives of the ancient races of Courland and Livonia. These persons, about 2,400 in number, occupy a limited area of about a verst in width between Mellesilla and Lyserort, and are separated from the Letts in the interior by a tract of morasses. They exhibit great national pride, deny their affinity with the Esthonians, are ignorant of the term Livonian, and call themselves "randalist," inhabitants of coast-lands, or "kalamied," fishermen. They are hardy sailors and skilful pilots. Several families occupy one long hut in common, and their villages resemble those of the Esthonians. They are usually fair-skinned, with chestnut or dark-brown hair; the beard, which is generally very abundant in middle life is seldom seen in young men before the age of twenty-five. Prof. Waldhauer has seen no instance of a red beard among them.

THE Chilian Government has just published in English, Spanish, and French, a "Synopsis Statistical and Geographical of Chili," treating of the condition of the country from January, 1878, to September, 1879. Among other useful matter it contains a short historical sketch, besides notes on its geographical position and physical aspect, its industrial zones, geological constitution, ethnography, and medical geography.

IN the new number of the Belgian Geographical Society's *Bulletin*, M. A. J. Wauters opportunely furnishes an article on Karema, on the eastern shore of Lake Tanganyika, where M. Cambier has just commenced the establishment of the first Belgian "Station hospitalière et scientifique" in East Central Africa.

THE *Cape Argus* publishes the results of the recent attempt to relieve the Trek Boers from the West Coast. After Mr. Palgrave returned to Capetown with the information that they had temporarily settled in what is called the Kaoko Veldt, Mr. Haybittle, by dint of hard travelling and the assistance of traders whom he met, succeeded in reaching the Boers in twenty-one days from Walfisch Bay. He describes the spot where he found them as a long limestone ridge about a day's journey from end to end, and about two days' journey south of the River Cunene, the nearest point on the coast being Point Rock, a distance of thirteen days' journey. In this ridge there are a number of depressions, in some of which springs are found, whence arises the name of Six Fountains. The country is almost devoid of population.

THE original paper in last Heft of the fourteenth volume of the Berlin Geographical Society's *Zeitschrift* is on the region around Koseer on the Red Sea, by Dr. Klunzinger. This number contains the usual annual bibliographical list of publications in all departments of geography, the most exhaustive and carefully arranged list of the kind to be found anywhere. In the *Verhandlungen* for November and January are important papers on the Marquesas Islands, by Baron von Schleinitz; on the Cordillera Passes, by Baron von Theilmann; on a journey on the Ural in the summer of 1879, by Dr. Arzuni; on agriculture in Japan, and on the geological survey of that country, by Dr. E. Naumann; and on the question whether the Andes are sinking, by Herr W. Reiss. Herr Reiss, after a careful review of what we know as to the condition of the coasts of Central and South America, where, while in one or two places a sinking seems apparent, a general rising is mostly proved, comes to the conclusion that the South American Continent, including the Andes, is increasing and not diminishing in elevation.

THE well-known traveller, Herr Ernst von Hesse-Wartegg, who has been staying in London for some time, delivered an interesting lecture on Thursday last, to the members of the German Athenæum, in Mortimer Street. The subject of the lecture was the social life of the Prairie Indians of North America, and was illustrated by numerous photographs and ethnological objects.

THE German Palestine Society has recently published part 3 of the second volume of its *Proceedings*. It contains a treatise on the Sulphur of the Jordan Valley, by Dr. Fraas (Stuttgart); a communication respecting the discovery of some valuable coins near Jerusalem, by Dr. Erman (Berlin); Notes on a Journey to Moab in 1872, by Rev. Klein (Kaiserslautern); an alphabetical list of all the localities in the Pachalik of Jerusalem, by Dr. Socin (Tübingen); an article on the ruins of Askalon, by Lic. Guthe (Leipzig), and various financial and administrative reports. The Society's last general meeting was held at Treves in September last. The efforts of the Society are now directed towards establishing a fund for scientific exploring expeditions to Palestine.

