THURSDAY, FEBRUARY 3, 1881

PREHISTORIC EUROPE

Prehistoric Europe. A Geological Sketch. By James Geikie, LL.D., F.R.S. 8vo. (London: Stanford, 1881.)

Les Premiers Hommes et les Temps Préhistoriques. Par le Marquis de Nadaillac. Two vols. 8vo. (Paris: Masson, 1881.)

THE condition of Europe outside the reach of history and the changes by which it has come to be what it is, the appearance of man and his progress in culture, combine to form a subject which cannot, in our opinion, be treated satisfactorily in the present state of knowledge. New facts are being daily brought to light, the speculations of yesterday are being tested by the discoveries of to-day, and the accumulation of materials necessary to form a sound judgment even in any one department, such, for instance, as archæology, is so great, that it may well daunt the courage of the boldest writer who knows the nature of the task before him. In the two books before us the subject is treated from totally different points of view. Dr. James Geikie takes his stand upon the glaciated mountains of Scotland, and attempts to throw the glacial net woven in his previous work, "The Ice Age," over the whole of Europe, and the Marquis de Nadaillac records the facts which he has collected from various quarters, America included, in what may be called a prehistoric gazetteer. The one avowedly takes up the position of an advocate, and pushes glacialism and interglacialism to an extreme, while the other takes the safer, though humbler, ground of a man who has no original views to put forward. The works of both will be useful exactly in proportion to the knowledge and judgment of the reader. There is wheat in both works, but it needs a careful winnowing, as we shall proceed to show.

In his previous work Dr. James Geikie proposed a classification of the Pleistocene deposits of Europe based mainly on observations which he has made in certain parts of Scotland, and attempted a more minute subdivision of the glacial strata than the threefold arrangement generally recognised by European geologists. He advocated a complicated series of arctic glacial and of warm interglacial periods, layers of clay with boulders representing the one, and strata of sand, gravel, loam, or peat the other. His views are by no means accepted, even for Scotland, and the small progress made in general classification during the last twenty years may be estimated from the fact, that scarcely any two geologists agree in correlating the clays and sands on the east and west side of the Pennine Chain with one another and with the glacial strata of Wales, Cumbria, or Scotland. There also is a considerable difference of opinion as to the clays themselves having been derived from glaciers or from icebergs. In his present work he treats these difficulties as solved, and devotes one large section to show "English geologists" (why English?) that all the fluviatile and cave-accumulations with Palæolithic man and the Pleistocene mammalia usually termed Post-glacial, are "of Interglacial, and not of Post-glacial date." The latter term is here used in the sense of being "later than the last great extension of glacier ice in Europe," while the former represents the interval of time between the retreat of one set of glaciers and the advance of another, or that between the deposits of one set of icebergs and those of another. Lyell, Prestwich, Evans, Hughes, and the great majority of those who have worked at the subject hold that the Pleistocene mammalia invaded Europe before the glacial cold had set in, and swung to and fro according to the fluctuations of temperature while the glaciers were advancing and retreating, and that there is proof that Palæolithic man and the extinct animals were in Britain "after the last great extension of the glaciers" (if they were glaciers and not icebergs). We will then appeal to the facts which have been repeatedly urged in the *Proceedings* of the Geological Society and of the Anthropological Institute, as well as in most of the separate works published in Britain since the year 1860.

The area over which Palæolithic implements and Pleistocene mammalia occur in direct relation to the glacial deposits is principally the valley of the Thames and of the Severn, and the Midland and Eastern counties. In the first of these they occur in fluviatile strata, such, for example, as the gravels on which London stands, which are composed of materials derived from the destruction of "the chalky boulder clay." In the valley of the Severn the Pleistocene mammalia are imbedded also in the *detritus* of the boulder clay of that region (Lucy). In the neighbourhood of Cambridge (Hughes, Fisher) the same is the case. In the neighbourhood of Bedford, Wyatt, Prestwich, and Lyell pointed out long ago, not only that the gravels containing the flint implements and fossil mammals were composed of materials that resulted from the wreck of the boulder clay, but that the deposit rested in a hollow which had been cut through "the great chalky boulder clay" of the district. At Hoxne the mammaliferous gravels with Palæolithic implements rest on that boulder clay. The clays in question are the only signs of the extension of glaciers (? icebergs) over those districts, and the fluviatile deposits are obviously of later date. This conclusion Dr. James Geikie does not venture to dispute, but he asks us to believe that formerly another sheet of boulder clay has covered up all these deposits, and that it has been removed so completely that no trace of it is now to be seen. He fixes his attention on the purple clay and the Hessle clay, which occupy an exceedingly limited area, in Yorkshire and Lincolnshire, and imagines that they represent glacial periods, one of which, not specified, extended over the fluviatile strata in question, and caused these strata to be inter- instead of post-glacial. These boulder clays are local and unimportant, and have not been met with over any deposit containing Palæolithic implements. In advancing this speculation he is drawing a cheque on our credulity which is not likely to be honoured. The strata in question are proved by their position to be later than the glacial deposits of the districts in which they occur; it is for him to prove that they are earlier than glacial deposits elsewhere. This he has not done. Still less can his conclusion be accepted that Palæolithic man and the Pleistocene beasts associated with him are solely "interglacial" in Britain and on the Continent in non-glaciated areas. The cases quoted above, and they might be greatly increased, prove that man and the Pleistocene beasts were

in Europe "after the last great extension of glaciers"—or in the Post-glacial times.

There is also reason to believe that man was living in Europe before and during the Glacial period, or, in other words, in Pre-glacial, Glacial, and Inter-glacial times, although the alleged discovery of man in the Victoria Cave, relied upon by Dr. J. Geikie, has been shown to have been founded on a mistake, and the inter-glacial age of the implements at Brandon and Thetford, which he quotes as being of great importance, is not accepted by very good judges such as Dr. Evans and Prof. Hughes. These however may be dismissed as throwing no light on the question as to the existence of man in Britain after the great extension of the glaciers.

Dr. J. Geikie's method of arriving at the climate of his "Inter-glacial periods" is equally faulty. He considers that they were warm and genial, because of the presence of certain land shells, such as *Cyrena fluminalis*, the climatic value of which is at present unknown, of certain marine shells, the distribution of which is dependent on the warm and cold currents, and of land-mammalia now found only in southern latitudes, such as the hippopotamus, the limit of whose endurance of cold is yet to be proved, since those in the Zoological Gardens in London will take their tubs in frosty weather. But, unfortunately for his argument, the last animal is associated with arctic species, such as the reindeer, in all the caves (Kirkdale, Durdham Down, &c.) except two, and in all the river deposits (Bedford, Acton, &c.) except some three or four, in which it has been found in this country. With equal reason we might argue that the climate was arctic from the presence of reindeer. The consideration which he urges, that the two groups of animals could not live side by side because they do not live now, is met by the direct testimony of their associated remains, not merely in this country but on the continent. The hyænas, for example, of Kirkdale and of the Vale of Clwyd ate reindeer and hippopotamuses, and dragged them into their dens, where their gnawed fragments occurred in one and the same stratum. We may remark that in dealing with the fauna of the Victoria Cave Dr. J. Geikie omits all notice of the reindeer, the presence of which destroys his argument as to climate. This selection may be taken as a fair sample of the mode in which he has dealt with the whole evidence offered by the Pleistocene mammalia. He deals with it, not with the impartiality of a judge, but as an advocate; and has only called those witnesses which count on his side. The vast numbers of reindeer associated with the remains of Palæolithic man from the caves of Cresswell as far as the Alps, and from the Pyrenees into the valley of the Danube, prove that the climate in those regions was in those times not "a warm inter-glacial" climate, but one in harmony with hat indicated by the blocks of stone in the gravels pointed out by Prof. Prestwich.

The interglacial net is spread far and wide over the Continent. It includes not merely the forest with fig-trees and Judas-trees and laurestinas of Moret, which, as Saporta points out, would have been killed off by a spell of hard frosts, to say nothing of such a climate as is implied by the supposed preceding Glacial period, of which there is no evidence in that locality. It covers the deposits of Mont Perrier, near Issoire, from which MM. Croizet and Jobert obtained a rich fauna, universally considered typical upper Pleiocene. It covers also the mammaliferous deposit of Liffe, near Gandino in the Italian Alps, in which the mammalia identified by Forsyth Major are unmistakably Pleiocene. It is even stretched so as to take in the so-called Pleiocene man of Olmo, near Arezzo, the age of which, as Dr. Evans has pointed out, is proved to be Neolithic by the associated implements. Thus we have things of widely different and of well-ascertained age grouped together under the head of "inter-glacial," and we have in this fact proof that the classification is so far worthless, as indeed every system must be which is based on ice, and ice only.

In further illustration of this we may quote the view of our author, that in the period usually termed Prehistoric, or recent, but by him "Post-glacial," Europe was connected by land with the Faröes, Iceland, and Greenland, and that the climate was genial. It is assumed that the "last glacial period" killed off all the Pleistocene forests in those latitudes, and that the present traces of forests are the result of subsequent growths, extending from one point to all the rest along a continuous tract of land. If we allow this, surely in the far north, to say the least, they are "interglacial," seeing that they are wedged in between "the last Glacial period" and the present glacial conditions. But we can allow neither his assumption nor can we accept his geography. The Post-glacial glaciers of Scotland spoken of on p. 526 seem to us proof that the ice-classification breaks down, and the admission that the Great Ice age is merely "a stage or phase of the Pleistocene period" is a frank confession tending in that direction.

It is only necessary to say a few words about the two large volumes of the Marquis de Nadaillac. His attitude of reserve with regard to Meiocene and Pleiocene man is judicial and impartial. But we would point out that here and there in the work serious errors are to be remarked. He considers, for example, the Archæopteryx a tertiary bird; he associates the Liassic fish of Lyme Regis with the "Tertiary fishes of Lebanon and Monte Bolca," and he writes of the Ichthyosaurus and Plesiosaurus as if they belonged to the Eocene age.

In neither of these works can we find any addition to what has been already known about Prehistoric Europe, and in both there are omissions of well-known facts which it is impossible to notice within the limits of these columns.

W. Boyd Dawkins

THE BIOLOGY OF PLANTS

Beiträge zur Biologie der Pflanzen. Herausgegeben von Dr. Ferdinand Cohn. Vol. ii. part 3, with 5 plates; vol. iii. parts 1 and 2, with 15 plates. (Breslau: J. U. Kern, 1877, 1879, and 1880.)

In the concluding part of the second volume of the well-known *Beiträge* three out of four papers are devoted to fungi and Bacteria, one only being physiological. This physiological paper is by Dr. Just, on the action of high temperatures upon the preservation and germination of seeds. The experiments, which are described in minute detail, were made with Nobbe's germinating apparatus and a thermostat. Horstmann's thermostat, which was the one employed for all tempera-

tures up to 60° C., is described and figured at p. 348, and consists essentially of a closed vessel with triple walls, the space between the inner and middle plate filled with water, the outer containing air. For higher temperatures a simple tin plate thermostat was employed, the space being filled with water for temperatures up to 100° Cent. and with glycerine or oil for higher temperatures. The source of heat was always a gas-flame with the usual thermo-regulator. Numerous tabulated results are given of experiments upon moist and dry seeds at various temperatures, and it was found, as might be anticipated, that perfectly dry seeds can withstand a high temperature, even between 120° and 125° Cent., without injury.

Dr. Koch describes how bacteria can be observed, prepared, and photographed, this paper forming the sixth of the extremely important series of researches on bacteria which have from time to time appeared in the *Beiträge*. A thin layer of bacteria with the fluid containing them is to be dried on a thin cover of glass. By placing the glass cover with the dried material in absolute alcohol, or better, in a 0·5 per cent. solution of chromic acid, the bacteria are fixed to the cover, although the coagulated ground substance in which the bacteria are imbedded can be made to swell up and the bacteria themselves to resume their natural forms when the cover is placed in a solution of acetate of potash (1 part to 2 of distilled water). The bacteria can be coloured by means of aniline, the best of all being aniline brown; but methyl violet and fuchsin will also answer. The stained object can be preserved permanently on slides by mounting in Canada balsam, concentrated solution of acetate of potash, or in glycerine. Twenty-four photographs of bacteria, mostly from specimens stained with aniline brown, illustrate the paper; and in some, as 5 and 6 on Plate XIV., the cilia of bacillus are very beautifully shown, magnified 500 and 700 diameters. Koch finds that it is easier to photograph the cilia than to observe them directly with the microscope.

The other papers in this part are on certain Ustilaginæ, by Dr. Schroeter; and on two new species of Entomophthora (*E. conglomerata* and *E. rimosa*) discovered upon dead gnats, by Prof. N. Sorokin.

The first and second parts of vol. iii. contain eleven papers. Four of these are devoted to Bacteria, and form the seventh to the tenth of the series of Researches on Bacteria already alluded to. The titles of the papers are VII. Experiments on Infection with *Micrococcus prodigiosus*, by Dr. A. Wernich; VIII. Researches on the Bacteria in Air, by Dr. Miflet; IX. On the Action of the Electrical Current on the Multiplication of Bacteria, by Dr. F. Cohn and Dr. Mendelssohn; and X. Studies of Blue Milk, by Dr. F. Neelsen. Two of these papers may be briefly mentioned. By means of a specially contrived apparatus fitted with a new continuous aspirator, the invention of Paul Boehme in Brunn, atmospheric air from different localities was examined. These were (1) air in Botanical Laboratory; (2) in Fever Hospital; (3) in the Pathological Theatre; (4) in the Surgical Theatre; (5) air in Botanic Garden; (6) air for soil; and (7) air for drains. The results were briefly as follows:—1. Germs of bacteria capable of developing are abundant in the air, and could readily be collected and cultivated in a special mineral solution, malt extract, or solution of Liebig's extract of beef. 2. Many forms of bacteria can produce reproductive germs in air, while others, as *B. Termo*, seem only capable of producing germs in putrescent matter. 3. Air from the soil contained occasionally germs of bacteria. 4. Air from the Fever Hospital contained no germs, owing to the completeness of the ventilation and disinfection. 5. Air from a sewer contained abundance of germs of bacteria capable of reproducing.

Neelsen, in his paper on Blue Milk, finds that the special organism in it may assume three or four different forms, sometimes like Bacterium, then like Bacillus, then like a Chroococcus, and lastly like a Leptothrix. He discusses the Theory of Cohn and others that the Bacteria form many separate genera and species, and the Theory of Lankester and Warming, that they are forms of a protean species, and seems to conclude that the germs of a given form may under different conditions develop in one or other direction, as observed by him in blue milk.

Dr. Schroeter continues his observations on the Development of Rust, and Dr. Oscar Kirchner describes the Development of *Volvox minor*, Stein. Dr. Hielsher describes the Anatomy and Biology of the Genus Streptocarpus, and details many interesting facts regarding that curious and beautiful genus. When the seed of *Streptocarpus polyanthus* germinates, numerous adventitious roots form on the primary axis, one of the two cotyledons soon disappears, while the other develops greatly, and forms a perennial foliage leaf. On the petiole of this leaf numerous adventitious roots develop and the primary axis disappears. The leaf produces adventitious buds from which the flowers develop, while it also develops a series of adventitious leaf-buds. Dr. Beinling contributes a paper on the formation of adventitious roots and buds on the leaf-cuttings of Peperomia. Prof. Klein describes in detail the anatomy of *Pinguicula alpina* as an insectivorous plant, and points out that the plant occurs in two forms, one with green leaves, the other with the leaves more or less red-brown in colour, and that the tissues assume an intense yellow colour when acted on with caustic potash solution. The remaining papers are by Dr. Schwartz, Chemico-botanical Studies on the Acids in Lichens, and Dr. Eidam on the Gymnoasci. The various papers ably sustain the reputation of this work, and all of them will well repay careful study.

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.]

Dust and Fogs

I MUCH regret the Hon. R. Russell, in his letter to NATURE, vol. xxiii. p. 267, takes such an extremely desponding view of the influence which my experiments on cloudy condensation are likely to exercise upon the present attempts to rid the atmosphere of our large towns of their ever-recurring fogs. The object of these experiments was to find out what caused fogs, in the hope that with the knowledge thus acquired we might be better able to find a remedy. The preferable course seemed to be to find the cause first, and then if possible devise some remedy, rather than try remedies at haphazard.

It is certainly very far from my desire to discourage the present attempts which are being made to clear the atmosphere of our large towns of smoke, and I have recognised the advantages which would result from the adoption of more perfect forms of combustion. In my paper I have simply distinguished between fogs and smoke, and separated them for distinct consideration and treatment, and have at the same time directed attention to some points which ought to be considered before deciding on their prevention.

With regard to Mr. Russell's difficulty in reconciling the result of the experiments with what is observed with regard to fogs in London, Paris, and other large towns, it appears to me to have arisen entirely from not putting sufficient weight on the all-important influence of the amount of vapour in the air of the different places. It is condensed vapour which forms the fog, and dust simply determines whether it will condense in fine- or coarse-grained particles. The atmosphere of Paris, compared with that of London, is an extremely dry one, and the air is seldom in a condition to produce fogs. The atmospheres of the other towns mentioned are also drier, some of them very much drier, than that of London. London however will probably be always more subject to fogs than other cities on account of its great size, some part of it being always in its own smoke.

Considered from a different point of view, might not the fog of January 31, 1880, referred to by your correspondent, be cited in evidence of a conclusion the opposite of that drawn by the writer, and in favour of the correctness of the experimental results? From this point of view the low white fog cleared away because it was formed in the comparatively pure air of the streets, while the higher fog did not clear away because it was formed in the products of combustion The true explanation however would rather appear to be, that where the fog was white it was also of less depth than in those places where it "extended high" and mixed with the smoke; and the sun, which was only sufficient to dispel the lesser depth "more or less," would evidently be insufficient to clear away the greater depth. It is however impossible to form any definite idea as to how this particular fog conducted itself, without much fuller information as to air-current, &c.

I have communicated to the secretary of the Royal Society of Edinburgh a second experimental paper on fogs, with special reference to dry fogs. In this paper the full answer to the latter part of Mr. Russell's letter will be found. JOHN AITKEN

Darroch, Falkirk, January 24

Professors Exner and Young

MY statement in respect to Prof. Exner's having announced the thermo-electric neutrality of a bismuth-antimony pair immersed in pure nitrogen, rested upon a note in NATURE (vol. xxii. p. 156), and this it seems was based upon a statement in *L'Electricité*. I have seen those of Prof. Exner's papers which have appeared in the *Annalen der Physik*, and there is certainly nothing of the sort in *them;* but I supposed that it must be contained in some other paper in some one of the numerous other publications to which I have not access here. It never occurred to me, until within a very short time, that there could be any mistake as to his having made such an assertion. How or where the error originated I cannot quite understand; but I trust Prof. Exner will accept my apologies for my share in its propagation, and that he and all concerned will be satisfied that no misrepresentation was intended on my part. The incident is a good illustration of the extreme care necessary in commenting upon the views of another person. C. A. YOUNG

Princeton, U.S.A., January 12

The Flying-fish

IT is remarkable that there should still be any doubt as to the facts in connection with the flight of the flying-fish. Dr. Günther ("Study of Fishes," p. 622), summarising the observation of Möbius, says that "they frequently overtop each wave, being carried over it by the pressure of the disturbed air" (in the open sea!). Again, flying-fishes "never" fall on board vessels "during a calm or from the lee side." At night "when they are unable to see they frequently fly against the weather-board, when they are caught by the current of air and carried upwards to a height of twenty feet above the surface of the water." Surely the fish going at the rate of at least ten miles an hour would on striking the "weather-board" be dashed, bruised and helpless, back into the water instead of coming over the side fresh and vigorous, flapping about on the deck. Except when "by a stroke of its tail" it turns towards the right or left, Möbius concludes that "any deflection from a straight course is due to external circumstances, and not to voluntary action on the part of the fish."