AT the last meeting of the Berlin Anthropological Society the latest news received from Prof. Bastian and Dr. Finsch were communicated by the president. Dr. Bastian stayed at Batavia until October last, and then left that place; he does not mention where he intended to proceed to next, but seems to have started on a prolonged tour, as he has sent all his collections and the scientific results of his investigations to Berlin. Dr. Finsch writes from the Marshall Islands, and says that intercourse with the natives of that group of islands is very difficult and expensive. He has collected over 300 ethnological objects, most of which, however, date from the places he visited before arriving in the Marshall group.

THE German Admiralty intends to publish a work on the scientific voyage round the world, made by the German corvette *Gazelle* during the years 1874 to 1876. The work will be divided into three parts. Part I. will contain a short description of the origin of the expedition, its objects and a general account of the voyage. The second part will be devoted to the deep-sea measurements, the meteorological and magnetical observations. Part III. will treat of the marine fauna and flora. The total cost of the work is estimated at 60,000 marks (3,000*l.*), for which the Admiralty will apply to the Federal Council.

NO. III. for 1879, of the *Journal* of the Asiatic Society of Bengal, contains a valuable *résumé* of the survey work accomplished during the Afghan campaign by the surveying officers attached to the various columns.

AT the meeting of the Geographical Society on Monday next an account by Mr. Hore, of the London Missionary Society's station at Ujiji, of his recent exploration of the Lukuga outlet of Lake Tanganyika, will be read, as well as a paper by Dr. Emil Holub, on the Marutse-Mabunda Empire in South Central Africa.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The Rev. J. C. Saunders, of Downing College, is announced to lecture this term on "Chemistry, Physiology, and Botany," and Messrs. Saunders and Hicks are the examiners in the coming "Special" B.A. examinations in natural science for an ordinary degreee, taking in geology and the other subjects mentioned.

NATURAL science scholarships are offered this year at Clare College (60*l.*), Caius (40*l.* or 60*l.*), King's (the Vintner of 90*l.*), Christ's, Emmanuel, and Sidney Sussex, St. John's (50*l.* for three years), Trinity and Downing (40*l.* to 70*l.*) In most colleges preference will be given to students under twenty by calling them Minor Scholars; exhibitioners, in general, may be of any age.

AT present botany and vegetable physiology appear to be getting more and more at a discount in Cambridge, notwithstanding the able teaching of Dr. Vines. He has had to close his laboratory, the room being otherwise required; and Dr. Hicks, (Sidney), sustains the burden of teaching botany during the term in both elementary and advanced lectures, in addition to the joint demonstratorship in chemistry. Several lectureships in botany are vacant in London.

AN amended series of regulations has been issued and will probably be carried, in regard to the Cambridge Natural Sciences Tripos. Twelve months' notice is to be given of the branches of science in which the practical examination is to be held. The class list in the first part of the examination is to be quite distinct from that issued after the second part. In the

second part of the examination there will be two questions at least in each branch of science included in the examination in each paper.

THERE are now about ten courses of professional and inter-collegiate lectures announced at Cambridge for the benefit of the selected Indian Civil Service Candidates; so that Oxford, Cambridge, and London are fairly in the field of competition in educating men for this great field of labour.

WE notice with pleasure that the Cambridge Senate have conferred the honorary degree of Master of Arts on Mr. Pattison Muir, prælector in chemistry at Caius College.

MR. J. G. FITCH'S lectures at Cambridge this term, on the practice of education, are attended by between sixty and seventy students, of whom about one-half are men. The new literary schools are soon in use. There will be an examination for teachers in June, under the Teachers' Training Syndicate, and certificates will be granted for theoretical knowledge in teaching. Mr. Oscar Browning will keep a register of all the university men who pass the examination, and will act as a means of communication between them and head-masters who require assistants. With all the more confidence we may look forward to great advantages from Mr. James Ward's lectures on the Theory of Education next term, he having given high proof of ability as a physiologist.