I have watched flying-fish repeatedly, and have invariably seen them fly, or rather glide, over the surface of the sea, and from one to two feet above it, rising gently to the swell when there was no wind, and occasionally turning to the right or left without touching the water. I do not say that when there is a breeze the tail of the fish may not touch it, but I think that, with the foam and spray of the broken water, it would be very difficult to be sure of it, and, moreover, if the tail was used the motion would be a jerking one. Mr. Wallace speaks of their "rising and falling in the most graceful manner," which, although he is referring to another species, applies also to the North Atlantic form (*Exocœtus evolans*). Mr. Bennett ("Gatherings," &c., p. 14) says that they "spring from the sea to a great elevation." This is probably in reference to their coming on board ship at night, attracted, it is supposed, by the lights. I believe the pectoral fins are kept extended without any motion, except perhaps as Mr. Whitman,[1] a recent observer, says, just when they rise from the sea. He gives 800 to 1200 feet as the greatest distance he has seen them fly, and about forty seconds as the longest time out of the water. By what mechanical means they move when out of the water is still to me a mystery.

I have never known the flying-fish to be pursued by other fish, nor ever seen any bird near them; indeed few birds are ever seen far from the land north of the southern tropic, where flying-fish are most abundant. The dolphin (*Coryphæna*) is supposed to be their greatest enemy. I had once an opportunity of seeing one opened—in the West Indies—its stomach was quite full of *Orthagoriscus mola*, very young, being not quite an inch long.

FRANCIS P. PASCOE

1, Burlington Road, W., January 21

Mr. S. Butler's "Unconscious Memory"

I MUST reply to the review of my book, "Unconscious Memory," in your issue of the 27th inst., and to Dr. Krause's letter on the same subject in the same issue.

Mr. Romanes accuses me of having made "a vile and abusive attack upon the personal character of a man in the position of Mr. Darwin," which I suppose is Mr. Romanes' way of saying that I have made a vile and abusive personal attack on Mr. Darwin himself. It is true I have attacked Mr. Darwin, but Mr. Romanes has done nothing to show that I was not warranted in doing so. I said that Mr. Darwin's most important predecessors as writers upon evolution were Buffon, Dr. Erasmus Darwin, Lamarck, and the author of the "Vestiges of Creation." In the first edition of the "Origin of Species" Mr. Darwin did not allude to Buffon nor to Dr. Erasmus Darwin, he hardly mentioned Lamarck, and he ignored the author of the "Vestiges" except in one sentence. This sentence was so gross a misrepresentation that it was expunged—silently—in later editions. Mr. Romanes does not and cannot deny any part of this.

I said Mr. Darwin tacitly claimed to be the originator of the theory of evolution, which he so mixed up with the theory of "Natural Selection" as to mislead his readers. Mr. Romanes will not gainsay this. Here is the opening sentence of the "Origin of Species":—

"When on board H.M.S. *Beagle* as naturalist, I was much struck with certain facts in the distribution of the inhabitants of South America, and in the geological relations of the present to the past inhabitants of that continent. These facts, as will be seen in the latter chapters of this volume, seemed to throw some light on the origin of species; that mystery of mysteries, as it has been termed by one of our greatest philosophers. On my return home it occurred to me in 1837 that something might perhaps be made out on this question by patiently accumulating and reflecting upon all sorts of facts which could possibly have any bearing on it. After five years' work I allowed myself to speculate upon the subject, and drew up some short notes; these I enlarged in 1844 into a sketch of the conclusions which then seemed to me probable; from that period to the present day I have steadily pursued the same object. I hope that I may be

[1] See *Zoologist* for November, 1880.

excused for entering upon these personal details, as I give them to show that I have not been hasty in coming to a conclusion." —"Origin of Species," p. 1, ed. 1859.

What could more completely throw us off the scent of the earlier evolutionists, or more distinctly imply that the whole theory of evolution that follows was an original growth in Mr. Darwin's own mind?

Mr. Romanes implies that I imagine Mr. Darwin to have "entered into a foul conspiracy with Dr. Krause, the editor of *Kosmos*," as against my book "Evolution, Old and New," and later on he supposes me to believe that I have discovered what he calls, in a style of English peculiar to our leading scientists, an "erroneous conspiracy." The idea of any conspiracy at all never entered my mind, and there is not a word in "Unconscious Memory" which will warrant Mr. Romanes' imputation. A man may make a cat's paw of another without entering into a conspiracy with him.

Later on Mr. Romanes says that I published "Evolution, Old and New," "in the hope of gaining some notoriety by deserving, and perhaps receiving, a contemptuous refutation" from Mr. Darwin. I will not characterise this accusation in the terms which it merits.

I turn now to Dr. Krause's letter, and take its paragraphs in order.

1. Dr. Krause implies that the knowledge of what I was doing could have had nothing to do with Mr. Darwin's desire to bring out a translation of his (Dr. Krause's) essay, inasmuch as Mr. Darwin informed him of his desire to have the essay translated "more than two months prior to the publication of" my book, "Evolution, Old and New." This, I have no doubt, is true, but it does not make against the assumption which I made in "Unconscious Memory," for "Evolution, Old and New," was *announced* fully ten weeks before it was published. It was first announced on February 22, 1879, as about to contain "copious extracts" from the works of Dr. Erasmus Darwin and a comparison of his theory with that of his grandson, Mr. Charles Darwin. This announcement would show Mr. Darwin very plainly what my book was likely to contain; but Dr. Krause does not say that Mr. Darwin wrote to him before February 22, 1879—presumably because he cannot do so. I assumed that Mr. Darwin wrote somewhere about March 1, which would still be "more than two months before" the publication of "Evolution, Old and New."

2. Dr. Krause says I assume that "Mr. Darwin had urged him to insert an underhand attack upon him (Mr. Butler)." I did not assume this; I did not believe it; I have not said anything that can be construed to this effect. I said that Dr. Krause's concluding sentence was an attack upon me; Dr. Krause admits this. I said that under the circumstances of Mr. Darwin's preface (which distinctly precluded the reader from believing that it could be meant for me) the attack was not an open, but a covert one; that it was spurious—not what through Mr. Darwin's preface it professed to be; that it was antedated; that it was therefore a spurious and covert attack upon an opponent interpolated into a revised edition, the revision of which had been concealed. This was what I said, but it is what neither Mr. Romanes nor Dr. Krause venture to deny. I neither thought nor implied that Mr. Darwin asked Dr. Krause to write the attack. This would not be at all in Mr. Darwin's manner.

3. Dr. Krause does not deny that he had my book before him when he was amending his article. He admits having taken a passage from it without acknowledgment. He calls a page and a half "a remark," I call it "a passage." He says he did not take a second passage. I did not say he had; I only said the second passage was "presumably" taken from my book, whereas the first "certainly" was so. The presumption was strong, for the passage in question was not in Dr. Krause's original article; it was in my book, which Dr. Krause admits to have had before him when amending his article, and it came out in the amended article; but if Dr Krause says it is merely a coincidence, of course there is an end of the matter.

4. Dr. Krause, taking up the cudgels for Mr. Darwin, does not indeed deny the allegations I have made as to the covertness, and spuriousness, and antedating of the attack upon myself, but contends that "this is not due to design, but is simply the result of an oversight"; he is good enough to add that this oversight "could only be most agreeable" to myself. When I am not in the wrong I prefer my friends to keep as closely as they can to the facts, and to leave it to me to judge whether a modification of them would be "most agreeable" to me or no. What, I wonder, does Dr. Krause mean by oversight? Does he mean that Mr. Darwin did not know the conclusion of Dr. Krause's essay to be an attack upon myself? Dr. Krause says, "To every reader posted up in the subject this could not be doubtful," meaning, I suppose, that no one could doubt that I was the person aimed at. Does he mean to say Mr. Darwin did not know he was giving a revised article as an unrevised one? Does he mean that Mr. Darwin did not know he was saying what was not true when he said that my book appeared subsequently to what he was then giving to the public? Does he pretend that Mr. Darwin's case was not made apparently better and mine worse by the supposed oversight? If the contention of oversight is possible, surely Mr. Darwin would make it himself, and surely also he would have made it earlier? Granting for a moment that an author of Mr. Darwin's experience could be guilty of such an oversight, why did he not when it was first pointed out, more than twelve months since, take one of the many and easy means at his disposal of repairing in public the injury he had publicly inflicted? If he had done this he would have heard no more about the matter from me. As it was, he evaded my *gravamen*, and the only step he even proposed to take was made contingent upon a reprint of his book being called for. As a matter of fact a reprint has not been called for. Mr. Darwin's only excuse for what he had done, in his letter to myself, was that it was "so common a practice" for an author to take an opportunity of revising his work that "it never occurred" to him to state that Dr. Krause's article had been modified. It is doubtless a common practice for authors to revise their work, but it is not common when an attack upon an opponent is known to have been interpolated into a revised edition the revision of which is concealed, to state with every circumstance of distinctness that the attack was published prior to the work which it attacked.

To conclude: I suppose Mr. Romanes will maintain me to be so unimportant a person that Mr. Darwin has no call to bear in mind the first principles of fair play where I am concerned, just as we need keep no faith with the lower animals. If Mr. Darwin chooses to take this ground, and does not mind going on selling a book which contains a grave inaccuracy, advantageous to himself and prejudicial to another writer, without taking any steps to correct it, he is welcome to do so as far as I am concerned—he hurts himself more than he hurts me. But there is another aspect of the matter to which I am less indifferent: I refer to its bearing upon the standard of good faith and gentlemanly conduct which should prevail among Englishmen—and perhaps among Germans too. I maintain that Mr. Darwin's recent action and that of those who, like Mr. Romanes, defend it, has a lowering effect upon this standard.

S. BUTLER

Geological Climates

WHEN a reader of the intelligence of Mr. Wallace misunderstands my words it becomes plain to me they have failed to convey my meaning. I do not accept the interpretation he has put upon them, nor do I admit that even that interpretation would tell so much in favour of his theory as he supposes.

As however I agree with him that the question is far too large to be fully discussed in your columns, I shall allow the controversy, so far as I am concerned, to terminate, and shall publish my detailed views on geological climate in another way.

SAMUEL HAUGHTON

Trinity College, Dublin, January 27

On the Spectrum of Carbon

IN the discussions on the spectrum of carbon which have recently appeared in your journal much stress is laid on the impossibility of volatilising that substance by any heat which man can produce. I think this assumption is not warranted by experience. Two or three facts in Despretz' account of a remarkable set of experiments which he made about thirty years ago, seem to me to show it to be unfounded. This is given in the *Comptes rendus*, vol. xxviii. He exposed rods of anthracite to the action of 125 Bunsens (zincs $5\frac{1}{4}$ in. high) and also to the solar focus of an annular lens 36 in. diameter. The rods bent under the combined action, and even appeared to fuse! In vol. xxix. he describes experiments with rods of sugar-charcoal under a battery of 500 similar cells. The electric egg was covered suddenly with a hard block crystalline powder.

He thinks attempts to fuse carbon should be made in condensed nitrogen and in metallic vessels. In the same volume he says that with 600 cells rods of sugar-charcoal bend—swell at the

ends—and when they touch, weld together, and their surfaces become metallic, like graphite.

Diamonds heated in charcoal tubes were suddenly changed and became conductors. Still more remarkable effects were produced when he used collaterally with the 600 Bunsens 135 Muncké with zincs 13¾ in. high and 19¾ in. wide. With these sugar-charcoal was volatilised immediately.

I think it may be inferred from these facts that even at the temperature of a powerful electric arc enough charcoal vapour may be present to form its spectrum, and there is little doubt that the temperature of discharge of a good inductorium combined with a sufficient condenser is still hotter than the arc.

It is to be noticed that Despretz in these experiments anticipated Dr. Siemens's electric furnace. He mentions that he fused 3750 grains of platinum in a few minutes, and could have done more had he had a larger crucible. R.

A Case of Fascination

SOME years ago it was my fortune to witness a case of "fascination" between a large striped snake and a medium-sized toad. When first seen they were about fifteen inches apart. The snake lay in a coil with its head thrust out towards its victim, and moving slowly, its eyes glittering and its tongue darting incessantly.

The toad was standing on the very tips of its claws, with its limbs rigidly drawn up to their full length, its eyes fixed upon its captor and fairly bursting from their sockets, its mouth covered with foam, and its whole body swaying to and fro, and seeming just ready to pitch forward upon its face.

The movement of the snake became more and more rapid, and the agitation of the toad more intense, until the space between them was reduced to some three or four inches, when the snake opened wide its mouth, and the laboured breathing of its victim stopped short in a low guttural moan.

At this point my own agitation became so great that, seizing a heavy stone, I finished the snake at one blow. The instant the snake was struck the toad fell backward as suddenly as though itself had been hit, and lay upon its back for some minutes with no signs of life. At length it gained its feet and began to creep languidly away. J. T. BROWNELL

Lyons, N.Y., January 18

Birds Laying in January

AS a proof of the unusual mildness of the weather just previous to the intense frost and severe snowstorms most parts of the country have lately been suffering from, it may interest some of your readers to learn that not far from this place, on the 13th Jan., a wren's nest with seven eggs in it, quite fresh, was taken. The nest I have in my possession, and it bears every evidence of having been lately tenanted. The eggs, I am sorry to say, are broken; they were placed in a cup for safety, and were most unfortunately knocked down when the room was dusted, giving however unmistakable proof of their having been but lately laid.

I do not know whether there is any instance on record of a wren's nest having been found in January before.

JOHN H. WILLMORE

Queenwood College, near Stockbridge, Hants, January 28

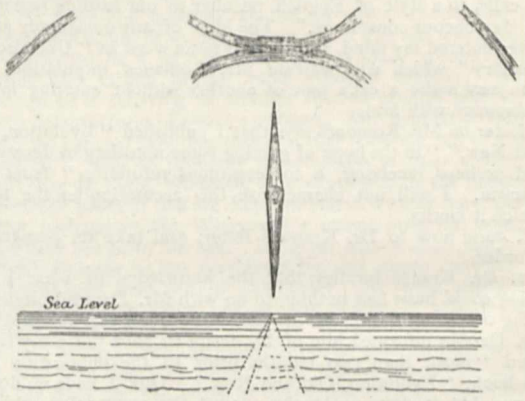
Vibration of Telegraph Wires during Frost

WHILE walking with my son by the Liverpool, Crosby, and Southport Railway between Crosby and Hall Road stations he called my attention to the telegraph wires, which were in a state of rapid vibration. The day was frosty, the time 11.30 a.m., and the sun, which had been showing us a bright disk through the haze, was beginning to throw out rays and shine a little strongly. At first I thought the movement must be only apparent—a mere optical delusion—as the air was perfectly calm. A closer examination convinced me to the contrary, as the under part of the wires were covered with pendant ice needles, a sort of rime, which moved to and fro indicating a torsional or twisting vibration of the wires, and as the rapidity of the vibrations decreased this was more clearly seen. In about five minutes the movement ceased, and I have not noticed it since, though I have frequently passed under the wires on my way to skate. Can any of your correspondents account for the phenomenon? It appeared as if in some way connected with previous contraction by the frost and sudden expansion in jerks by the sun's rays. My son informs me that two years ago, during a frost, he noticed the strained wires of a garden-fence behaving in the same curious way.

Park Corner, Blundellsands T. MELLARD READE

"Mock Sun"

I SEND a sketch of a parhelion which I saw from the East Cliff, Hastings, on Thursday, January 20, at 3 p.m. The crescents above the sun were fairly bright and well developed, and there were faint traces of a *second* ring outside, and some distance from, the first.



There was a slight fog at the time, with a north-east wind and *hard frost*, which has continued up to this time. We have had no snow here since that "terrible Tuesday," the 18th.

I do not remember ever having seen this phenomenon before, except in pictures of the Arctic Regions.

St. Leonards, January 24 J. E. H. PEYTON

ON SOME RECENT CHARTS AND MAPS OF CURVES OF EQUAL MAGNETIC VARIATION OR DECLINATION

SINCE the year 1701, when Halley published his famous chart showing curves of equal magnetic variation for the Atlantic and Indian Oceans, the construction of similar charts, amended and enlarged as data increased, has been of great interest to magnetic science and of practical value to the navigator.

Halley's chart of 1701 was expanded to embrace the navigable parts of the whole world, and brought up to the epoch 1756 by Mountaine and Dodson, whose labours were followed by those of Churchman in 1794, Yeates in 1817, and Hansteen (for several distinct epochs between 1600 and 1787) in 1819. In 1833 Barlow's chart, together with curves for the North Polar regions, accompanied a descriptive paper in the *Phil. Trans.* for that year.

In 1840 Gauss and Weber's charts of theoretical curves of the three magnetic elements for the whole world, including special Polar charts, were published. These curves were culculated on the basis of a mathematical theory founded upon a large number of observations fairly distributed over the surface of the globe.

About this latter period the practice of ascertaining the errors of the compass on shipboard (as due to the effects of iron) for every ship in the Royal Navy, at certain periods and on change of magnetic latitude, was established by the Admiralty on the recommendation of a compass committee specially appointed to consider the question of compass efficiency and management. This, as bearing on the subject under review, was an important step towards obtaining reliable data for the construction of Variation charts now becoming so essential an element in navigation.

Following on this, Archibald Smith's mathematical investigations of the theory of the deviations of the compass on board ship enabled Sabine to correct observations made in the Atlantic and the Antarctic Oceans

with great precision. The charts accompanying Sabine's "Contributions to Terrestrial Magnetism," No. ix. (*Phil. Trans.* 1849), were among the earliest on which the data whence the curves were drawn are recorded, although it may be observed that even a portion of the observations made at sea and utilised in these charts had no corrections applied to them for the effects of the ship's iron.

Considering the local magnetic disturbance found to exist on land in many regions and the large area of water-covered portions of the globe, observations made at sea, when systematically carried out and corrected for local attraction in the ship, have become an important factor in ascertaining the magnetic variation for the use of navigators at any given epoch.

Evans's Variation chart for the epoch 1858, embracing the navigable parts of the world, and in which the whole of the observations made at sea were corrected for the effects of the ship's iron, was published by the Admiralty. A further advance on Variation charts of an earlier date was the addition to this of a map showing the amount of annual change of the variation as determined at several localities, enabling reductions for the succeeding ten years to be made with a reasonable approach to the truth.

The increase of iron-built and composite vessels in late years has rendered a reliable Variation chart a necessary adjunct to navigation. This object appears to have been kept steadily in view by the Hydrographic Department of the Admiralty, for, in 1871, a new edition of the "Variation Chart of the World," reduced to that epoch (with polar charts added) was published in continuation of the chart for 1858. This chart was the result of the joint labours of Capt. Evans and a member of the compass department, Navigating-Lieut. Creak, R.N.

We have now to notice the more recent publications of these contributions to terrestrial magnetism. A chart of the curves for 1880, in continuation of those for the epochs 1858 and 1871, by Staff-Commander Creak, has been published by the Admiralty. In its construction the observations made during the voyage of H.M.S. *Challenger* (1872-76) have been introduced, and amongst results from other sources, specially those taken from Mr. A. Schott's papers on the secular change of the variation published as Appendix No. 8 to the U.S. Coast Survey Report for 1874, and also as a preliminary publication to the Report for 1879; Dr. Thorpe's observations in the United States, made about the 40th parallel of latitude, and results from the maps of the excellent magnetic survey of a large portion of the Eastern Archipelago in 1874-77, made by Dr. Rijckevorsel, have also been included.

As confined to special portions of the world a map of the United States for the epoch 1875, constructed by Mr. J. E. Hilgard, Assistant U.S. coast and geodetic surveys, published in the *American Journal of Science* for March, 1880, and illustrating an article on the subject of magnetic variation or declination, is of a high order of excellence.

In this map the curves, which show several flexures strictly pourtraying results arising from local disturbance, have been drawn for every degree of [equal] variation. The results are from observations made during the progress of the U.S. Coast Survey up to 1877, also from about 200 observations made in the interior of the country under the direction of Mr. Hilgard, to which were added every available observation from the land and boundary surveys, as well as those of private observers. Many of these results having been obtained at different periods of time, have been reduced to the given epoch by means of Mr. A. Schott's paper on Secular Change before referred to.

Although in maps and charts covering large geographical areas the variation lines for the land portions are generally drawn in regular curves (and so far deviating from strict accuracy), whilst those for the larger sea areas are necessarily so done, still in delineating the magnetic features of a portion of a continent the system followed by Mr. Hilgard, as also by Lamont in his European surveys between 1850 and 1860, commends itself for accuracy.

The late Prof. A. D. Bache, who took a personal interest in the study of terrestrial magnetism, bequeathed a fund for scientific research. The expenses of obtaining the 200 observations in the interior of the United States before mentioned, were defrayed by a grant from this fund.

THE ZOOLOGICAL STATION AT NAPLES

"WHAT *is* a zoological station?" is a question we have often heard asked when Dr. Dohrn's institution at Naples is under discussion. A "zoological station" (according to Dr. Dohrn), we may reply, is a kind of zoological garden for marine animals, or what is commonly called an "aquarium," only that, contrary to the usual practice at Brighton, Westminster, and elsewhere, the scientific element of the establishment is mostly cultivated instead of the popular branch. Such at least is the case under Dr. Dohrn's system, and also, we believe, in other zoological stations that have been formed after his example.

It must be recollected that the lower forms of organic life, to the study of which zoological stations, as thus described, are mainly devoted, are much more numerous than the vertebrata, and much less understood. Even in our own seas a vast amount remains to be done before our knowledge of the thousands of marine organisms which populate our waters and shores can be deemed to be anything like complete. Still more is this the case in the Mediterranean, where under a bright sky and burning sun the clear waters teem with animal life in all its varieties. It was no doubt the well-known productiveness of the coast of Naples and the facilities offered for dredging in its land-locked Bay that induced Dr. Dohrn to fix his "Zoological Station" in this quarter instead of planting it on the shores of his Fatherland.

After several years of incessant labour Dr. Dohrn has got his establishment into excellent working order, and, as will be seen by our advertisement pages, promises us after so much cultivation a rich and abundant harvest. The proper subject to take up when the publication of results was determined upon was obviously the Biology of the Bay of Naples. Great difficulties however beset the advance of this project. As regards the Fishes, the more highly-organised Crustaceans, the Mollusca, and some of the Cœlenterata and Echinodermata, it appeared possible for the students at the Zoological Station to avail themselves largely of the results arrived at by former workers. But when they proceeded to examine into the scattered literature in which the innumerable armies of Lower Crustaceans, Annelids, Nemertians, Planarians, Nematodes, and such-like creatures are described, the case was very different. The ancient naturalists have mostly characterised their species in these groups in such vague diagnoses that it is impossible to identify them. Under such circumstances the students of the higher animals are accustomed to resort to the type-specimens whence the descriptions were taken in order to see what the authors really intended. But the impossibility of preserving many of the lower animals cuts this resource away from the marine zoologists, who have consequently contented themselves in some instances with referring their specimens to species never sufficiently described, in other cases with describing them as new. Hence has arisen a mass of confusion which can be only regarded as parallel to what existed among the more highly-organised animals in the ante-Linnean period. The transformations undergone by many of the lower marine animals and the extraordinary sexual differences add

greatly to the difficulties already spoken of. Even when an animal of one form is gravely suspected to be merely the immature stage or corresponding sex of another form it is most difficult to prove it, and it frequently requires a whole series of researches conducted by practised biologists with logical exactitude to show that such is really the case.

Under these circumstances, even with the now rich collections and well-stored library of the Zoological Station, it was a serious question how the proposed "History of the Life of the Bay of Naples" could be best accomplished. Dr. Dohrn has wisely adopted the project of attacking the fortress by a number of small approaches. By dividing the labour into a large series of restricted monographs he hopes finally to accomplish a complete account of the fauna and flora of the Bay of Naples. In the first place, under this system each of his assistants can thus take up the group he is most familiar with, and work it out. Then in this way he is likewise able to secure the contributions of various naturalists who pay temporary visits to the Zoological Station, but who would not bind themselves to join in an extensive general work on the whole subject.

It will be seen by reference to our advertising columns that Dr. Dohrn's scheme thus elaborated is now on the eve of execution. Two of the proposed monographic memoirs on the Ctenophoræ by Dr. Cheen of Leipsic, and on the Fishes of the genus *Fierasfer*, by Prof. Emery of Cagliari, are already issued, and three other memoirs are announced as being in preparation for the present year. Dr. Dohrn is quite cosmopolitan in his arrangements. Though, as might have been expected, the greater number of his fellow-workers are natives of the Fatherland, he has many Italian co-operators, and the monographs may be written in German, Italian, English, or French. It is with some regret we observe that no English naturalist is yet on the list of contributors, although, as is well known, many of our countrymen have done good work on Dr. Dohrn's "tables." We trust that English recruits may still be enlisted in so good a cause, and that the "Fauna and Flora of the Bay of Naples" may attain to a goodly list of subscribers, and be brought to a satisfactory conclusion.

CHARLES FREDERIC KUHLMANN

WE regret to record the death, at Lille, during the past week, of Charles F. Kuhlmann, the distinguished French chemist and economist. Born at Colmar, May 22, 1803, he pursued his scientific studies under Vauguelin at Strassburg, and later at Paris. In 1832 he was appointed Professor of Applied Chemistry at Lille. Soon after he devoted himself almost exclusively to the practical solution of the problems of manufacturing chemistry, and established at Lille extensive works, which rank to-day among the important chemical manufactories of the world. During the past forty years he has been a prominent figure in the industrial, scientific, and even political circles of France, attracting general admiration by a remarkable combination of inventive power and executive ability. The Government named him Commander of the Légion d'Honneur, and the French Academy of Sciences elected him a corresponding member, in recognition of his important services, while he was frequently called upon to occupy prominent posts of responsibility in public life and commercial undertakings. His failing health during the past year forced him to decline one of the leading honours in the scientific world of France, the presidency of the Société Française pour l'Avancement des Sciences.

As an investigator Kuhlmann was a prominent member of that group of Alsatian chemists which includes Wurtz, Friedel, and Schützenberger, and forms the chief school of modern French chemistry. His researches, extending over nearly every department of inorganic chemistry, and touching on the tinctorial branches of organic chemistry, are characterised by a broad range of knowledge, a happy application of fact and theory, and a marked reverence for the demands of pure chemistry, while contributing so notably to the advancement of applied science.

First among his great researches mention should be made of that on baryta compounds, made over twenty years since, and by means of which he created the entire industry of this important group of salts. Another investigation, scarcely less valuable, was that made a few years previously, which led to the introduction of the process of saturation in the manufacture of sugar. Equally prolific of practical results were his extensive studies on the crystallisation of insoluble bodies, on the chemistry of mortars and cements, of manures, of bleaching, of dyeing and printing, and of numerous other branches. Especially interesting were his researches (1847) on the formation of nitric acid from ammonia, and on the relation of this reaction to the fertility of the soil. Among his more purely scientific investigations mention should be made of those on the formation of ethers, on the formation of cyanides and of prussic acid, on nitrous oxide, on the use of oxide of iron as an oxidising agent for organic compounds, on the action of gases on minerals, on the use of gaseous hydrofluoric acid for the analysis of silicates, and on a variety of minerals. The subject of crystallisation was throughout his career of investigation one of Kuhlmann's favourites, and we are indebted to him for the artificial reproduction of a variety of natural minerals, the most novel of which are the pseudomorphic forms of protoxide of manganese, of the sulphides of copper and lead, and of these metals themselves.

In 1879 Kuhlmann gathered together his numerous researches, extending over a period of forty years, into a volume of 750 pages, in which we have a remarkable picture of his many-sided and untiring activity.

The deceased leaves behind him a son who has already obtained a name as a chemist, and who made an able report to the French Government on the Chemical Section of the Philadelphia Exhibition. T. H. N.

THE SCIENTIFIC SOCIETIES OF DUBLIN

OF the scientific societies of Dublin two take special rank as publishing societies; but from inquiries made of us we conclude that their publications are not everywhere known.

The Royal Irish Academy issues both *Transactions* of a quarto size and *Proceedings* in octavo. Of its series of *Transactions* 26 volumes have been published. Of these vols. 1 to 23 contained memoirs chiefly on Science, but occasionally on Polite Literature and Antiquities. Vol. 24 was divided into two sections—the first, Science; the second, Polite Literature and Antiquities. Vols. 25 and 26 were exclusively Science. Vol. 27, in course of publication, is devoted to Polite Literature and Antiquities; and vol. 28, which also is in course of publication, is devoted to Science. These quarto volumes contain from 600 to 700 pages each, with numerous plates and other illustrations. To give some idea of their contents we add the following analysis of vol. 26. It contains papers on Astronomical Subjects by Dr. Doberck (2), J. Birmingham, J. L. E. Dreyer, and C. E. Burton; on Meteorological Subjects, by Dr. H. Lloyd; on Geological Subjects, by Rev. Dr. S. Haughton, Dr. E. Hull, Dr. A. Leith Adams, and Prof. O'Reilly (2); on Mathematical Subjects, by J. C. Malet (3), Dr. A. S. Hart, Dr. J. Casey; on Biological Subjects, by Dr. R. J. Harvey, Dr. E. P. Wright (4), and W. H. Mackintosh; on Chemical Subjects, by H. N. Draper and R. J. Moss. The memoirs which form the volumes of *Transactions* are published shortly after they are read, and without waiting to form a part of a volume. The *Proceedings*, like the *Transac-*

tions, now also form two series: the Science Parts being published twice a year, in December and April, and the Polite Literature and Antiquary Part once a year, in December. Quite recently the Academy have determined to publish another series of quarto *Transactions* under the title of "The Cunningham Memoirs," part 1 of the first volume of which, containing a memoir by Dr. John Casey, F.R.S., on Cubic Transformations, has just appeared.

The publications of the Royal Dublin Society are of the same type as those of the Irish Academy, except that they are exclusively confined to science. Of their new series of *Transactions*, parts 1 to 13 of volume 1 have been published, and for convenience of publication the first two parts of volume 2, containing "Observations of Nebulæ and Star Clusters, 1848–1878," by the Earl of Rosse, have also appeared. The first two volumes of these *Proceedings* have been published, and a part makes its appearance pretty regularly every third month. Following the example of the Academy, the memoirs forming the *Transactions* are published separately.

It would thus appear that not only is there evidence of scientific life among the societies of Dublin, but that there is also an abundant opportunity for the publication of any really valuable scientific information, and so far at least as the publications of the Irish Academy are concerned they fall in no respect as regards type, paper, or illustrations, behind the best of our London societies.

JOHN DUNCAN

ALONG with a cheque for 5*l.* to John Duncan, whose story was told by Mr. W. Jolly in NATURE of January 20, we have received the following note from Mr. W. Westgarth:—

January 27, 1881

DEAR SIR,—On reading the account of John Duncan in your last week's issue, it occurred to me that surely your readers would respond to your invitation to get up a small fund, say of 100*l.* to 200*l.*, for the brave old man who has so long and perseveringly fought, and against all "odds," for the cause of science and mind. I enclose 5*l.* towards the object. Should you see objections to opening a list in NATURE, please send on my small dole to Mr. Jolly as he directs. W. WESTGARTH

We have the greatest pleasure in acting upon Mr. Westgarth's hint, and we trust that many of our readers will be prompt to follow his good example. Subscriptions addressed to the Editor of NATURE, 30, Bedford Street, Covent Garden, W.C., will be duly forwarded. We have already received the following:—

	£	s.	d.
W. Westgarth	5	0	0
Publishers of NATURE	5	5	0
F.R.S.	0	10	0
Mrs. Forster	1	0	0

CASSELL'S NATURAL HISTORY[1]

THE third volume of this useful cyclopædia of zoology consists of the concluding portion of the Birds by R. Bowdler Sharpe, and of the Reptiles and Amphibia by the Editor. On glancing over the well-printed and beautifully-illustrated pages, a few facts have struck us, to which, for the benefit of the series, we would call the editor's attention. In the opening sentence of Chapter I. of this volume we are referred to "the preceding chapters" for an account of the Picarian birds. The context proves it should be to the preceding volume. This, which might mislead the reader, is evidently the result of the publication of the work in parts, and could be easily avoided.

All through Mr. Sharpe's portion of the work, when the scientific names of birds are referred to they are quoted generally within brackets in the same line as the popular name; while in the editor's special portion no such useful uniformity is attended to. Sometimes, as on p. 245, the eye has to wander from the text to foot-notes at the bottom of the page; sometimes, as at p. 248, the name is quoted after Mr. Sharpe's fashion (for a mixture of both styles see p. 362). The use of the word "kind," when the editor refers to "species," is in our judgment, though perhaps sanctioned by its use in the English translation of the Bible, not happy. Thus we read that, while genera among the reptiles are abundant, "kinds" are numerous. The "kinds" of some families swim freely; some "kinds" have a skin; by the way, what kind of a reptile be it that has *no* skin? In other cases the word "member" instead of species is used. Is it not a mistake to say that in many Chelonians "the well-known 'tortoise-shell' covers over all the hind parts." Surely in *Caretta squamosa* the tortoise-shell plates cover over most of the carapace. While the families of the Chelonian order are given, we find, when we come to the Lacertine order, no intelligible mention of the families of the split-tongued lizards. In referring to the important paper on Archæopteryx by the Professor of Geneva, the editor ought to have seen that the name of Carl Vogt was correctly spelled. The divisions of the Snakes is such as must necessarily confuse any student. The sub-order Thanatophidia is made to include two sub-orders in the text, when in the table of classification one of these sub-orders, Solenoglypha, is called a family. The groove-fanged Opisthoglypha are included with the Aglyphodontia with solid teeth. In a work of this nature nothing is, we take it, of more importance than that there should be some well-defined system of classification, not necessarily to be treated of in full detail, but as far as is possible to be rigidly adhered to. That this is possible, a glance over the sections of this and the previous volume treating of Birds will abundantly demonstrate; and that this is practicable, even with an extreme compression of space, is also to be proved by an appeal to the way in which the eighth order of Birds is managed, where, though only three pages were allowed to this most interesting and important of orders, yet we are even in these few lines enabled to get an idea of the orderly sequence of its families. This work is in many ways so excellent, that we venture on these criticisms with the object of trying to keep it up to a fairly good standard, and of making it useful in some measure as a work of reference.

As specimens of the excellent illustrations in this volume we have, through the courtesy of the publishers, the opportunity of presenting to our readers the two following. The Common Quail (*Coturnix dactylisonans*) visits Europe in the summer, when prodigious numbers are trapped and sold for purposes of food. Waterton mentions that 17,000 specimens were brought to Rome in one day. They are to be found in large quantities on the coasts of the Mediterranean, and so abundant are they in the beautiful Island of Capri, that it is said that it was from this source that the bishops in the olden times derived a large part of their wealth. The Quail is most rapid in its flight, and performs long and fatiguing journeys. Sunset is its time for active exertion; during the day it remains quite quiet, reserving its energies for the evening, when it goes off in quest of food.

Their favourite nourishment is insects, but at times they feed on grain and seeds; small stones are also swallowed to facilitate digestion. The habits of the quail are most unamiable and unsocial, and generally, when they meet with one of their own species, they display a very pugnacious disposition. The female has a much better nature; she is a most excellent mother, even protecting young birds who have been deprived of their parents' care. She builds her nest of small portions of plants, and lays eight to fourteen eggs; these are pear-

[1] "Cassell's Natural History." Edited by Prof. P. Martin Duncan, M.B., F.R.S. Vol. III. (London, Paris, and New York: Cassell, Petter, Galpin, and Co., 1880.)

shaped in form, of a light-brown colour, marked with a darker shade; the young seem full-grown when only six months old, and are ready to join their parents in their long autumn journey, which may extend as far as the Cape of Good Hope, where they are known to arrive in large numbers. The quail, unlike the partridge, also figured in our illustration, has several wives, and displays great spirit in keeping rivals at a distance; while the mother is attending to the care of her young ones, the cock bird, too, often amuses himself in the vicinity with his companions.

Our second ustration is taken from the higher of the two classes of the Ichthyopsida, known as the Amphibia; these skull-bearing animals have no amnion and but a rudimentary allantois, and they breathe by gills at some period of their life. In this volume they are placed as an independent class alongside of the Sauropsidian reptiles. Among the permanently tailed Amphibians (Urodela) the sub-order containing those species with gills that fall off (*Caducibranchiata*) contains the interesting species known as Salamanders. It is of one of these of which we give the accompanying figure, not only as a fair specimen of those in the volume we are reviewing, but also in the hope of awakening some interest in a rather uncommon

FIG. 1.—The Partridge and the Common Quail.

Amphibian. "The next genus [to Salamandra], Pleurodeles, has *short* ribs, which give the appearance as if they penetrated the flanks, but their ends come against the tissue under the skin and produce horny projections thereon. The tail is long and compressed, and the small tongue is *adherent only in front*, and there are two series of palatine teeth in longitudinal series. The Spanish kind (*P. Waltlii*) has an ashy grey body, very prettily marked with long transverse stripes and dots. It is like a heavy lizard." Lord Clermont, in his useful work on the Reptiles of Europe, describes the tongue as small, warty, free behind and on the sides, adhering in front; he also describes the ribs as piercing the skin, and they are also said by some to be capped by horny tubercles; but this is denied by Leydig. Prof. St. George Mivart tells us that this species differs from all the other Urodela in the length and strength of its ribs, the longer ones considerably exceeding the length of two of the longest vertebræ of the body. M. Waltl first discovered it at Chiclana in Spain; Schinz states that it is very common in Andalusia in tanks and cisterns of water; Wallace gives its distribution as Spain, Portugal, and Morocco. Lord Clermont hints that the *Bradybates ventricosus* of Tschudi is probably the young of this species.

Now when Lord Clermont wrote his book there was not much more known about this interesting little animal,

but some sixteen months ago Dr. F. Leydig of Bonn published an excellent account of it in *Wiegmann's Archiv*, in which he gives a short account of Dr. Joseph Waltl, who first discovered Pleurodeles, and of the gallant Dr. Michahelles, who called it after his friend, its discoverer (1830). Among the specimens sent to Bonn, one was living, and in it could be easily seen the tips of some of the ribs sticking through the skin; and that "this penetration" of the skin of the sides was not in the first instance caused by or through the transport, the accompanying note from the kind sender proved. "You will remark that in the Pleurodeles the ribs pierce the integuments, and that if this be an accident, it is in some sort a physiological one." The habits of the Pleurodeles seem to be more or less like that of our native Tritons. During the procreative season they remain upright in the water; later they leave it and hide themselves in damp places under stones. Like the Water Newts, they possess a sort of cry; when frightened, as on being suddenly seized, they emit a low, short, almost squeaking sound, generally repeated several times. This seemed to come not so much from the throat as to be caused by a rapid expulsion of air through the openings of the nose—in fact, to be a sort of snort.