THE Cambridge Natural Science Board announces that Prof. Hughes's lectures this term are on the Pre-Cambrian and Carboniferous rocks, while in palæontology, Mr. Tawney will lecture on Trilobites. Mr. Walter Keeping, B.A., continues his (open) lectures at Christ's College, on Rocks and Rock Masses, their Formation and Metamorphosis.

MR. HILLHOUSE is lecturing on botany in the lectures for women, and Mr. Walter Keeping on geology supplementing Prof. Hughes's lectures.

A NEW Cambridge medical association has been formed, and has obtained permission to meet in the old anatomical schools. Every effort will be made to render this association a most valuable means of advancing the interests of medical science in the University.

PROF. STUART and Mr. Garnett are the examiners in mechanism and applied science for the year.

THE law on the constitution of the high council of education in France is progressing favourably before the Senate. No other members will be admitted than professional teachers, except delegates of the five National Academies: Sciences, Beaux Arts, Française, Sciences Morales et Politiques, Inscriptions et Belles Lettres.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 29.—"A Note on Protagon." By Arthur Gamgee, M.D., F.R.S., Brackenbury Professor of Physiology in Owens College, Manchester.

In this paper the author notices the allegations of Thudichum that protagon is an impure body containing more than 1 per cent. of inorganic matters, including no less than 0·76 per cent. of potassium.

He communicates a report from Prof. Roscoe, F.R.S., whom he requested specially to determine the mineral impurities and the amount of potassium in one of the samples of protagon, of which the analyses had formerly been communicated to the Royal Society.

By means of the spectroscope Dr. Roscoe determined the existence of a trace of potassium, which he estimated as equal to one-twentieth of a milligramme in one gramme of protagon (0·005 per cent.). Further, he found that on ignition protagon left a small quantity of fused metaphosphoric acid corresponding to 1·08 per cent. of phosphorus; the mean quantity of phosphorus deduced from the observations of Gamgee and Blankenhorn being 1·068.

"On the Physical Constants of Liquid Hydrochloric Acid." By Gerrard Ansdell, F.C.S., Chemical Assistant at the Royal Institution. Communicated by Prof. Dewar, F.R.S.

In continuation of my former experiments on the properties of liquid acetylene gas, I have recently examined the physical constants of liquid hydrochloric acid. The gas was made by the action of strong sulphuric acid on dry chloride of ammonium, being afterwards freed from sulphuric acid and dried before entering the tubes.

The Cailletet pump was used in the same way as described in my former paper, two iron reservoirs being used, one containing the air manometer, and the other the tube with the gas to be liquefied.

Apart from the mere determination of the vapour tensions, densities, &c., the ratios of the volume of saturated vapour to that of the liquid was considered of the highest importance, as from these numbers the latent heat of transformation and other important data can be easily calculated. For these reasons the gas was examined in rather a different way to the acetylene, the volume to which it had been compressed at the point of liquefaction (or the volume of the saturated vapour) at any given temperature being first accurately determined, and then the pressure increased until the condensed liquid entirely filled the upper part of the tube. The volume of this liquid column was then measured, so that a comparison between the volume of the saturated vapour and the volume of the total condensed liquid was obtained at each temperature.

The results of the whole series of experiments are recorded in a condensed form in the following table:—

A.	B.	C.	D.	E.	F.
4	137·31	$\frac{1}{38·89}$	7·55	18·18	29·8
13·8	103·50	$\frac{1}{53·19}$	8·35	12·39	37·75
22·0	81·19	$\frac{1}{70·06}$	9·10	8·92	45·75
33·4	55·75	$\frac{1}{105·98}$	10·12	5·50	58·85
44·8	36·34	$\frac{1}{168·67}$	11·96	3·03	75·20
48·0	31·33	$\frac{1}{197·60}$	12·00	2·61	80·80
50·56	25·70	—	14·30	1·79	85·33
51·00	23·96				

In this table

A = temperature of gas.

B = volume of the saturated vapour at point of liquefaction.

C = fractional volume of the gas at point of liquefaction in relation to the initial volume under one atmosphere of pressure.

D = volume of the condensed liquid.

E = ratio of volume of liquid to that of the gas.