FIG. 2.—*Pleurodeles Waltlii*

It had a tendency to crawl vigorously backward when uneasy, by prising the ends of the ribs against the skin: this snake-like progression no doubt causing the skin openings. Prof. Leydig's specimen lived on slugs of small size, which it took eagerly as well as worms, indeed preferring these latter. The skin surface was rather dry than clammy. The colour changes through the chromatophores were clearly to be noticed; during cold weather it was of a tolerably uniform dark, when warmer the colour became lighter, numerous dark spots standing out from a light gray ground colour. On very warm days it would lie for hours motionless on the surface of the water.

It would almost seem worth one's while to pay a visit to those Andalusian tanks, and by their semi-limpid sides and under the shelter of their surrounding fig and olive-trees work out the complete history of this interesting little form.

These woodcuts will show that in point of illustration this volume keeps up with both its predecessors in effect; while we have gently hinted at a few blemishes, the work deserves a very considerable mead of praise, and we heartily recommend it as an excellent volume to be placed in the hands of all interested in the animal kingdom.

NOTES

THE *Akhbar* published a programme of the excursions which have been arranged for the next session of the French Association at Algiers on April 14. The excursions are very numerous, and are classified according to the length of time required for their completion. One of the most attractive in the vicinity of Algiers is the tomb of the Kings of Mauritania; Laghouat and the desert is one of the most protracted, and requires eight days for its completion. The travellers will enjoy unexampled facilities for visiting the country. The seat of the French Association is 76, rue de Rennes, Paris. Applications are to be made to M. Gariel, Professor of Physics to the École de Medicine, permanent secretary. A reduction of 50 per cent. has been granted by the railway companies; the arrangements made for the sea passage will be published in proper time. An influential local committee has been established in Algiers. M. Chauveau, Professor to the Veterinary School of Lyons, has been appointed president of the session; the vice-president is M. Janssen.

MINERALOGICAL science has suffered a great loss by the early death, on January 27, of Prof. Dr. Emanuel Boricky, who was well known by his microscopical researches in petrography. Boricky was born at Milín, near Příbram (Bohemia) in the year 1840, and he had therefore just completed his fortieth year. In 1865 he became an assistant of the mineralogical section of the Bohemian Museum, and in 1866 he was named Assistant Professor of Mineralogy at the University of Prague. Having attained the degree of a Doctor of Philosophy, he became a teacher of mineralogy at one of the colleges of Prague in 1868, and in 1869 he was promoted to the post of a custos of the mineralogical collections at the museum. Since 1871 he ha

lectured in the Bohemian language on petrography at the University of Prague. He was a diligent and successful worker in science, and his microscopical researches have made his name familiar to mineralogists far beyond the boundaries of his native country. He has left a monograph on the porphyries ready for printing. Science has lost in him a devoted student, and the Bohemian nation regrets the death of one of its best sons.

THE *Times* announces the death of Mr. William White, a well-known chemist and mining authority. Mr. White was the author of numerous works, including the "History of Chemistry," "Economy of Health," "Chemistry of Vegetation," "Chemistry for Students," "Hints from a Chemist," "Mineral Resources of Newfoundland," &c, and was for over half a century a constant contributor to scientific literature. He had held at different periods lectureships on metallurgy and chemistry at various educational establishments, and had earned for himself a reputation as a lecturer and writer on agricultural chemistry. He died in London on Sunday last, at the age of seventy-one, from a painful disease contracted while conducting experiments in his laboratory.

THE Prussian Government, according to Berlin papers, intends to purchase the Godeffroy Museum at Hamburg for the Berlin Anthropological Museum. The former is one of the most interesting zoological and anthropological collections, particularly with regard to Eastern Asia and the islands of the Pacific; it was formed by the Hamburg firm of that name by means of special scientific expeditions during the last decades.

THE Senatus of Glasgow University has just been presented with a portrait of the Very Rev. Principal Caird, the esteemed head of the University, and Mrs. Caird with a replica. The portraits are the gift of subscribers belonging to all religious and political parties, and are the works of Mr. Millais, R.A. The Principal is represented in academic dress, and the likeness is very striking. The portrait presented to the Senatus will be placed in the University library, the walls of which are already adorned with likenesses of former principals and professors.

M. MARIETTE, better known as Mariette Bey, the celebrated Egyptologist, has died in Alexandria. M. Maspero, his pupil, Professor of Egyptology to the Collège de France in Paris, has been appointed by the Egyptian Government to fill the place vacated by the death of M. Mariette.

A PROPOSITION has been made by the *Operator* and other electrical papers of the United States to open at New York an international exhibition of electricity in 1882. It is stated that the United States Congress will vote a sum of money to subsidise the American exhibitors at the exhibition of this year in Paris.

THE Royal Commission appointed in 1879 to inquire into the cause of accidents in mines have concluded the taking of evidence. The attention of the Commission is now directed to a series of experiments as to the explosive nature of coal dust, as to the best kind of safety lamp, and as to other matters designed to elucidate the causes of explosions. It is proposed that some experiments shall take place to test the efficacy of the electric light as an illuminating power in mines.

THE Committee formed for the exploration of the remarkable holes, which have recently appeared on the surface of Blackheath, have been negotiating with an experienced well-sinker, and intend to commence active operations in the course of a few days in the hope of finding a clue to their origin. Contributions in aid of the work, from persons interested in the investigation, will be gladly received by the honorary treasurers of the Committee—Dr. Prior Purvis, Landstown Place, Blackheath, or Mr. E. W. Brabrook, F.S.A., director of the Anthropological Institute, 28, Abingdon Street, Westminster.

ORDINARY MEETINGS of the Sanitary Institute of Great Britain, 9, Conduit Street, W., for the reading of papers and discussion upon sanitary matters, will be held during 1881 on the second Wednesday in the months of February, April, and June, chair to be taken at eight o'clock precisely. At the first meeting, February 9, a paper will be read by W. H. Michael, Q.C., upon "The Law in Relation to Sanitary Progress," to be followed by a discussion.

AN earthquake was felt over a considerable area of Switzerland on January 27. It was felt with varying degrees of intensity at Berne, Muensingen, Thun, Basle, Solothurn, Zurich, Bienne, Oberhofen, and Aarberg. The principal shock occurred at 2.20 in the afternoon, Berne mean time. A slight shock was observed at three o'clock the same day, and another equally slight at six the following Friday morning. According to a report of the Berne Observatory the first and principal shock was in the direction from east to west, with a slight northerly deviation. The oscillation was both vertical and lateral, and according to some accounts, was preceded by a rumbling subterranean sound. Its intensity may be judged from the facts that the chimes in the church clocks were made to strike and the bells to toll, books were thrown from their shelves, and pictures detached from the walls, while in Berne alone more than 100 chimneys were thrown down. This is the twenty-fourth earthquake that has been recorded in Switzerland since November, 1879, and is probably the most severe.

A SHOCK of an earthquake was felt at 5 p.m. on January 24 at Bologna, Florence, Venice, Padua, Ferrara, &c. At Bologna there were also slighter shocks at midnight, and at 8 and 9.15 a.m. next day; while Florence likewise had a second shock at 7.53 a.m. on the 25th.

IN a recent number of the *Journal de Physique*, of which the late M. d'Almeida was so long the editor, the following interesting episode is narrated:—During the investment and siege of Paris by the German armies in the winter of 1870-71 M. d'Almeida took a prominent part in certain attempts to re-establish telegraphic communication between Paris and the provinces, using the River Seine as a conductor. This suggestion originated with M. Bourbouze (of galvanometer fame), who was, after the war, created a chevalier for his suggestion. It was proposed to send powerful currents into the River Seine from batteries at the nearest available point outside the German lines, and to receive in Paris, by delicate galvanometers, from the river such a portion of these currents as might not have leaked into the earth. After some preliminary experiments had been made between the Hôtel de Ville and the manufactory of M. Claparède at St. Denis, by Professors Desains, Jamin, and Berthelot, it was decided to make the attempt, and accordingly on December 17, 1870, M. d'Almeida was despatched by balloon to the provinces in order to try to establish this novel mode of telegraphy without wires. The balloon descended after sundry perils in the Arcadian solitudes of Champagne outside the Prussian lines. Thence he proceeded *viâ* Lyons and Bordeaux to Havre. Not finding suitable appliances and apparatus, there was again a delay in sending to England for the necessaries, which on arrival were conveyed to Poissy, where M. d'Almeida regained the banks of the Seine on January 14, 1871. Here however the frost proved inimical, the river having been frozen hard since the beginning of December. The attempts at communication were however to have been made on January 24, when the armistice was proclaimed. It was too late; and the world missed a famous scientific exploit from amongst those which made the siege of Paris notable beyond all other sieges of history.

M. JULES FERRY, French Minister of Public Instruction, and M. Tirard, Minister of Agriculture and Commerce, paid an

official visit the other day to the schools of apprenticeship established at the expense of the City of Paris in the rue Herold and the boulevard of La Villette. The time required for the scientific education of the young workmen is three years. During the first year the pupils are trained in working wood as well as iron. The choice of the speciality is only made at the beginning of the second year. No work is executed without a drawing having been made, so that the workman is enabled to understand the use of the object he is manufacturing. Regular courses of lectures are given in the establishment on scientific subjects. Meanwhile experiments are conducted in three different primary schools, to determine whether it is possible to join manual to mental training in all the city schools.

PROF. HULL has published a fourth edition of his "Coal-Fields of Great Britain" (Stanford). This edition has been largely rewritten, and contains an entirely new chapter on Carboniferous Plants, by Prof. Williamson, F.R.S. The Classification of the Carboniferous Series of Beds has been modified in accordance with the views enunciated in Prof. Hull's paper on this subject read before the Geological Society in 1877. Various other modifications have been made in accordance with the results of recent geological research, and the statistical portions have been brought down to 1878.

MESSRS. LONGMANS AND CO. send us the fourth edition of Prof. Atkinson's "Natural Philosophy for General Readers and Young Persons," translated and edited from Ganot's French work. To this edition have been added twenty-five pages of new matter and sixteen additional illustrations.

MR. E. S. BAKER, photographer of Bristol, sends us a photograph of a jar, which is a fine illustration of the fact that water expands on freezing. During the recent frost the water in the jar froze, and the ice is seen protruding from its mouth to a considerable distance like a well-shaped cork.

MR. C. V. RILEY of 1700, Thirteenth Street, Washington, writes to us that, having been obliged to cease the publication of the *American Entomologist*, he has a few full sets of vol. iii., just closed, to dispose of, and has concluded to send the full volume to all former subscribers who may want it, or to any Library, Natural History Association, or editor of journal, postage prepaid, at the reduced price of $1.50. The information in the magazine, Mr. Riley states, is of permanent interest, and the volume will be of value to any one interested in entomology in any of its bearings.

M. CH. JOLY has republished as a pamphlet a paper which he lately contributed to the *Journal* of the National Horticultural Society of France, under the title of "Note sur une Exposition de Géographie botanique et horticole, organisée par la Société Centrale d'Horticulture de Nancy."

NEW SOUTH WALES, Victoria, and South Australia have agreed to jointly bear the expense of exterminating the *Phylloxera vastatrix*, the alarming extension of which in Victoria has threatened the destruction of the wine industry.

WE have received the three first numbers for this year of the *Chicago Field*, which seems modelled on a small scale after its well-known English contemporary.

THE *Revue Scientifique* of January 29 contains a lecture recently given at the Sorbonne by M. Faye, on the Volcanoes of the Moon.

AT Cracow a new Polish review for literature, science, and art is now being published fortnightly. Its title is *Museum*, and its editor Dr. Thaddaeus Rutowski.

THE works in the Arlberg tunnel are progressing. On the Tyrolese side the lower shaft has been pushed to a distance of 340 metres, by help of the boring machines, and in spite of the hardness of the rock the daily progress is two metres. The upper shaft is some 100 metres behind.

A NUMBER of Roman antiquities were found last year during some military earthwork operations near Metz, close to the Lunette d'Arçon. It appears that the place was one of the most important burial-places of Roman Metz. The Metz Geological and Archæological Society gave the details at its last December meeting. Some thirty-five vases, four metal objects, three coins, and two tombstones with inscriptions are mentioned. Of human remains four skulls were found, one of which was lying upon a square stone plate, besides carbonised (cremated?) bone remains in a round stone urn. The inscriptions were epitaphs; of the three coins, one dated from the year 41 (when Claudius commenced to reign), another from the year 160 (reign of Antoninus Pius). Prof. Schaaffhausen of Bonn states that three of the skulls found belong to three different tribes. One belonged to a German, another to a Frisian, the owner of the third came from so far a country as Lapland.

A REMARKABLE discovery of Russo-byzantine antiquities was made near Kiew some weeks ago, when a canal for the water-works of the city was being excavated. They consist principally of twenty gold and enamelled lockets, three buttons of the same materials with heads of saints upon them, gold rings, agraffes and studs, all dating from the fifteenth or sixteenth century; they doubtless served as ornaments upon the costumes of the grand princes. Besides these some thirty-four silver coins were found, also a highly original bronze vessel in the shape of a fabulous quadruped. The metal value of all the antiquities is estimated at 1000 roubles (150*l.*). The Archæological Commission has taken possession of them.

OUR ASTRONOMICAL COLUMN

THE OBSERVATORY OF HARVARD COLLEGE, U.S.—We have received the Annual Report presented to the Visiting Committee of this Observatory by Prof. Pickering on December 6. The year has been one of unusual activity in the establishment, funds which had been liberally forthcoming from its friends having enabled both the equatorial and meridian circle to be regularly employed, and further having allowed of many researches of importance being conducted with the smaller instruments. With the large equatorial Prof. Pickering claims that he has succeeded in making a more extensive series of observations for position of the satellites of Mars at the last opposition than was obtained elsewhere, and states that Deimos was last seen at Harvard Observatory; the number of observed angles of position of Deimos was 825, and of Phobos 278, and that of observed distances 245. In addition to measures for position photometric observations were made, which appear to show that if the satellites possess a capacity for reflecting sunlight equal to that of the planet, Deimos may have a diameter of about six and Phobos of seven miles. It was noted at various observatories that Deimos appeared somewhat brighter in 1879 than at the preceding opposition in 1877, and in both years Prof. Pickering states it seems to have been brighter measured photometrically, and to have been seen more easily when it followed than when it preceded Mars.

Photometrical determinations of the times of eclipses of Jupiter's satellites, commenced in the summer of 1878, have been continued during the year, and it is considered with reasonable hope that these phenomena may be more accurately observed than hitherto by this method. Observations of planetary nebulæ described in the previous Report have been nearly completed.

With regard to spectroscopic observations, Prof. Pickering says the most remarkable discovery is that the spectrum of No. 17681 of Oeltzen's Catalogue, the place of which for 1880 is in R.A. 18h. 1m. 17s., N.P.D. 111° 1', possesses a peculiar character. "The light of this star is principally concentrated in two points of the spectrum, one in the blue, the other in the yellow, a little more refrangible than the D line. A faint continuous spectrum is also seen."

The variable star of Ceraski, the true period of which was determined at Harvard College, is referred to; systematic observations have been made upon it. The Report describes the progress made in observations with the "meridian photometer," whereby it is intended to determine the light of all stars visible to the naked eye between the North Pole and N.P.D. 120°. The principal want of the Observatory at the present time is stated to be the means of publication of these and other classes of observations, the large number of volumes issued during the last five years having exhausted the funds specially appropriated for defraying expenses of publication.

CERASKI'S VARIABLE STAR T CEPHEI.—Prof. Julius Schmidt, from his own observations of minima of this variable in the last five months of the past year, finds reason to conclude that in that interval each successive period was longer by 0·08753m. or 5·25s. than the preceding one, and has calculated the times of minima upon this assumption between June 11, 1880, and February 15, 1881. For elements with this correction to the period to be applied, he adopts for his starting-point—

Minimum ... 1880, December 7, 10h. 6·7m.
Athens M.T. + 2d. 11h. 50·812m. E.

E being the number of periods from December 7. Thus the next minimum is found to occur on February 5, at 6h. 50·3m. Athens time, or at 5h. 15·4m. M.T. at Greenwich. Prof. Schmidt has remarked what we believe was soon detected by Mr. Knott from his observations in October last, that for more than two hours about the minimum there is no perceptible variation of brightness; decrease and increase are very rapid, particularly the latter.

SWIFT'S COMET, 1880 *e*.—The Superintendent of the Observatory at Washington, Admiral Rodgers, communicates to *Science* of January 10, an orbit of this comet which has been calculated by Prof. Frisby from three meridian observations made there on October 25 and November 7 and 25, and without any assumption as to the periodic time. The revolution resulting from this application of the general method is about 2178 days, or a little less than six years, and thus the conclusion arrived at by MM. Schulhof and Bossert of Paris, and Mr. S. C. Chandler of Boston, U.S., receives confirmation. From the position of the orbit it happens at present that only every second return to perihelion can be made available for observations.

BARON DEMBOWSKI.—Practical astronomy has sustained a severe loss in the death of Baron Ercole Dembowski, which took place on the evening of the 19th ult. at Monte, Frazione di Solbiate, Arno. Few have attained as great skill or exhibited greater industry and patience in that somewhat difficult and tedious branch, the measurement of the double stars, to which the Baron specially devoted himself, and we hope some means may be found of publishing in a collective form the results of his long-continued labours in this direction.

METEOROLOGICAL NOTES

OUR readers will learn with much satisfaction that Sweden has resolved to take part in the international meteorological and magnetical observations in the Polar regions, and arrangements have been made for carrying on the observations from June 1, 1882, till June 1, 1883. The house erected at Masselbay in Spitzbergen by Nordenskjöld's expedition, is still in good condition, and will be fitted up for the observatory. In connection with the Spitzbergen Observatory, Haparanda, at the head of the Gulf of Boothnia, is to be created into a first-class observatory, and furnished with Theorell's self-registering and printing meteorological apparatus; and all other observations will be made which are expected of a first-class observatory. M. Hjeltström is appointed director of the Haparanda Observatory. The funds to meet the expenses of the expedition and the two observatories have been most generously supplied by M. L. O. Smith, Stockholm. Prof. Hildebrandsson, the eminent Swedish meteorologist, has been entrusted with the discussion of the observations made by Prof. Nordenskjöld on the celebrated *Vega* Expedition, to the publication of which meteorologists will look forward with the liveliest interest.

IN his fourteenth contribution to meteorology Prof. Loomis returns to the discussion of the interesting question of the course and velocity of storm centres in tropical regions. In a previous communication he had shown that in middle latitudes the average progress of storm centres corresponds pretty closely with the average direction of the prevailing wind of these latitudes. In marked contradistinction to this result is that now obtained regarding the course of the intertropical cyclones which occur within the region of the North-east Trade Winds. These cyclones, instead of following the ordinary course of the Trades towards the south-west, advance westward, but in a direction somewhat north of west.

DURING the winter months, storms while crossing the United States frequently advance during a part of their course from north-west to south-east. This course is followed most frequently in the region between the Rocky Mountains and the Mississippi, is seldom continued as far south as lat. 30°, and the storm centre, after reaching its most southerly point, often changes its course towards the north-east. Storms which cross the United States north of lat. 38° generally pursue a course a little to the north of east; while those which come from south of that latitude pursue a course nearly north-east. During the summer months however few storms travel south of lat. 38°, and during this part of the year the average course of storms is almost exactly towards the east.

PROF. LOOMIS next institutes a comparison between the West India hurricanes and those of the Bay of Bengal, China Sea, &c. The average course of the latter is towards the west, ranging from 13° south of west to 86° north of west, which agrees closely in this respect with the general course pursued by West India hurricanes. The velocity of their onward course is however markedly different, being only about eight miles per hour, which is less than half the average velocity of the West India cyclones. The average latitude when the course becomes north is nearly lat. 20°, being 10° more to southward than in the West Indies, and the velocity during this part of the course is only about nine miles an hour. Ultimately the cyclones curve round and pursue a course nearly east-north-east, with a velocity of onward movement scarcely reaching ten miles an hour, or less than half of the velocity found for West India hurricanes. Lastly, while in the West Indies cyclones or hurricanes have been found no farther south than lat. 10° N., in Southern Asia they have occurred as far south as lat. 6° N.

THE concluding part of the Contribution is taken up with an examination of those storms of middle latitudes which advance in a westerly direction. In these cases, which may be regarded as abnormal directions, it is found that the wind is generally greatest on the east side of the low centre of the storm. While there are thus on the east side of the low-pressure areas, causes tending to increase pressure on that side, there are different conditions on the west side tending to divert the winds westward, and this, Prof. Loomis thinks, is the most important reason why in such cases the storm centres advance to westward. In the United States, over the Atlantic, and in Europe, the influence of one area of low pressure upon another is a very common cause of abnormal movements of storm centres—such, for instance, as the coalescence of two low areas into one, resulting occasionally in an apparent westerly movement of the centre of lowest pressure.

THE "Results of Meteorological Observations made at Mauritius during 1877" fully sustains the high reputation of Dr. Meldrum's previous reports for fulness of detail, accuracy, and special observations not usually given in meteorological reports. The hourly monthly values have been calculated from the readings of the barograph for the year, and a valuable table is appended to this part of the report (p. 5), showing the mean monthly diurnal variation of atmospheric pressure for the three years 1875-77. The value of these results will be greatly enhanced when the thermograph which has been received has been got into working order. A comparison, a very satisfactory one, is made of the barograph readings with those of the standard barometer. As in 1876 the wind during 1877 attained its annual maximum velocity in the colder months from June to August, and its minimum in the warmer months, from November to March; and its diurnal maximum velocity from 11 a.m to 2 p.m., and its minimum from about 2 to 5 a.m. The departures, however, from these times are such as to point to a considerable number of years' observations as required before the true average can be ascertained. Thirty-one stations for recording the rainfall are now in working order, and in each case the annual amounts available from 1862 are printed, and the averages of the years given for each station. Mean temperatures for seven stations appear in the report, the three highest

stations, with the mean temperatures for 1877, being, Curepipe (1800 feet) 68°·3, Bonne Veine (1500 feet) 69°·5, and Midlands (1400 feet) 73°·2. The difference in height (400 feet) of the first and last of these, and the difference of their mean annual temperatures, 4°·9, call for inquiry, and in connection therewith it may be suggested that a small map showing the physical features of Mauritius and the positions of the various stations would usefully illustrate these reports. As regards thunderstorms, which are carefully recorded, none occurred from May to October during 1876 and 1877, and the daily maximum is from 1 to 4 p.m., with a tendency to a secondary maximum about sunset, and the daily minimum from 10 p.m. to a little after sunrise.

In a supplement to No. 366 of the *Bulletin International* of the Paris Observatory M. Mascart gives an interesting and rapid sketch of the meteorology of Europe for December last, illustrated with two maps showing the storm-tracks over the Continent during the month. During the first half of the month the storm-tracks were all to northward of the British Isles and Denmark, and fine weather prevailed particularly in Scotland, Denmark, and Germany. In France high barometers ruled with light winds, and temperatures high for the season. The contrast afforded with the weather in France during December, 1879, is is most striking; thus on December 10 of both years barometers were unusually high in France, but in 1880 the mean temperature was 50°·5, whereas on December 10, 1879, the mean temperature was −14°·1. The bearings of the geographical positions of anticyclones, with their high pressures, on the temperature of the regions covered by them is a point well worthy of examination. The influence of a high-pressure area resting over the Atlantic and extending on its eastern side over Western Europe, has doubtless a very different influence on the temperature of that part of the Continent than an area of high pressure covering the Continent and terminated on its west side by France and Spain, even though the barometer be equally high over the west of Europe. During the second half of December the storm-tracks took a much more southerly course, several being as far south as the Channel and the north shores of Germany. The result was an extension south of the cold, so that in Orkney and the Hebrides temperatures were nearly 3°·0 below the normal, on the Tweed about the normal, rising farther south to 1°·1 above the normal in North Wales, 5°·0 in the Channel Isles, and 6°·7 in Paris. During December, 1879, temperature in Paris was 21°·2 below the normal, the mean for that month being 17°·6, or 27°·9 colder than that of last December.

GEOGRAPHICAL NOTES

On Tuesday night, at the Royal Institution, Mr. Edward Wymper described his ascents of Chimborazo and Cotopaxi to a distinguished audience. While purely athletic mountaineers had his sympathy in the practice of mountaineering as a sport, Mr. Whymper confessed that his sympathies were much more with those who employed their brains as well as their muscles. His journey to the Andes was to be one of work, and all its arrangements were devised so as to economise time to the uttermost. In observations for altitudes and position, in studying the manners and customs of the country, in photography and sketching, in the collection of objects of interest, from beeties on the summits of mountains to antiquities buried in the ground, he found quite sufficient to occupy his time. From Bodegas the party was composed of two Swiss mountaineers, the cousins Carrel of Val Tournanche, Mr. Perring, some muleteers, and their teams. When they reached the summit of Chimborazo, on the 3rd of January, after a most arduous climb, they found the wind blowing at the rate of 50 miles an hour, from the north-east, and driving the snow before it. With extreme difficulty, a reading of the mercurial barometer was effected. The mercury fell to 14·1 inches with a temperature of 21 deg. Fahr. This being worked out, in comparison with a nearly simultaneous observation at Guayaquil, gave 20,545 feet for the height of Chimborazo. They began the descent at 20 minutes past 5, with scarcely an hour and a quarter of daylight, and reached their camp (about 17,400 feet above the sea-level) about 9 p.m., having been out nearly sixteen hours, and on foot the whole time. Passing from an extinct to an active volcano, Mr. Wymper next gave an account of his journey to the crater of Cotopaxi. Observing with the telescope, during an enforced stay at Machachi, that much less smoke or vapour was given off at night than by day, he resolved, if possible, to pass a night on the summit. On the 18th of February the party got to the edge of the crater, having passed almost the whole way from their camp at a height of 15,000 feet to the foot of the final cone over snow, and then over ash mixed with ice. The final cone was the steepest part of the ascent, and on their side presented an angle of 36 deg. When they reached the crater vast quantities of smoke and vapour were boiling up, and they could only see portions of the opposite side at intervals, and the bottom not at all. Their tent was pitched 250 feet from the edge of the crater, and during a violent squall the india-rubber floor of the tent was found to be on the point of melting, a *maximum* thermometer showing a temperature of 110 deg. on one side of the tent and of but 50 deg. on the other; in the middle it was 72·5 deg. Outside it was intensely cold, and a thermometer on the tent cord showed a *minimum* of 13 deg. At night they had a fine view of the crater, which has a diameter from north to south of 2000 feet, and from east to west of about 1500 feet. In the interior the walls descend to the bottom in a series of steps of precipice, and slope a good thousand feet, and at the bottom there was a nearly circular spot of glowing fire, 200 feet in diameter. On the sides of the interior higher up, fissures, from which flickering flames were leaping, showed that the lava was red hot a very short distance below the surface. The height he found to be 19,600 feet. The party remained at the top for twenty-six consecutive hours, sleeping about 130 feet below the loftiest point. At first they had felt the effects of the low pressure of the atmosphere, and again, as at Chimborazo, took chlorate of potash with good effect. All signs of mountain sickness had passed away before they commenced the descent, and did not recur during the journey. Nearly five months later Mr. Whymper returned to Chimborazo, and from a second reading of the barometer at 14·028 inches, with a temperature of 15 deg. Fahrenheit, he made the height 20,489 feet, the mean of the two readings giving 20,517 feet. While on the side of Chimborazo he witnessed a magnificent eruption of Cotopaxi, ashes rising in a column 20,000 feet above the rim of the crater and then spreading over an area of many miles. Prof. Bonney had submitted the ash to microscopic examination, and found that the fineness varied from 4000 to 25,000 particles to the grain in weight, and from observation of the area over which the ash fell Mr. Whymper calculated that at least two million tons must have been ejected in this one eruption.

A TELEGRAM was read at a recent meeting of the French Academy of Sciences from M. de Brazza, who has been conducting an exploration in the region of the Ogowé and Congo, West Africa. Quite recently a French station has been founded in the upper course of the former river in connection with the International African Association. In July last, M. de Brazza informs the Academy, he reached the Congo from this station on the Ogowé, between the river Inpaka Mpania and the river "Lawson Afrisi." Gaining the favour of King Makoko he pacified the tribes on the right bank of the Congo, and peacefully descended the river in a canoe. On October 3 he founded the station of Ntamo Ncoma on land ceded by King Makoko on the right bank of the Congo. M. de Brazza surveyed the route between the Ogowé and Congo; it is twelve marches in length, over a plateau of an average height of 800 metres. The country is healthy, and the population dense and peaceful. In November last M. de Brazza arrived at Mdambi Mbongo, the advanced post of Mr. Stanley, whom he met, and with whom he reached the latter's headquarters at Vivi on November 12. If the new station can be maintained and victualled, it is no doubt well chosen as a starting-point for further discovery, for both north and south of it there are large regions of which he knew nothing.

AT the meeting of the Geographical Society on Monday last, Mr. E. Delmar Morgan gave some account of his journey last year to Semiretchia and the town of Kulja. Being unable to make use of the more southern line of communications, Mr. Morgan travelled by the northern post-road from Orenburg to Troitsk and Petropaulofsk, and thence to Omsk and Semipalatinsk. He then struck southwards to Sergiopol, where he was detained three weeks owing to the southern road being blocked by snow. He afterwards went to Kulja for a short time, and he also made some excursions to Issyk-kul and other places of interest. In the course of the discussion which followed the paper, Mr. Ashton Dilke, the only other Englishman

who has visited Kulja, gave an interesting account of his experiences in that region a few years back.

FEARS had been entertained by many that the expedition sent out by the Russian merchant M. Alexander Sibiriakoff to discover the North Passage by means of the steamer *Oscar Dickson*, on board of which M. Sibiriakoff was himself, had been lost, and M. Konstantin Sibiriakoff, his brother, had already equipped another expedition to find and assist the *Oscar Dickson*. In the meantime the welcome news has arrived that Alexander Sibiriakoff reached Tobolsk at the end of December. The *Oscar Dickson* and another ship, the *Nordland*, had met fresh ice near Mate-Ssale, and had retired into the Gydan Bay on the coast of Siberia, in order to winter there.

M. TARRY, a member of the French Commission for Trans-Saharan Communications, is stated to have discovered in the south of Wargla the ruins of a large city called Cedrada, which had been entombed by sands of the desert. This city is placed in the Valley of Wed Mya, and in the vicinity of a number of sources which in former centuries watered thousands of palm-trees. Orders have been sent to procure a set of sounding apparatus, and it is expected a large quaniity of pure water will be extracted from the earth. M. Tarry published an appeal to the local papers in order to obtain from the Government the foundation of a colony in this remote region.

DEEP-SEA EXPLORATION[1]

II.

4. *FOOD.*—The late Prof. Sars, in his remarks on the distribution of animals in the depths of the sea, asks "Whence do animals that live at depths far below the limits of vegetation obtain their food?" Bronn, Wallich, Wyville Thomson, and others have endeavoured to answer this question; but I do not think the problem has yet been satisfactorily solved. A considerable quantity of vegetable food is undoubtedly supplied from the Sargasso Sea and a similar area in the Pacific Ocean, as well as by the sea-weeds which fringe every coast. But this supply is not sufficient for the indirect support of the countless host of animals that inhabit the depths of the ocean, all of which are necessarily zoophagous or subsist on other animals. Plant life, except perhaps one of a peculiar kind, which will be presently noticed, appears to be absent in depths exceeding 150 fathoms.

In all probability the chief supply of vegetable food is derived from the countless diatoms, coccoliths, rhabdoliths, and oscillatoriæ, which are plants of a low degree of organisation, and swarm on the surface of the sea; these are swallowed by pelagic animals (such as *Salpæ* and Pteropods, or "sea-butterflies"), and the latter fall to the bottom after death, and form that flocculent or glairy mass which I have described in the Report of the *Porcupine* Expedition of 1869 as covering the bed of the North Atlantic at great depths.[2] The preservative effect of sea-water on animal tissues would stay decomposition for a long while; and Mr. Moseley ascertained by a curious experiment that it would take only about four days for a *Salpa* to reach the bottom at a depth of 2000 fathoms, and that the *Salpa* was not greatly decomposed after having remained in sea-water for a month in the tropics.

When we say that vegetable life does not exist at any considerable depth, we must not forget that some kind is said to occur in great abundance even in the benthal or deepest zone. The word "benthal" is applied to depths exceeding 1000 fathoms (see my Address, which is referred to hereafter in this lecture). Shells, corals, and other organisms, are everywhere permeated by what are considered to be minute plants allied to fungi or confervæ, which form branching canals, like those of the *Cliona* or perforating sponge; and such canals have been also detected in all fossiliferous strata of a marine nature, from the Silurian to the present epoch. These plants, or Thallophytes, have been called "parasitic"; but they do not live on any other living thing. They can hardly serve as food for deep-sea animals, because they are never exposed. Whether they may not be a link to connect the animal and vegetable kingdoms may be a matter for further investigation.

Food is of course a very important factor as regards the size of all animals. I have noticed, in my work on "British Conchology," that Mollusca from moderate depths are generally larger than those of the same species from shallow water; but this does not seem to be the case with a species of coral obtained in the *Challenger* Expedition, which ranged from a depth of 30 to one of 2900 fathoms, and was very variable in size.

5. *Light.*—Milton tells us of the

> "world of waters dark and deep."

One of the most interesting problems relating to the subject of this lecture is whether the above is a poetical idea or based on fact, as regards the absence of light in the abysses of the ocean.

We do not know to what extent the sun's rays penetrate the sea, nor whether the bottom at all depths is absolutely devoid of light. An ingenious apparatus, which was contrived by Dr. Siemens for ascertaining the presence of light at different depths by means of highly sensitive photographic paper, has never yet been properly tried. An experiment of this kind made by Prof. Forel proved that in the Lake of Geneva, even at a depth of only thirty fathoms, the paper was entirely unaffected after protracted exposure. But the water of that lake is peculiar; it is said to be rendered less transparent by suspended and floating particles of mica brought from glacier streams, and to have thus acquired its deep blue colour. I cannot believe that the only abyssal light, if there be any, is phosphorescent.

At all events we are certain that, as regards the sea, many animals at very great depths have eyes, and that there is no absence of colour.

Cuttlefishes, which have eyes not less highly organised than our own, have frequently been obtained from depths of many hundred fathoms; they do not eat phosphorescent polypes and such small deer. Nor are the deep-sea Mollusca blind. During the *Porcupine* Expedition of 1869 an undescribed species of *Pleurotroma* from 2090 fathoms had a pair of well-developed eyes on short footstalks; and a *Fusus* from 1207 fathoms had its eyes at the base of the tentacles. The last-named mollusks chiefly prey on bivalves. I have taken at moderate depths, living on the same ground, closely-allied species of univalve mollusks, some of which were eyeless or blind, and others were provided with the usual organs of vision. Numerous instances have been given by the *Challenger* naturalists of apparently seeing as well as of apparently sightless animals taken at great depths. Prof. Semper, of Würzburg, says, in "The Natural Conditions of Existence as they Affect Animal Life" (1881), "Many creatures furnished with well-constructed eyes live associated with the actually blind species, and which have been partly enumerated above." He mentions among the former five species of fish (one of a new genus) discovered in the *Challenger* Expedition at depths of from 675 to 2040 fathoms, besides several Mollusca and Crustacea.

Some land-slugs and mollusks (e.g. *Geomalacus maculosus* and *Achatina acicula*) are also blind. On the sea-shore and in shallow water most bivalves, as well as all the species of *Chiton*, are eyeless.

Some deep-sea animals are brightly and deeply-coloured. In the *Challenger* Expedition shrimps "of an intense bright scarlet colour" were obtained in very great abundance; and many Holothurians or Sea-cucumbers were of a "deep purple" hue. The same observation occurred to me in the *Porcupine* and *Travailleur* Expeditions.

6. *Temperature.*—The highest temperature of the sea-bottom observed in the *Challenger* voyage at depths over 1000 fathoms was 50°·5 Fahr., in 2550 fathoms; the lowest was 32°·1 only, in 1950 fathoms. The average bottom-temperature at great depths does not much exceed the freezing-point; but life does not appear to be affected by that circumstance. In the Arctic Expedition of 1875 I found an abundance and variety of animals in icy cold water.

7. *Depth.*—The average depth of the ocean between latitudes 60° N. and 60° S. is nearly three miles, or 2500 fathoms. The greatest depth which has been ascertained by sounding is five miles and a quarter, or 4620 fathoms, and occurs in the North-west Pacific Ocean; it is nearly equal to the height of Mount Everest, the highest known mountain, in the proportion of 27,720 to 29,000 feet.

8. *Inequalities of the Sea-bottom.*—The operations of the Telegraph Construction and Maintenance Company have materially added to our knowledge of the shape and contour of the floor of the ocean. They have shown us that the bed of the sea is quite as uneven as the surface of the land, and that it represents the same mountains, hills, gorges, and valleys, equally

[1] A Lecture by J. Gwyn Jeffreys, LL.D., F.R.S. Given at Swansea, Llanelly, and Barrow-in-Furness, in December 1880 and January 1881. Continued from p. 302.

[2] See *Proc.* Roy. Soc. 1870, p. 420.

diversified in the one case by oceanic currents on the surface as well as on the bottom, and in the other by foaming rivers and gentle streams. I will give a few instances of such inequalities in the North Atlantic. While repairing in 1878 the Anglo-American Cable, a tract of rocky ground was discovered, about 100 miles in length, in the middle of the North Atlantic, between 33° 50′ and 36° 30′ West longitude, and about 51° 20′ North latitude. Within a distance of eight miles the shallowest sounding was 1370, and the deepest 2230 fathoms, a difference of 860 fathoms, or 5160 feet; within four miles the difference was 3180 feet, and within half a mile 1380 feet. There are also the Laura Ethel Bank, with a depth of only 36 fathoms, and the Milne Bank, with 81 fathoms, both about 550 miles from Newfoundland, which is the nearest continental land. Other instances are the Josephine Bank, with 82 fathoms, and Gettysburg Bank, with 30 fathoms, the distance of the former from Cape St. Vincent being 250, and the latter 130 miles, with intermediate depths of from 1700 to 2500 fathoms. The soundings in the *Bulldog* Expedition also gave 748 between 1168 and 1260 fathoms, and the *Valorous* soundings gave 690 between 1450 and 1230 fathoms in another part of the North Atlantic and very far from any land.

A glance at the large series of diagrams of the *Challenger* soundings will at once serve to convince one of the extreme unevenness of the sea-bottom everywhere in the Atlantic and Pacific oceans. It would be difficult to find a greater degree of unevenness in any diagrams of the earth's surface, the total extent of which scarcely exceeds one fourth of that of the sea.

Diagrams to illustrate the inequalities of the sea-bottom in the case of the telegraph cable, and the irregularities of level in a similar extent of land in the Perthshire Highlands, are placed before you.