F = pressure in atmosphere.

The critical point was found to be 51°·25 C.

It will be seen from this table that the volumes of the saturated vapours and liquid gradually approach each other as the temperature nears the critical point, and would undoubtedly become identical, if the experiments could be carried on up to the critical point.

The ratio between the volume of the saturated vapour and the volume of the liquid at different temperatures decreases very regularly until within about three degrees of the critical point, where a singular point in the curve occurs, and the ratio approaches unity with great rapidity. The volume of the liquid increases very regularly up to a temperature of about 48° C., and at 51° C., or within 0·25 of a degree of the critical point, the distinction between the saturated vapour and the liquid vanishes, as although liquid is plainly seen to condense on the surface of the mercury, on increasing the pressure the line of demarcation immediately disappears, and it is impossible to say whether the tube is filled with the saturated vapour or the liquid itself; therefore no results could be obtained nearer the critical point than about a fourth of a degree.

Avenarius, in a paper entitled "The Causes which determine the Critical Point" ("Acad. Sci. St. Pétersbourg," 1876-77), made a number of experiments on ether, and came to the conclusion that the volumes of the saturated vapour and of the condensed liquid at the critical point were not identical.

My own experiments appear to confirm his results, in so far as it is evidently impossible to measure the relative volume of fluid and gas within less than a fourth of a degree of the critical point, and at this place the volumes are certainly unequal. This, however, does not disprove their identity as the critical point.

The density of the liquid at different temperatures was determined in the same way as described in my former paper, and gave the following numbers:—

Temperature.	Density.
0° C.	·908
15·85	·835
33·0	·748
47·8	·619

It has therefore not quite such a high density as liquid carbonic acid which is 0·95 at 0° C., and is about twice as high as acetylene, which is 0·450 at the same temperature. It is interesting to note that acetylene is the lightest known fluid substance. Unfortunately Faraday does not seem to have determined its density.

Mathematical Society, February 12.—C. W. Merrifield, F.R.S., president, in the chair.—Mr. D. Edwardes was elected a Member, and subsequently admitted into the Society.—The following communications were made:—Geometrical notes, by Prof. H. J. S. Smith, F.R.S.—On the reflection of vibrations at the confines of two media between which the transition is gradual; and on the stability or instability of certain fluid motions, by Lord Rayleigh, F.R.S.—The calculus of equivalent statements further communication), by Mr. H. McColl.

Geological Society, February 4.—Henry Clifton Sorby, F.R.S., president, in the chair.—Francis Bond, Charles Herbert Cobbold, Frank Crisp, William Henry Dover, Mirza Mehdy Khan, John Notman, and John Evelyn Williams, were elected Fellows of the Society.—The President announced that, according to a circular, copies of which had been sent to the Society, certain old students of Freiberg were endeavouring to collect the means for erecting a monument in Freiberg to the memory of the late Prof. Bernhard von Cotta, and, further, of establishing a fund for the assistance of needy students at the Mining Academy of that place.—The following communications were read:—On the oligocene strata of the Hampshire Basin, by Prof. John W. Judd, F.R.S. The study of the succession of strata in the fluvio-marine series of the Isle of Wight and the New Forest is attended with considerable difficulties, partly on account of the inconstant character of the beds composing estuarine formations, and partly because of the thick superficial deposits which everywhere cover them. By Webster a lower freshwater series, a middle marine, and an upper freshwater series were recognised; but Mr. Prestwich showed, in the year 1846, that at Hamstead Cliff we have both freshwater and marine strata lying above all these; and in 1853 Edward Forbes proved that the marine and freshwater strata seen at Bembridge Ledge were not, as had previously been supposed, the equivalent of those of Headon Hill, but occupy a distinct and higher horizon. Hitherto, however (in spite of some suggestions to the contrary which were made by Dr. Wright and Prof. Hébert), the strata exposed at the base of Headon Hill have been believed to be a repetition, through an anticlinal fold, of those seen at Colwell and Totland Bays. In the memoir it is shown, both by stratigraphical and palæontological evidence, that the Colwell and Totland Bay beds are distinct from and overlie those at the base of Headon Hill. The distinctness and importance of the purely marine series exposed at Whitecliff Bay, Colwell Bay, and several localities in the New Forest is pointed out; and it is shown that, among the 200 forms of mollusca which they contain, only one-fifth are found in the Barton clay below. For this important division of the strata the name of the *Brockenhurst Series* is proposed. In consequence of the detection of an error in the accepted order of succession of the strata, a rectification of the classification of the fluvio-marine series is rendered necessary, and it is proposed to divide them as follows:—1. The Hempstead Series (marine and estuarine), 100 feet. 2. The Bembridge Group (estuarine), 300 feet. 3. The Brockenhurst Series (marine), 25 to 100 feet. 4. The Headon Group (estuarine), 400 feet. By this new grouping the strata of the Hampshire Basin are brought into exact correlation with those of France, Belgium, North Germany, and Switzerland; and the whole series of fluvio-marine beds in the Isle of Wight, which are shown to have a thickness of between 800 and 900 feet, are proved to be the representatives of the lower and middle oligocene of those countries. The use of the term oligocene in this country is advocated on the ground that by its adoption only can we avoid the inconvenient course of dividing the fluvio-marine series between the eocene and the miocene.