9. *Deposits.*—The floor of the ocean is covered by a more or less thick layer of ooze or mud, and of clays of different sorts and colours, which is inhabited by various animals. One of these deposits is called "*Globigerina*"-ooze, and is widely distributed over the bed of both the Atlantic and the Pacific. Another deposit is called "Red Clay," and is found at depths exceeding 2000 fathoms. Mr. Murray, one of the *Challenger* naturalists, has carefully worked out the deep-sea deposits which were observed and collected during the expedition. According to him the *Globigerina*-ooze occurred in the North Atlantic at forty-nine stations, from depths between 780 and 2675 fathoms; in the South Atlantic at six stations, from depths of between 1375 and 2150 fathoms; and in the Pacific Ocean at twenty-two stations, from depths of between 275 and 2925 fathoms. He also mentions other deposits, viz. Coral-mud, Radiolarian ooze, and Diatomaceous ooze. Mr. Murray also says that volcanic products, such as pumice, lava, and scoriæ, as well as the peroxide of manganese, are universally spread over the bottom of the deep sea; and, in consequence of copper, cobalt, and nickel having been detected in the clays, he was tempted to suggest the presence of meteoric or cosmic dust in those deposits.

An animated, but quite amicable, controversy has of late years taken place as to whether *Globigerina* (from which the first-mentioned ooze has taken its name) lives only on the bottom or on the surface of the sea, or on both of them. You will doubtless ask, What is a *Globigerina?* It is a microscopic shell, consisting of a few globular cells, which are added together in the course of growth, the smallest cell being the original one or nucleus, and the largest being the last formed. All the cells are full of a protoplasmic substance called sarcode, which is amorphous or has no definite structure—no head, no limbs, no heart, viscera, muscles, or nerves. Its entire body is a stomach, and nothing but a stomach. The same kind of sarcode forms the living pulp of sponges, which have a horny or glass-like skeleton instead of a shell. The *Globigerina* is a member of an extensive and extremely variable class of invertebrate animals called Foraminifera; and this class, as well as sponges, belong to a kingdom called Protozoa, the name of which imports not that it was the earliest form of life, but that its organisation is of the very primary or simplest kind. The cells of the *Globigerina* are in their living state covered with the most delicate spines of comparatively great length, which are set outwards, and probably serve to keep at a respectful distance all predatory animals of an equally minute size. Between these spines some of the sarcode is occasionally, if not habitually, protruded at the will of the animal through very fine pores of the shell, which gave rise to the name Foraminifera. Such prolongations or expansions of the sarcode are called pseudopodia, and are used for capturing and taking into the body or stomach animal or vegetable particles which serve for food, and are engulfed in the internal sarcode. Having premised thus much, and in the hope that my description may be tolerably intelligible to those who have not, like myself, studied the Foraminifera, I will proceed with my account of the controversy. I have frequently taken with a towing-net on the surface of the sea a multitude of floating *Globigerinæ*, which were certainly alive and showed their pseudopodia as well as their long and thick-set spines. Major Owen and Lieut. Palmer, who especially studied the surface-fauna of the Atlantic, observed and have published the same facts.[1] Therefore when, in the joint report of my colleagues and myself to the Royal Society, on the results of the first *Porcupine* Expedition in 1869, it was stated or strongly inferred that the *Globigerinæ* really "inhabit the bottom on which they are found in such extraordinary abundance," and that the hypothesis accounting for such accumulation by their having fallen to the bottom after death, their lives having been passed at or near the surface, was conclusively disproved, I ventured to record my dissent from that conclusion. The observations of Mr. Murray, one of the naturalists in the *Challenger* Expedition, have fully confirmed the hypothesis that *Globigerina* lives on the surface; and Sir Wyville Thomson now admits[2] it as an established fact. But Dr. Carpenter is not satisfied. He is of opinion that "whilst the *Globigerinæ* are pelagic in an earlier stage of their lives, frequenting the upper stratum of the ocean, they sink to the bottom *whilst still living*, in consequence of the increasing thickness of their calcareous shells, and not only continue to *live* on the sea-bed, but probably *multiply* there—perhaps there exclusively."[3] I must say that I am not convinced by the instances and arguments which he adduced in support of his opinion. There is no question that a great many species of Foraminifera live always on the sea-bottom; but I do not know that any species of pelagic or surface-dwelling animal inhabits also the sea-bottom. Dr. Wallich found that the stomachs of star-fishes which came up with the sounding-line from 1260 fathoms contained fresh-looking *Globigerinæ*, and that the latter were full of sarcode. This does not prove much, because sea-water is to some extent antiseptic or retards putrefaction. Many star-fishes feed like earthworms, and swallow quantities of organic and inorganic matter for the purpose of extracting nutriment from it. Sir Wyville Thomson says, in his paper "On Dredgings and Deep-Sea Soundings in the South Atlantic" (*Proc.* R. S. vol. xxii. p. 427), that the appearance of *Globigerina* and certain other Foraminifera, "when living on the surface, is so totally different from that of the shells at the bottom that it is impossible to doubt that the latter, even although they frequently contain organic matter, are all dead." Mr. Murray adds (*Proc.* R. S. vol. xxvi. p. 535):—"No living specimen of a *Globigerina*, an *Orbulina*, a *Pulvinulina*, or of the new genera found on the surface, which undoubtedly came from the bottom, has yet been met with. The foregoing observations appear to justify the opinion that these organisms live only in the surface and sub-surface waters of the ocean."

I will not however presume to assert that Dr. Carpenter may not be right; but is he justified in taking for granted "that the *onus probandi* rests on those who maintain that the *Globigerinæ* do *not* live on the bottom"? It is rather difficult to prove such a negative.

The colour of the "Red Clay" was attributed by Mr. Murray to the presence of oxide of iron.

Mr. Etheridge obligingly examined some of the pebbles and minerals which I had dredged in the *Valorous* Expedition at depths of from 690 to 1750 fathoms. He reported that many of them were "most likely derived from Iceland." If this were the case, the pebbles and minerals might have been transported by a deep submarine current.

The deposits in very deep water, and beyond the range of fluviatile and tidal action, are so slight as to be almost filmy, and are chiefly composed of the skeletons or hard parts of *Globigerinæ*, Diatoms, and *Radiolariæ*. The subjacent layer of mud or ooze, where it is beyond the scope of river action, may have been formed from the ruins of a sunken continent.

The proportion of carbonate of lime contained in the deep-sea mud or ooze of the North Atlantic, which was procured in the first two cruises of the *Porcupine* Expedition of 1869, slightly differed. In a sample from 1443 fathoms, dredged off the west

[1] *Journal* of the Linnean Society, vol. ix. p. 147.
[2] *Proc.* Roy. Soc. vol. xxiii. p 34.
[3] *Ibid.* p. 235.

coast of Ireland in the first cruise, the proportion given by the late Mr. David Forbes was only about one-half, while in another sample from 2435 fathoms, dredged off the south coast of Ireland in the second cruise, Mr. Hunter found a little over 60 per cent.

As to a mysterious deposit called *Bathybius*, Mr. Buchanan, who had charge of the chemical work on board the *Challenger*, proved by careful and repeated analysis that this substance was not organic; and he "determined it to be sulphate of lime, which had been eliminated from the sea-water, always present in the mud, as an amorphous precipitate on the addition of spirit of wine." Mr. Murray came to the same conclusion; and the lifeless and inorganic nature of *Bathybius* may now be considered settled. This gelatinous slime was once imagined to be primordial, and to constitute the basis of life. But the sea-bed is the tomb of past generations, not the womb of creation.

10. *Geological.*—The late Sir Charles Lyell says, in the sixth edition of his "Elements of Geology" (1865), "that white chalk is now forming in the depths of the ocean, may now be regarded as an ascertained fact, because the *Globigerina bulloides* is specifically undistinguishable from a fossil which constitutes a large part of the chalk of Europe." He assumed that the *Globigerina* inhabited the ooze on the sea-bed. Edward Forbes and other geologists had initiated and adopted the same view that Chalk was a deep-sea deposit. In my Presidential Address to the Biological Section of the British Association at the Plymouth Meeting in 1877, I ventured to question the validity of this theory, and especially that which my colleague and friend Sir Wyville Thomson started as to the "continuity of the Chalk" from the Cretaceous to the present period. I there endeavoured to show that the Chalk differed in composition from the Atlantic mud, and that the fauna of the Chalk formation represented shallow and not deep water. My view has, I am glad to say, been to some extent admitted by Sir Wyville Thomson in his "Report on the Scientific Results of the Voyage of H.M.S. *Challenger*," when he speaks (pp. 49 and 50) of the belt of "shallower water" during the Cretaceous period. At all events, Mr. Wallace has lately accepted and confirmed my opinion.[1] It is highly probable that the Gault, which underlies the Chalk and is the lowest member of the Upper Cretaceous formation, was a deep-water deposit, because it abounds in small shells of the *Arca* and *Corbula* families, which are wanting in the Chalk; as well as in Ammonites and other free-swimming Cephalopods.

Mr. Sollas, indeed, in his paper "On the Flint Nodules of the Trimmingham Chalk" (*Annals and Magazine of Natural History* for December, 1880) believes that some deep-sea mud is analogous with the Chalk. He is aware that the former contains siliceous organisms and the latter none; and he supposes that the flints had been in some way derived from these organisms. But how flints originated and were formed is still a vexed question. Mr. Sollas is perhaps our best authority on Sponges; but he states (p. 444) that "the bottom-water of the sea is remarkably free from organic matter." This statement does not agree with the analyses of the bottom-water of the sea which were made by Mr. Lant Carpenter, Dr. Frankland, and Mr. Buchanan, the chemist of the *Challenger*, nor with the observations of Sir Wyville Thomson in his "Depths of the Sea," in which he says (p. 46) "the bottom of the sea is a mass of animal life."

Several species of Mollusca which were previously known as fossil only, and were supposed to be extinct, have lately been dredged by myself and others from the bottom of the Atlantic. Some of these same species had been described and figured by Prof. Seguenza of Messina from Pliocene beds in Sicily. I have no doubt that many more, perhaps all, of such fossil species will be hereafter discovered in a living state by means of deep-sea explorations.

Some geologists, and especially of late years, have advocated the theory that oceans have continued for an enormously long period to occupy the same areas that they still occupy. Mr. Darwin was, I believe, the first to broach this idea. He says, in the chapter "On the Imperfection of the Geological Record," "We may infer that where our oceans now extend oceans have extended from the remotest period of which we have any record; and, on the other hand, that where continents now exist large tracts of land have existed, subjected, no doubt, to great oscillations of level, since the earliest Silurian period." There does not seem to be any fact adduced or reason given for either of the above inferences.

[1] "Island Life."

If the present oceans and continents have remained unchanged since the Silurian period, how can we account for the widespread distribution of fossiliferous formations, Palæozoic, Mesozoic, Cainozoic or Tertiary, and Quaternary or Recent, miles in thickness, all over Europe, Asia, Africa, Australasia, and New Zealand? All oceanic islands are of volcanic origin; but some of them contain Miocene fossils. These formations are chiefly marine, both deep water and shallow; and they necessarily imply the presence of oceans in those parts of the globe which are now continents and dry land. All the "secrets of the deep" will probably never be revealed to man, nor is he likely to know what terrestrial formations underlie the floor of the mid ocean.

In my paper "On the Occurrence of Marine Shells of Existing Species at different Heights above the Present Level of the Sea," which was published in the *Quarterly Journal of the Geological Society* for August 1880, I stated that many existing species of Mollusca which inhabit great depths only are found in a fossil state at considerable heights above the present level of the sea, so as to show an elevation equal to nearly 12,000 feet, and that such elevation must have taken place at a very late and comparatively recent stage of the Tertiary or Post-Tertiary epoch. In the face of facts like this, can we rightly assign to the present oceans that geologically remote antiquity which is claimed for them?

11. *Incidental.*—Clarence's dream of wrecks, corpses, wonderful treasures, and

> "reflected gems
> That woo'd the slimy bottom of the deep,
> And mock'd the dead bones that lay scatter'd by,"

has not yet, I believe, been realised by any dredger. I have in this way explored for between forty and fifty years all our own seas, besides a considerable part of those on the coasts of North America, Greenland, Norway, France, Spain, Portugal, Morocco, and Italy; but I have never found anything of value except to a naturalist, nor any human bone, although many thousand human beings must have perished in those seas.

12 *Concluding Remarks.*—To give a better idea of the ocean and of its life in the depths as well as on the surface, let me strongly recommend my hearers to read Mr. Moseley's admirable volume entitled "Notes of a Naturalist on the *Challenger*." His graphic account of this marvellous voyage far surpasses in interest (to say nothing of accuracy) every work of fiction or imagination, and it has not the melancholy dulness of most books on history and travels.

The subject of this lecture is inexhaustible; and, as our knowledge of it becomes more extended, we must continually say with Seneca, "Our predecessors have done much, but have not finished. Much work yet remains, and much will remain; nor to any one, born after a thousand ages, will be wanting the opportunity of still adding something." Such increase of knowledge must tend to confirm our acknowledgment, with a reverential awe, of that Great Creator whose wondrous works are dimly seen in every form of life, marine and terrestrial, and especially in

> "all that glides
> Beneath the wave, yea, in the wave itself,
> And mighty waste of waters."

GAS AND ELECTRICITY AS HEATING AGENTS[1]

I.

ON March 14, 1878, I had the honour of addressing you "On the Utilisation of Heat and other Natural Forces." I then showed that the different forms of energy which Nature has provided for our uses had their origin, with the single exception of the tidal wave, in solar radiation; that the forces of wind and water, of heat and electricity, were attributable to this source, and that coal formed only a seeming and not a real exception to the rule,—being the embodiment of a fractional portion of the solar energy of former geological ages.

On the present occasion I wish to confine myself to one branch only of the general subject, namely, the production of heat energy. I shall endeavour to prove that for all ordinary purposes of heating and melting, gaseous fuel should be resorted to for the double reason of producing the utmost economy and of doing away with the bugbear of the present day, the smoke nuisance; but that for the attainment of extreme degrees of heat

[1] A lecture by C. William Siemens, D.C.L., LL.D., F.R.S., on January 27, in St. Andrew's Hall, Glasgow, under the auspices of the Glasgow Science Lecture Association.

the electric arc possesses advantages unrivalled by any other known source of heat.

Carbonaceous material such as as coal or wood is practically inert to oxygen at ordinary temperatures; but if wood is heated to 295° C. (593° F.), or coal to 326° C. (617° F.), according to experiments by M. Marbach, combination takes place between the fuel and the oxygen of the atmosphere, giving rise to the phenomenon of combustion. It is not necessary to raise the whole of the combustible materials to this temperature in order to continue the action; the very act of combustion when once commenced gives rise to a great development of heat, more than sufficient to prepare additional carbonaceous matter, and additional air for entering into combination; thus a match suffices to ignite a shaving, and that in its turn to set fire to a building.

The first effect of combustion is therefore to heat the combustible and the air necessary to sustain combustion to the temperature of ignition, but in dealing with the combustible called coal other preparatory work has to be accomplished besides mere heating in order to sustain combustion. The following is an analysis from Dr. Percy's work on "Fuel" of a coal from the Newcastle district:—

Carbon	81·41	Nitrogen	2·05
Hydrogen ...	5·83	Sulphur	0·74
Oxygen	7·90	Ash	2·07

which shows at a glance that nearly 16 per cent. of the total weight consists of such permanent gases as hydrogen, oxygen, and nitrogen. These gases are partly occluded or absorbed within the coal, but are also combined with carbon-forming volatile compounds, such as the hydrocarbons and ammonia, so that when coal is subjected to heat in a closed retort, as much as 35 per cent. passes away from the retort in a gaseous condition and as vapour of water, partly to condense again in the form of tar, and of ammoniacal liquor, and partly to pass into the gas mains as illuminating gas, a mixture mainly of marsh gas (Ch_4), olefiant gas (C_2H_4), and acetylene (C_2H_2), its value as an illuminant depending upon the percentage of the last two constituents rich in carbon. The result of the distillation of a ton of coal will be as follows, from data with which Mr. A. Upward has kindly supplied me:—

	cwt.
Coke	13·60
Tar	1·20
Ammoniacal Liquor	1·45
Gas	3·15
Carbonic acid	0·18
Sulphur removed by purifying	0·30
Loss	0·12

So great is the loss of heat sustained in an ordinary coal fire, in consequence of the internal work of volatilisation, that such a fire is scarcely applicable for the production of intense degrees of heat, and it has been found necessary to deprive the coal in the first place of its volatile constituents (to convert it into coke) in order to make it suitable for the blast furnace, for steel melting, and for many other purposes where a clear intense heat is required.

In the ordinary coke oven the whole of the volatile constituents are lost, and each 100 lbs. of coal yield only 66 lbs. of coke, including the whole of the earthy constituents which on a large average may be taken at 6 lbs., leaving a balance of 60 lbs. of solid carbon. In burning these 60 lbs. of pure carbon, 220 lbs. of carbonic anhydride (CO_2) are produced, and in this combination $60 \times 14,500 = 870,000$ heat units (according to accurate determinations by Favre and Silbermann, Dulong, and Andrews) are produced.

The 34 per cent. of volatile matter driven off yield, when the condensible vapours of water, ammonia, and tar are separated, about 16 lbs. of pure combustible gas (being equal to about 10,000 cubic feet per ton of coal), which in combustion produce $16 \times 22,000 = 352,000$ heat units. The escape of these gases from the coke oven constitutes a very serious loss, which may be saved, to a great extent at least, if the decarburisation is effected in retorts. The total heat producible from each 100 lbs. of coal is in that case $870,000 + 352,000 = 1,222,000$ or 12,220 units per lb. of coal. Deduction must, however, be made from this for the heat required to volatilise 34 lbs. of volatile matter for every 100 lbs. of coal used, and also for heating the coke to redness, or say to 1000° F. Considering the multiplicity of gases and vapours produced it would be tedious to give the details of this calculation, the result of which would approximate to 60,000 heat units, or 600 units per lb. of coal treated.

We thus arrive at $12,200 - 600 = 11,600$ heat units as the maximum result to be obtained from 1 lb. of best coal. Considering, however, that the coal commonly used for industrial purposes contains more ashes and more water than has been here assumed, a reduction of say 10 per cent. is necessary, and the calorific power of ordinary coal may fairly be taken at 10,500 units per. lb.

In applying this standard of efficiency to actual practice it will be found that the margin for improvement is large indeed. Thus in our best steam-engine practice we obtain one actual HP. with an expenditure of 2 lbs. of coal per hour (the best results on record being 1·5 lb. of coal per Indicated HP.) A HP. represents $33,000 \times 60 = 1,980,000$ foot-lbs. per hour, which is $\frac{1,980,000}{2} = 990,000$ foot-lbs., or units of force, per lb. of fuel.

Dr. Joule has shown us that 772 foot-lbs. represent one unit of heat, and 1 lb. of coal therefore produces $\frac{990,000}{772} = 1282$ units of heat instead of 10,500, or only one-eighth part of the utmost possible result.

In melting steel in pots in the old-fashioned way, as still practised largely at Sheffield, 2½ tons of best Durham coke are consumed per ton of cast steel produced. The latent and sensible heat really absorbed in a pound of steel in the operation, does not exceed 1800 units, whereas 2½ lbs. of coke are capable of producing $13,050 \times 2·5 = 32,625$ units, or 18 times the amount actually utilised.

In domestic economy the waste of fuel is also exceedingly great, but it is not easy to give precise figures representing the loss of effect, owing to the manifold purposes to be accomplished, including cooking and the heating and ventilation of apartments. If ventilation could be neglected, close stoves such as are used in Russia would unquestionably furnish the most economical mode of heating our apartments; but health and comfort are after all of greater importance than economy, and these are best secured by means of an open chimney. Not only does the open chimney give rise to an active circulation of air through the room, which is a necessity for our well-being, but heat is supplied to the room by radiation from the incandescent material instead of by conduction from stove surfaces; in the one case the walls and furniture of the room absorb the luminous heat rays, and yield them back to the transparent air, whereas, in the latter case, the air is the first recipient of the stove heat, and the walls of the room remain comparatively cold and damp, giving rise to an unpleasant musty atmosphere, and to dry rot or other mouldy growth. The adversaries of the open fireplace say that it warms you on only one side, but this one-sided radiant heat produces upon the denizens of this somewhat humid country, and indeed upon all unprejudiced people, a particularly agreeable sensation; which is proof I think of its healthful influence. The hot radiant fire imitates indeed the sun in its effect on man and matter, and before discarding it on the score of wastefulness and smokiness, we should try hard, I think, to cure it of its admitted imperfections.

If incandescent coke is the main source of radiant heat, why, it may be asked, do we not resort at once to coke for our domestic fuel? The reasons are twofold: the coke would be most difficult to light, and when lighted would look cheerless without the lively flickering flame.

The true solution consists, I venture to submit, in the combination of solid and gaseous fuel when brought thoroughly under control, by first separating these two constituents of coal. I am bold enough to go so far as to say that raw coal should not be used as fuel for any purpose whatsoever, and that the first step toward the judicious and economic production of heat is the gas retort or gas producer, in which coal is converted either entirely into gas, or into gas and coke, as is the case at our ordinary gas works.

When in the early part of the present winter London was visited by one of its densest fogs, many minds were directed towards finding a remedy for such a state of things. In my own case it has resulted in an arrangement which has met with a considerable amount of favour and practical success, and I do not hesitate to recommend it to you also for adoption. Its general application would, as regards dwelling-houses, make our town atmosphere as clear as that of the surrounding country. If it can be shown that the arrangement may be easily and

cheaply applied, that it will relieve our housemaids of the most irksome portion of their daily work in laying fires and cleaning grates, and that a warm and cheerful fire can be made at a considerably cheaper rate than when using coal, you will admit, I hope, that the proposal is worthy of a trial.

In outward appearance my fire-grate, which I have not made the subject of a patent, and which may therefore be put up by any grate or gas-fitter without restraint, is very similar to the ordinary coal-grate; the latter may indeed be converted into the smokeless grate at a very trifling cost. The essential features of this grate are that solid carbonaceous fuel, such as coke or anthracite, are used in combination with as much gas as is found necessary to raise the former to the point of incandescence, that the combustion is entirely confined to the front of the grate, whence radiation into the room takes place, and that any heat reaching the back of the grate is conducted away and utilised in heating the incoming air, by which combustion in front of grate is supported; in this way greater brilliancy and considerable economy are realised.

One arrangement by which this is effected is represented in diagram 1 (see NATURE, vol. xxiii. p. 26). The iron dead plate *c* is riveted to a stout copper plate *a* facing the back of the fire-grate, and extending five inches both upwards and downwards from the point of junction. The dead plate *c* stops short about an inch behind the bottom bar of the grate to make room for a half-inch gas-pipe *f*, which is perforated with holes of about one-sixteenth of an inch placed at distances of one and a half inch along the inner side of its upper surface. This pipe rests upon a lower plate *d*, which is bent downwards towards the back so as to provide a vertical and horizontal channel of about one inch in breadth between the two plates. A trap-door *e*, held up by a spring, is provided for the discharge of ashes falling into this channel. The vertical portion of this channel is occupied by a strip of sheet copper about four inches deep, bent in and out like a lady's frill and riveted to the copper back piece. Copper being an excellent conductor of heat, and this piece presenting (if not less than a quarter of an inch thick) a considerable sectional conductive area, transfers the heat from the back of the grate to the frill-work in the vertical channel. An air current is set up by this heat, which, in passing along the horizontal channel, impinges on the line of gas flames and greatly increases their brilliancy. So great is the heat imparted to the air by this simple arrangement that a piece of lead of about half a pound in weight introduced through the trap-door into this channel melted in five minutes, proving a temperature exceeding 619° F. or 326° C. The abstraction of heat from the back has moreover the advantage of retarding the combustion of the coke there while promoting it at the front of the grate.

The sketch represents a fire-place at my office, in a room of 7200 cubic feet capacity facing the north. I always found it difficult during cold weather to keep this room at 60° F. with a coal fire, but it has been easily maintained at that temperature since the grate has been altered to the gas-coke grate just described.

In order to test the question of economy, I have passed the gas consumed in the grate through a Parkinson's 10-light dry gas-meter; the coke used is also carefully weighed.

The result of one day's campaign of nine hours is a consumption of 62 cubic feet of gas and 22 lbs. of coke (the coke remaining in the grate being in each case put to the debit of the following day). Taking the gas at the average London price of 3*s.* 6*d.* per 1000 cubic feet, and the coke at 18*s.* a ton, the account stands thus for nine hours:—

	d.
62 cubic feet of gas at 3*s.* 6*d.* per thousand	2·604
22 lbs. coke at 18*s.* a ton	2·121
Total	4·725

or at the rate of 0·525*d.* per hour. In its former condition as a coal-grate the consumption exceeded generally two and a half large scuttles a day, weighing 19 lbs. each, or 47 lbs. of coal, which at 23*s.* a ton equals 5·7*d.* for nine hours, being 0·633*d.* per hour. This result shows that the coke-gas fire, as here described, is not only a warmer but a cheaper fire than its predecessor; with the advantages in its favour that it is lit without the trouble of laying the fire, as it is called, and keeps alight without requiring to be stirred, that it is thoroughly smokeless, and that the gas can be put off or on at any moment, which in most cases means considerable economy.

A second and more economical arrangement as regards first cost is shown in diagram 2 (NATURE, vol. xxiii., pp. 92, 93), and consists of two parts, which are simply added to the existing grate, viz.: (1) the gaspipe *d* with a single row of holes of about $\frac{1}{16}$ inch diameter, 1·5 inch apart along the upper side inclining inward, and (2) an angular plate *a*, of cast iron, with projecting ribs *b*, extending from front to back on its under side, presenting a considerable surface, and serving the purpose of providing the heating surface produced by the copper plate and frill-work in my first arrangement. In using iron instead of copper it is necessary however to increase the thickness of these plates and ribs in the inverse ratio of the conductivity of the two metals, or as regards the back plate, from $\frac{1}{4}$ inch to $\frac{9}{4}$ inch according to the best determinations recently published by Sir W. Thomson. This thickness would be practically inconvenient, and in order to avoid it the construction of the grate had to be modified for cast iron.

An inclined plate fastened to the lower grate bar directs the incoming air upon the heating surfaces and provides at the same time a support for the angular and ribbed plate, which is simply dropped into its firm position between it and the back of the grate.

The front edge of the horizontal plate has vandyked openings *c*, forming a narrow grating, through which the small quantity of ashes that will be produced by combustion of the coke or anthracite in the front part of the grate discharge themselves down the incline towards the back of the hearth, where an open ash-pan may be placed for their reception.

In adapting the arrangement to existing grates, the ordinary grating may be retained to support the angular plate, which has in that case its lower ribs cut short, to the level of the horizontal grate.

But it may be asked, Are you sure that the coke and gas grate you advocate will do away with fogs and smoke? My answer is, that it would certainly do away with smoke, because the products of combustion passing away into the chimney are perfectly transparent. Mr. Aitken has, however, lately proved in an interesting paper read before the Royal Society of Edinburgh, that even with perfect combustion a microscopic dust is sent up into the atmosphere, each particle of which may form a molecule of fog. We have evidence, indeed, that the whole universe is filled with dust, and this is, according to Prof. Tyndall, a fortunate circumstance, for without dust we should not have a blue, but a pitch-black sky, and on our earth we should be, according to Mr. Aitken, without rain, and should have to live in a perpetual vapour bath. The gas fires would contribute, it appears, to this invisible dust, and we should, no doubt, continue to have fogs, but these would be white fogs, which would not choke and blacken us. It is not clearly shown what this fine dust, resulting from the combustion of gas, consists of, and it seems reasonable to suppose that in perfect combustion it will be avoided.

Granted the cure of smoke, it might still be questioned whether such a plan as here proposed could be carried out on so large a scale as to affect our atmosphere with the existing mains and other plant of the gasworks. If gas were to be depended upon entirely for the production of the necessary heat, as is the case with an ordinary gas and asbestos grate, it could easily be proved that the existing gas mains would not go far to supply the demand; each grate would consume from 50 to 100 cubic feet an hour, representing in each house a consumption exceeding many times the supply to the gaslights. My experiments prove, however, that an average consumption of from 6 to 8 cubic feet of gas per hour suffices to work a coke gas grate on the plan here proposed. This is about the consumption of a large Argand burner, and therefore within the limits of ordinary supply.

But independently of the practical question of supply, it is desirable on the score of economy to rely upon the solid carbon chiefly for the production of radiant heat for the following reason:—

1000 cubic feet of ordinary illuminating gas weigh 34 lbs., and the heat developed in their combustion amounts to $34 \times 22{,}000 = 748{,}000$ heat units.

One pound of solid coke develops in combustion, say, 13,400 heat units (assuming 8 per cent. of incombustible admixture), and it requires $\frac{748{,}000}{13{,}400} = 56$ lbs., or just half a hundredweight, of this coke to produce the same heating effect as 1000 cubic feet of gas. But 1000 cubic feet of gas cost on an average

3*s.* 6*d.* and half a hundredweight of coke not more than 6*d.* (at 20*s.* a ton), or only one-seventh part of the price of gas.

If heating gas was supplied at a much cheaper rate, it would in many cases be advantageous to substitute incombustible matter, such as balls of asbestos, for the coke or anthracite. The consumption of gas would in that case have to be increased very considerably, but the economical principle involved (that of heating the air of combustion by conduction from the back of the grate) would still apply, and produce economical results as compared with those obtained by the gas-asbestos arrangements hitherto used.

To illustrate the efficiency of this mode of heating the in-coming air by what is called waste heat, I will show you another application of the same principle which I have made very recently to the combustion of gas for illuminating purposes.

(*To be continued.*)

THE RECENT SEVERE WEATHER

IN a recent contribution to the literature of meteorology Mr. E. J. Lowe, F.R.S., endeavours to prove that droughts and great frosts are periodical, occurring at intervals of between eleven and twelve years. In support of this theory he remarks: "There can be no reasonable doubt that the cycles are more than eleven years and less than twelve (more nearly eleven than twelve)," and a table of "great frosts" is given, from which we take the dates for the present century in the same order as printed.

1801—2	1819—20	1860—61
1813—14	1837—38	1856—57
1810—11	1840—41	1870—71

The present year may now be added to the above list.

It will be noticed that there are some variations in the lengths of the intervening periods, but there is at the same time a distinct recurrence of eleven-year epochs.

The great frost of the month just ended will doubtless form one of the main features in the meteorology of the nineteenth century. In the table below are given the average temperatures of the United Kingdom for the three weeks ended January 10, 17, and 24 of the present year, together with the temperatures for the same weeks ended January 12, 19, and 26 of the year 1880. Each year the average for these periods was below the mean seasonal value. The deficiency is given in the fifth and tenth columns.

Districts.	1881.					1880.				
	1st week.	2nd week.	3rd week.	Average.	Below the mean.	1st week.	2nd week.	3rd week.	Average.	Below the mean.
	°	°	°	°	°	°	°	°	°	°
Scotland, East	30	24	25	26·3	11·7	38	34	34	35·3	2·3
England, N.E.	35	23	25	27·7	9·7	37	32	32	33·7	4·3
England, East	36	23	24	27·7	10·7	34	32	31	32·3	6·0
Midland Counties...	34	21	22	25·7	13·3	35	33	29	32·0	6·7
England, South.....	37	26	26	29·7	10·3	35	32	30	32·3	7·0
Scotland, West	33	23	26	27·3	12·0	40	34	33	35·7	4·0
England, N.W.....	35	25	27	29·0	11·0	38	34	33	35·0	5·0
England, S.W.	38	31	28	32·3	10·3	39	38	35	37·1	6·3
Ireland, North	35	24	26	28·3	12·0	42	37	31	36·7	4·3
Ireland, South	38	27	27	30·7	10·7	43	37	35	38·3	3·3
London	37·4	24·2	24·8	28·8	10·3	34·2	32·4	29·1	31·9	7·1

The weather during the above periods was cold in both years, and the deficiency of solar heat is more noticeable, if the figures of the second and third weeks in each year are compared. On several days bright sunshine occurred for several hours, yet at some stations the sunshine was so weak as to fail to mark the recording cards of Prof. Stokes's sunshine recorders.

The weather over the whole of north-western Europe has been generally intensely cold, and on January 28 the temperature at Haparanda (extreme north of Gulf of Bothnia) was reported as being 60° F. below freezing point. H. W. C.

THE AURORA OF JANUARY 31

WE have received the following communications on the recent brilliant display of aurora:—

HAVING noticed an auroral light through the mist on the evening of January 30, I looked out last evening, the 31st, and saw what to me at least was a new appearance. There was a strong yellowish-white auroral light in the north, with an uneven boundary—not a well-defined arch. From it there arose, at intervals of a minute or two, what looked like wisps of luminous mist of an elliptical form, with their longer axes east and west. These chased one another towards the zenith, appearing and disappearing with great rapidity, so that one could hardly say "look!" before they had vanished. Sometimes three or four were flashing out at once. They were of large size, and being unaccustomed to the description of such objects, I know not how to describe their size. They must however have subtended horizontally angles of 45° and more at the eye. This appearance lasted, from the time I first looked out at about 6h. 45m., for about ten minutes or less, and then the appearance gave place to ordinary streamers, yellowish-white at their base and rosy towards their summits.

The flashing lights which I have mentioned suggested to me this idea: One has seen two men shaking a carpet held at two adjoining corners. Their strokes not exactly coinciding, an irregular, undulatory movement is produced, something like the waves of a chopping sea. If a stratum of *something* was in such a state of undulation above the atmosphere, and became visibly luminous where the crests of the undulations dipped down into the atmosphere, it would produce the kind of appearance that I saw. OSMOND FISHER

Harlton Rectory, Cambridge, February 1

LEST the magnificent auroral display of last evening has not been generally visible, the following short account of it, as witnessed here, may not be unacceptable to the readers of NATURE.

At about 6.15 p.m. indications of the disturbance were noticed in an unusually bright appearance of the sky from the north-east to north-west by west, the light being white, and similar in character to that reflected from the upper part of a bank of fog. By 6.25 the upper limit of this phenomenon had gradually changed into a number of bands, alternately bright and dark, but not well defined, which after another short interval disappeared in a change of the light to a very ruddy tint, accompanied by a kind of throbbing in the north, exactly like rapid repetitions of faint lightning. At this period a great number of parallel bands of light of a beautifully clear salmon tint were extended from the ruddy bank in a southerly direction, those from the north passing beyond the zenith, and losing their definition in a diffused patch of light of the same colour. These bands slowly faded away, but were succeeded by a similar and equally beautiful display at from ten to fifteen minutes later.

About seven o'clock I walked two and a half to three miles in a northerly direction, and found in ascending a slight hill that the fog was sufficiently thick to obscure the stars. This I imagine explains the peculiar bank and thick appearance of the light near the horizon.

The whitish illumination in the same quarter of the sky was still visible at 12 p.m. JOHN HARMER

Wick near Arundel, February 1

A BRILLIANT aurora borealis has been visible here this evening. It commenced at twenty minutes to seven, extending from west-north-west to a little east of north. The western part was of a deep ruddy colour, extending (at a rough estimate) some 35 or 40 degrees from the horizon, and varied by long white streamers, one of which—nearly due north—reached to within 15 or 20 degrees of the zenith. I was unable to watch it for more than a few minutes, but at half-past ten the sky in the same direction was still remarkably bright. R. W. TAYLOR

Kelly College, Tavistock, January 31

A VERY brilliant auroral display was visible here last night. There was a short heavy shower of hail and rain at six o'clock, and the sky was entirely overclouded. Thirty minutes later the sky was again clear, and the northern horizon was beautifully illuminated, and broad quivering bands of light stretched from thence upward beyond the zenith, some in unbroken continuity, while others were broken up. Not connected with these rays, and on the south side of the zenith, were frequent flashes of light, usually crescentic in form. The light near the horizon was silvery and moonlight like, but higher up it became much ruddier. I watched the aurora from 6.30 till 7, when I was obliged to go in-doors till 10.30, and then able to observe it again. At that time the light near the northern horizon had greatly increased in brightness, but fewer bands extended

upwards and to a less distance. As I walked home along elevated country roads, the effect produced by a dark sky on one side with a bright sky on the other, as if lighted up by an invisible full moon, was very beautiful. E. H.

Sheffield, February 1

THE aurora borealis which occurred last night was first visible here at 6 p.m. As is usual, the glow extended in an arc about 15° above the horizon, and was of a faint greenish colour.

From it arose frequent streamers of the same colour, having a slow westerly motion: these streamers attained to various heights, one at 6.55 reaching almost to the zenith; their colour, of various intensities, was as a rule greenish, but at times the streamers were of a reddish tint, more remarkably that one which occurred at 5.55, above referred to. At 6.50 the low arc changed its character, becoming irregular, finally assumed the form of a double arc, of which the centres of curvature were north-east and north-west of the place of observation.

At irregular intervals, during the whole of the first half hour, after the first appearance of the aurora, a flickering arc of light would ascend from the lower arc, up to an elevation, in many cases, of about 80° At 7 p.m. the aurora decreased in intensity, and at about nine o'clock had disappeared.

Cirencester, February 1 G. W. PREVOST

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The term's work has been delayed a little by the severity of the weather. Many of the colleges were but half filled on the regular day of meeting.

At the University Museum the following courses will be given during the term:—Prof. Henry Smith lectures on Pure Geometry, and Prof. Barth. Price on Geometrical and Physical Optics. Prof. Clifton will lecture on Terrestrial Magnetism at the Clarendon Laboratory. In this department Messrs. Stocker and V. Jones will lecture on Mechanics, and will give practical instruction in Physics. In the Chemical Department Dr. Odling will continue his course on Organic Chemistry. Mr. Fisher will lecture on Elementary Inorganic, and Dr. Watts on Elememtary Organic, Chemistry. The laboratories will be open under the direction of Messrs. Fisher, Watts, and M. Robb. Dr. F. D. Brown will lecture (for the Professor) on Chemical Affinity. In the Physiological Department, in the absence of Dr. Rolleston through illness, there will be practical instruction given by Messrs. Robertson, Hatchett Jackson, and Thomas. Mr. Jackson will lecture on Circulation and Respiration; Mr. Thomas on Comparative Embryology; Mr. Robertson will form a class for Practical Microscopy; and Mr. Lewis Morgan will form a class for Human Anatomy.

The following afternoon lectures will be given in the Museum: Prof. Prestwich will lecture on the Palæozoic Strata, and Prof. Westwood will give an informal lecture on the Arthropoda. In the University Observatory Prof. Pritchard gives two courses, one on the Lunar and Planetary Theories, the other on General Elementary Astronomy, once a week in the evening.

At the Botanical Garden Prof. Lawson gives a course of elementary botany.

At the Colleges which possess laboratories the following courses will be given:—At Christchurch Mr. Baynes will lecture on Thermodynamics; Mr. Dixon, owing to the illness of Mr. Vernon Harcourt, will continue his course on Inorganic Chemistry. At Balliol Mr. Dixon will lecture on Elementary Electricity and Magnetism; at Exeter Mr. Lewis Morgan will lecture on Histology; at Magdalen Mr. Yale will give a series of practical demonstrations on the Physiology of Circulation and Respiration.

In the School of Natural Science Prof. W. A. Tilden has been nominated as Examiner in Chemistry; Dr. S. J. Sharkey, of Jesus College, has been nominated Examiner in Biology; and Mr. J. W. Russel, of Merton College, has been nominated Examiner in Physics.