PARIS

Academy of Sciences, February 9.—M. Edm. Becquerel in the chair.—The death of General Morin was announced. (M. Tresca's funeral discourse appears in *Comptes Rendus*.)—On virulent maladies, and particularly on the malady commonly called the cholera of fowls, by M. Pasteur. The small organism (or *microbe*) which causes this malady can be well cultivated in bouillon of fowl's muscles neutralised by potash, and sterilised by a temperature of 110° to 115°. Inoculation of guinea pigs with it causes only abscess, but fowls inoculated with contents of the abscess die. Fowls or rabbits living in company with the guinea-pigs having abscess become ill and die. The microbe multiplies in the intestines of fowls that have taken it with food, and the infected excrement is fatal to fowls inoculated with it. Repeated culture of the microbe by transference of minute drops from liquid to liquid, does not weaken the virulence, but by a certain mode of culture M. Pasteur *can* weaken it. If twenty out of forty fowls be inoculated with the very virulent virus, they nearly all die; but if the other twenty be inoculated with the attenuated virus, they all become ill, but very few die; inoculation of those that recover with the very infectious virus does not kill them. The novelty here is the preservative effect of inoculation in a disease caused by a living organism (in the virus of small-pox, &c., no life has been proved). The cholera of fowls may be prevented from becoming fatal, and the author describes the return to health of a fowl inoculated in the large pectoral muscles. He expresses the hope of obtaining artificial cultures of all kinds of virus, and notes the encouragement obtained for the search of vaccine virus of virulent maladies.—Epidemic caused in *Diptera* of the genus Syrphus by an *Entomophthora* fungus, by MM. Brongniart and Cornu. The Secretary, referring to this vast destruction of insects, recalled M. Pasteur's suggestion to seek the destruction of phylloxera by inoculation with some microscopic fungus, and invited the attention of naturalists to the subject.—Spectrometric measurement of high temperatures, by M. Crova. He describes an apparatus called a *spectro-pyrometer*. The optic zero corresponds to about 580° C., 1,000 optic degrees, to 1,900° C. Temperatures can be measured up to nearly 2,000° C.—Statistics of solar spots of the year 1879, by M. Wolf. The Zurich observations, completed by similar series at Palermo, Rome, Athens, Madrid, &c., gave, for mean relative number for 1879, $r = 6·0$ in place of 3·4 for 1878. Thus the epoch of minimum is distinctly passed. The series of observations of magnetic declination at Milan, Vienna, Prague, Munich, and Christiania, agree in giving 1878·5 as the epoch of minimum. Comparing with the preceding epochs of minimum and maximum, the two periods (spots and magnetic variations) are found in remarkable harmony, both as to total length, 11·7 years, and as to the two parts of the period (which is slightly longer than the average of 11¼ years).

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