An examination for a Fellowship in biological subjects will be held in March at University College. The examination will comprise papers of questions, and practical work in zoology, physiology, and botany, and will begin on Thursday, March 3, at 9 a.m. Intending candidates are desired to send in their names to the Master (if possible) before February 11, with a list of the subjects they offer for examination. They are also invited to mention any original work on which they have been engaged, and to send copies of any original articles or books on biological subjects of which they are the authors. Candidates are desired to call on the Dean with the usual testimonials and certificates on Wednesday, March 2, between 5 and 6 p.m.

CAMBRIDGE.—The senior wrangler in this year's Mathematical Tripos is Mr. Andrew Russell Forsyth, of Trinity College, born in Glasgow in 1858, and educated at Liverpool College. The next two are Mr. Robert Samuel Heath and Mr. Ernest Steinthal, both also of Trinity.

In connection with the list published in these columns in December, of those who had obtained first class honours in the Natural Sciences Tripos, the following statistics may be of interest:—In the year in which the Tripos was instituted (1851), 6 names appeared in the list; the same number in 1861; in 1871, 14; in 1878, 22; and in 1880, 31 passed the examination, obtaining honours. In 1869, 7 men passed the Special Examination in Natural Science for the ordinary B.A. degree; the number increased to 25 in the Easter examination of 1870; in 1878 it slightly diminished to 22; and in 1880, 16 passed the examination in December. So far as these results go, it would appear that an increasing number of those students who declare for natural science at Cambridge aim at thoroughness in their work, and are not content with that superficial smattering of book knowledge which is considered sufficient in the examination for the Pass degree.

M. FERRY, the French Minister of Public Instruction, has given an important character to the next meeting of the schoolmasters of France. Each of the 40,000 teachers of the 40,000 parishes (communes) is to meet with his fellow-teachers at the proper district towns. There are about 2000 of each of these little assemblies, each of which is to elect a delegate who will go to the chief town of the Department, and all these cantonal delegates are to appoint a department of delegates, who will go to Paris with a memoir written for communication and discussion before the pedagogical congress. All these memoirs are to deal with questions proposed by the Government.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 27.—"*Polacanthus Foxii*, a large undescribed Dinosaur from the Wealden Formation in the Isle of Wight." By J. W. Hulke, F.R.S. (Abstract.)

A description of the remains of a large dinosaur, discovered in 1865 by the Rev. W. Fox, in a bed of shaly clay between Barnes and Cowleaze Chines, in the Isle of Wight. Head, neck, shoulder-girdle, and fore-ribs were missing, but the rest of the skeleton was almost entire. Some of the præsacral vertebræ recovered show a double costal articulation. In the trunk and loins the centrum is cylindroid, relatively long and slender, with plano-concave, or gently biconcave ends. Several lumbar centra are anchylosed together, and the hindmost to the sacrum. The sacrum comprises five relatively stout and short anchylosed centra of a depressed cordiform cross-sectional figure. The post-sacral vertebræ have a stout short centrum.

The limb bones are short, their shafts slender, and their articular ends very expanded. The femur has a third trochanter, and the distal end of the tibia has the characteristic dinosaurian figure.

The back and flanks were stoutly mailed with simple, keeled, and spined scutes, and the tail was also sheathed in armour.

The animal indicated by these remains was of low stature, great strength, and probably slow habits. It is manifestly a dinosaur, and is considered to be very nearly related to Hylæosaurus.

Linnean Society, January 20.—The Rev. J. M. Crombie, F.L.S., in the chair.—The proposed alterations in the bye-laws were again successively read, voted for, and confirmed, excepting sect. 2, chap. viii. which was not confirmed.—Portfolios of British sea-weeds and zoophytes, prepared by Mr. W. Smith of Falmouth, were exhibited by the Rev. J. Gould.—A squirrel's nest was also shown and commented on by Mr. Chas. Berjeau.—A new form of microscopical cabinet designed by Mr. W. Hillhouse of Cambridge was explained by him, its compactness and portability rendering it advantageous to teachers.—Mr. Thos. Christy exhibited some horn-shaped galls growing on a branch of *Pistacia atlantica*, and somewhat similar in appearance to those known in India under the name of "Kalera-singhi" galls. From the galls a substance exuded not unlike Chian turpentine; Mr. Christy also drew attention to the fruit of the

White Quibracho.—Notes on the Orchideæ formed the subject of an important contribution from Mr. G. Bentham. Orchids early attracted the attention of botanists, though their popularity as objects of cultivation is comparatively a recent phase due in a great measure to Loddige's celebrated collections and to the fashion set up by the Duke of Devonshire in his famous Chatsworth collection, a still further incentive being given by Chas. Darwin in his studies of their singular modifications of fertilising apparatus and its protecting perianth. In their classification Swartz's labours (1800), thereafter the Richards', Dupetit-Thouars, and others, have been superseded by the influx of strange forms then unknown. Rb. Brown first established the principles of their natural arrangement on a solid basis, and Lindley's grouping remains true till the present day. Blume's observations must always take a high rank, and good analytic generic characters and illustrations obtain in the works of Sir W. Hooker, Wight, Griffith, Fitzgerald, and others. The younger Reichenbach has devoted great attention to the group, but we still lack from him a synopsis of contrasted characters adaptive to limitation of tribes and genera. Dr. Pfester has of late studied their vegetative characters advantageously; while J. G. Beer proposes divisions founded on modifications of the labellum, unfortunately neglecting other structural peculiarities. In reviewing the Lindleyan system Mr. Bentham observes that the primary division based on the consistence of the pollen has not been replaced by any other equally good, although it is by no means absolute. He admits that the distinctions dependent upon the so-called *caudicles* and gland can scarcely be maintained, independent of the confusion occasioned by the term having been applied to three different parts of the pollinary system. The result of Mr. Bentham's extended examination of all growing and dried specimens procurable, and of the literature extant, is that he divides the order into five tribes and some twenty-seven sub-tribes, as indicated below, and he further gives lengthened explanations of these and of the more remarkable genera, &c.:—ORCHIDEÆ: *Tribe I. Epidendreæ*—Subtribes (1) Pleurothalleæ, (2) Microstyleæ, (3) Liparieæ, (4) Dendrobieæ, (5) Erieæ, (6) Bletieæ, (7) Coelogyneæ, (8) Stenoglossæ, (9) Loelieæ; *Tribe II. Vandeæ*—Sub-tribes (1) Eulophieæ, (2) Cymbidieæ, (3) Cyrtopodieæ, (4) Stanhopieæ, (5) Maxillarieæ, (6) Oncidieæ, (7) Sarcantheæ, (8) Notyleæ; *Tribe III. Neottieæ*—Sub-tribes (1) Vanilleæ, (2) Corymbieæ, (3) Spirantheæ, (4) Diurideæ, (5) Arethuseæ, (6) Limodoreæ; *Tribe IV. Ophrydeæ*—Sub-tribes (1) Serapiadeæ, (2) Habenarieæ, (3) Diseæ, (4) Coryclieæ; *Tribe V. Cypripedieæ*.—In a paper by Mr. Edw. J. Lowe on some hybrid British ferns, the author's experiments lead him to believe that *Polystichum aculeatum* and *P. angulare* are forms of one species, and *P. lonchitis*, *Lastrea recurva*, and *L. Alpina* are merely mountain forms of *P. angulare* and *L. dilatata* respectively. Spores of *Athyrium Filix fœmina* were mixed, viz., vars. *Victoriæ*, with *frizelliæ* and *proteum* and var. *Fieldiæ*, with *Pullerii* and var. *Howardiæ*, with *Du Boulæ*, whence sprang varieties of singular beauty and vigour.—A revision of the genus *Vibrissea* was a communication by Mr. W. Phillips, which was taken as read.

Geological Society, January 19.—Robert Etheridge, F.R.S., president, in the chair.—Jabez Church, M.Inst.C.E., George Augustus Freeman, B.Sc. Lond., Charles Horsley, C.E., Edwin Simpson-Baikie, F.L.S., and Charles John Wood, M.Inst.C.E., were elected Fellows of the Society. William Henry Goss was proposed as a Fellow of the Society.—The following communications were read:—Further notes on the family Diastoporidæ, Busk, by G. R. Vine, communicated by Prof. P. Martin Duncan, M.B. Lond., F.R.S. In continuing his review of the family of the Diastoporidæ, the author stated that upon the question of the classification of the Polyzoa he is inclined to accept the views recently published by the Rev. T. Hincks in preference to the earlier ones enunciated by Prof. Busk. He now described the forms found in the Lias and Oolite, including *Diastopora stromatoporides*, Vine (= *liassica*, Quenst.), *D. ventricosa*, Vine, *D. oolitica*, Vine, *D. cricopora*, Vine. The author then proceeded to argue against the inclusion of the foliaceous forms in the genus *Diastopora*, and concluded by giving a definition of the genus, as now limited by himself.—Further notes on the Carboniferous Fenestellidæ, by G. W. Shrubsole, F.G.S. The author pointed out the discrepancies in the descriptions given by Lonsdale, Phillips, McCoy, and King of the genus *Fenestella*, as represented in the Silurian, Devonian, Carboniferous, and Permian formations respectively. He then proposed a new definition of his own, and described the following species:—*F. plebeia*, McCoy, *F. membranacea*, Phil. *F. nodulosa*, Phil., *F. polyporata*, Phil., *F. crassa*, McCoy, *F. halkinensis*, sp. nov.; and in conclusion he pointed out that the few species to which he has reduced the Carboniferous Fenestellæ find their representatives in the North American continent, only one really new form, *F. Norwoodiana*, having been described there.

Physical Society, January 22.—Prof. W. G. Adams in the chair.—New Member, Mr. G. Palgrave Simpson, B.Sc.—Notes on the construction of the photophone, by Prof. Sylvanus Thompson, were read by Prof. Rheinold. Prof. Thompson was led by experiment to question whether Prof. Bell's form of photophone receiver was adapted to give the best results. Theoretically he finds with a given maximum of incident light distributed uniformly over the surface, the change of resistance in a selenium receiver will vary proportionally with its linear dimensions, provided its parts be arranged so that on whatever scale constructed the normal resistance shall remain the same. A cell n times greater linearly each way will produce n times the variation in resistance for the same total amount of light. This follows from Prof. W. G. Adams' law that the change in the resistance of selenium is directly as the square root of the illuminating power. The author also finds that if the thickness of the conducting disks in the enlarged cell be kept the same as before and their number increased n times, the change of resistance will be n^3 times as great as before. Selenium cells should therefore be as large as possible, and the light should be distributed over them uniformly, not focussed to a point. A conical mirror would therefore be better than a parabolic one to receive the beam. Such a reflector would be cheaper to construct, and there would be a minimum loss by reflection, as the light would fall perpendicularly on a cylindrical cell parallel to its axis. To give the best effect, its angular semi-aperture should be 45°, and this will bring the front end of the cell in the same plane as the mouth of the reflector. Prof. Thompson has also constructed an improved cell by winding parallel wires on a cylinder of slate grooved with a double-threaded screw, and filling the interval between them with selenium. This form gives superior effects to Prof. Bell's disk device. Mr. Shelford Bidwell said that long annealing improved the sensitiveness of selenium for photophone purposes. He got the best speech from cells of high total resistance, made with fine wire. The selenium should however have a low specific resistance. With the apparatus he showed at a recent meeting of the Society he could now transmit articles from NATURE and the *Nineteenth Century* so as to be heard, every word, by the listener. Prof. Guthrie suggested that amorphous phosphorus should be tried in place of selenium as a more permanent substance.—Mr. Glazebrook, of the Cavendish Laboratory, Cambridge, read a paper on the measurement of small resistances and the comparison of the capacities of two condensers. In measuring small resistances by the Wheatstone balance the results differed on varying the resistance in the battery wires. According to Prof. Chrystal this was due to a thermo-electric effect produced by the hand at the middle point of the divided platinum iridium wire when the contact is made with it. It could be avoided by making this contact first and then making the battery contact. Mr. Glazebrook investigated the effect mathematically and experimentally. He suggested that the resistance in the battery wire should be kept small in comparison with the other resistances, and then the effect was inappreciable. It could best be eliminated by taking two measurements with reversed currents and calculating out. The author next considered the effect of a small leakage in comparing condensers by the Wheatstone balance method. The sensibility of this method is increased by increasing the two resistances and the resistance of the galvanometer. Dr. Hopkinson stated that he had found a modification of this plan to be very promising. For the battery he uses an induction coil, and for the galvanometer a telephone. Thus a high electromotive force and sensibility was obtained.

Anthropological Institute, January 11.—Edward B. Tylor, F.R.S., president, in the chair.—Mr. G. M. Atkinson exhibited some stone celts from British Guiana.—Mr. John Evans, F.R.S., gave a short account of the proceedings of the International Congress of Prehistoric Archæology and Anthropology held at Lisbon in September last, at which he had been present in the capacity of delegate from the Institute. One of the excursions was to Otta, to inspect the beds in which it was thought that traces of man living in Miocene times had been discovered. This discovery had been accepted by many members of the Congress, but Mr. Evans had not been satisfied as to the un-

doubtedly human origin of the single bulbs of percussion on the flints, nor as to their actually forming integral parts of the beds in or on which they were found, nor as to the geological antiquity of the beds themselves.—The President read a communication from Mr. F. F. Tuckett, on the subject of a supposed diminution in the size of heads during the last half century.—A paper by Mr. W. D. Gooch was read, on the Stone age in South Africa. The paper was illustrated by a large number of specimens collected by the author.

Royal Asiatic Society, January 24.—Sir H. C. Rawlinson, K.C.B., president, in the chair.—The following gentlemen were elected as Resident Members:—Colonel S. C. Law, E. H. Man, J. W. McCrindle; and Thomas T. Fergusson, Rev. Mr. Cain, Atinaram S. G. Jayakar of Maskat as Non-Resident.—A paper was read by Mr. Simpson, F.R.G.S., on the identification of Nagara-hara with reference to the travels of Hiouen-Tsang. Nagara-hara, he stated, was the name of the chief city of the Jelalabad Valley, as also of the Province, the extent of which, according to Hiouen-Tsang, was probably from Gundamack to the Khyber Pass. It was visited by Hiouen-Tsang and Fah-Hian, who describe some of the buildings in it, at the same time referring to its distance from Hidda (now Hada), and thus confirming the suggested identification. Mr. Simpson stated that when in the Jelalabad Valley with General Sir Samuel Browne's column in 1879, he made many explorations into the Buddhist remains there, discovering, *inter alia*, an isolated rock covered with ruins of Buddhist masonry, bearing the local name of Bala-Hissar (*i.e.* "the Citadel"), the whole ground about it being strewed with stones and fragments of topes. Around it may also be seen a series of ridges, most likely the remains of the ancient defences of the town. Hiouen-Tsang states that it was four miles in circumference, and that it was six miles from Hidda, both of which measures agree exactly with those made by Mr. Simpson. M. Vivien de St. Martin, who very nearly worked out a correct map of this district in his "Mémoire sur la carte de l'Asie Centrale," was, Mr. Simpson states, misled by the map published in the "Ariana Antiqua."

Statistical Society, January 18.—Mr. James Heywood, F.R.S., in the chair.—The following papers were read:—On the method of statistical analysis, by Wynnard Hooper.—On the growth of the human body, by J. Towne Danson.

PARIS

Academy of Sciences, January 24.—M. Wurtz in the chair.—M. Berthelot presented a supplement to his recent work, containing various new measurements by himself and others.—The following papers were read:—On the periodic development of any function of the radii vectores of two planets, by M. Tisserand.—On the theory of heat, by M. Resal.—On a new disease caused by the saliva of a child that had died of hydrophobia, by MM. Pasteur, Chamberland, and Roux. Rabbits inoculated with the dilute saliva died within thirty-six hours; symptoms, loss of appetite, paralysis, asphyxia, congestion of trachea, with hæmorrhage, swellings in groin, axillæ, &c. Other rabbits inoculated with saliva or blood from the first soon died also. The disease is attributed to a small organism (found in the blood); it is of rod shape, constricted at the middle and surrounded by mucous matter. It is like the microbe of chicken cholera, but has no effect on fowls. By artificial cultivation it is changed in form somewhat. Guinea-pigs, though so like rabbits, seem hardly affected by inoculation. Dogs that were inoculated died in a few days, but without symptoms of rabies. The disease seems distinct from rabies, but the authors do not at this stage affirm its absolute independence.—Experiments proving that thiotetrapyridine and isodipyridine have not the poisonous power of nicotine, whence they are derived, by M. Vulpian.—The mechanical contact of gneiss and limestone in the Bernese Oberland, observed by M. Baltzer, by M. Studer. M. Baltzer was requested by the Swiss Geological Commission to study the superposition of gneiss on the Jurassic system in the region named. This he did in 1874-76, and his observations are given in the work now presented.—M. Heer was elected Correspondent in Botany in place of the late M. Schimper.—Elements and ephemerides of comet *f* 1880 (Pechüle), by M. Bigourdan.—Presentation of a photograph of the nebula of Orion, by Prof. Draper. The exposure was for fifty-one minutes.—On the divisions of certain homogeneous functions of the third order with two variables, by M. Pepin.—On the distinction of integrals of linear differential equations in sub-groups, by M. Casorati.—On the separation of the roots of equations, the first member of which is decomposable into real factors and satisfies a linear equation of the second order, by M. Laguerre.—On the development of elliptic integrals of the first and second species in entire recurrent series, by M. Farkas.—On the choice of unit of force in absolute electric measurements, by M. Lippmann. The electric standards and chief theoretical formulæ being independent of choice of the unit of force, the choice is not of very great importance, and a change of it is always easy. The dyne presents no essential advantage in some cases. For unification of measurement in electricity and the rest of physics electricians might take for fundamental units the second, metre, and gramme.—Laws of liberation of electricity by pressure in tourmaline, by MM. Jacques and Curie. The two ends of a tourmaline liberate equal quantities of contrary electricity. The quantity liberated by a certain increase of pressure is of contrary sign and equal to that produced by equal diminution of pressure. It is proportional to variation of pressure, and independent of the length of the tourmaline. For a given variation of pressure per unit of surface it is proportional to the surface.—On baryta used to obtain arsenic, with arsenious acid and sulphides of arsenic, by M. Brame.—Action of dry carbonic acid on quick lime, by M. Raoult. When CO_2 is sent into (say) 100 gr. quick lime in a glass vessel which has been heated to the point at which the glass begins to soften, the lime absorbs the gas very powerfully, and becomes incandescent, remaining so about fifteen minutes. A bibasic carbonate is produced. It is practically impossible to produce neutral carbonate of lime by direct synthesis. Lime that has once been heated over 1100° acts on dry carbonic acid at a much slower rate than before.—On the losses of nitrous compounds in manufacture of sulphuric acid, and a means of attenuating them, by MM. Lasne and Benker. The means referred to are a direct injection of sulphurous acid.—On the resistance to flexure of tempered glass, by M. de la Bastie. This is proved from experiments to be considerably superior to that of ordinary glass.—On cholestène (cholestérilène), by M. Walitzky.—On the preparation of crotonic aldehyde, by Mr. Newbury.—On the *Mus pilorides*, or musk-rat of the Antilles, considered as a type of a new sub-genus in the genus *Hesperomys*, by M. Trouessart.—Formation of the blastoderm in Araneides, by M. Sabatier.—Resection of two metres of the small intestine, followed by cure, by M. Koeberlé.—The wild vines of California, by M. de Savignon. There are five varieties of these, though all have hitherto been usually comprised under the name *Vitis Californica*.—On *Theligonum cynocrambe*, L., by M. Guilland.

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