THURSDAY, FEBRUARY 16, 1882

HYPOTHETICAL HIGH TIDES

IN his interesting lecture entitled "A Glimpse through the Corridors of Time," recently published in NATURE, Prof. Ball, accepting Mr. George H. Darwin's view—that the moon was once part of the earth's mass, and after separation long revolved much nearer to us than now—estimates that when 40,000 miles distant she produced tides 216 times greater than the present, and advances the theory that these high tides have been the most powerful agents in producing changes on the earth's surface. He further presents this theory to geologists as a solution of some of their most difficult problems.

All this is exceedingly interesting if true. There can be no question that a tide of six hundred feet sweeping over all shores and lowlands twice a day would be a most powerful destructive and creative engine; and it may be conceded at once that its potency in remodelling the earth's surface would far surpass any agent of change now in action. Hence we may fairly infer that if such tides had prevailed in former times they should have left behind them universal and indisputable evidence of their existence.

Having studied with some care the geological record in places where it is as nearly complete as anywhere, I must say that I fail to find there any traces of the action of these stupendous tides pictured to the imagination by Prof. Ball. On the contrary the whole of that record, from the Archæan to the present time, offers evidence opposed to such a theory as he proposes.

Of what took place before the *Laurentian* strata were deposited we can gain no knowledge from the rocks, because these are the oldest known. We can only say that they are aqueous sediments of which the materials were derived from pre-existent land. Though much metamorphosed they are plainly the prototypes of the sandstones, shales, and limestones of later formations, and, we may fairly conclude, were deposited under like conditions. In the granites of the Laurentian we apparently have representatives of the coarser sediments formed along shores; the slates are the clays of ancient times, the wash of the land deposited in quiet waters off shore, while the marbles—which in some places form a considerable portion of the Laurentian series—are undoubtedly organic sediments that accumulated in quiet water, deep or shallow, by the slow processes of growth and decay of animal structures. Graphite, the product of plant life—probably fucoidal—exists in large quantities in the Laurentian rocks, and they contain enormous beds of iron ore which must have been accumulated by the aid of organic matter. Hence we may say that in the Laurentian age life was abundant, and much of this was littoral life, and that the vital unites with the physical in opposition to the high tide theory.

The *Huronian* series consists mostly of slates, quartzites (sometimes ripple-marked), and beds of iron ore, all shore and shallow water deposits speaking of quiet times and no high tides.

The *Cambrian* rocks are but imperfectly shown on the eastern side of the North American continent, and we will not stop to inquire minutely into the circumstances of their deposition. We may say, however, in passing, that they contain no really coarse material, and are all, so far as is known, the deposits of quiet waters.

In the *Lower Silurian* series, which is here remarkably complete, we have a record that tells with great clearnes the physical as well as the vital history of the continent in that age.

The *Potsdam Sandstone*, the base of our Silurian, is an old beach spread over large areas of pre-existent land by a slow and quiet subsidence, and the invasion of the sea. The Laurentian highlands, the Adirondachs, the Archean area south of Lake Superior, formed the shores of this sea; and the Ozark Mountains, the nucleus of the Black Hills, &c., were islands in this sea, each with its shore line. The old Potsdam beach is now exposed, and has been examined in hundreds of localities along a line of a thousand miles or more, and there the ancient sea margin can be followed as easily and certainly as we can now meander the line of the Atlantic coast. We everywhere find the history of the old beach written with unquestionable accuracy and in great detail. The strata are frequently ripple-marked and sun-cracked, their surfaces are covered with the interlacing casts of seaweeds, the sand is bored in every direction by annelids, and is full of the fragmentary or complete shells of the beach-loving lingulas. This record not only includes no traces of extraordinary high tides, but is full of positive evidence that in the beginning of the Silurian age no tides much higher than at present swept the Atlantic coast of North America.

Above the Potsdam sandstone is spread a great sheet of organic material, the Trenton limestone group, in places a thousand feet thick, the deposits of quiet waters, and composed almost entirely of the hard parts of animals which inhabited them. As we approach the old shores these limestones become more earthy, and in places they abut directly against Laurentian cliffs, which supplied so little mechanical material as to form but a trifling percentage of the deposit made. Here we are on the old shore line, and are surrounded with evidence of the slow and quiet accumulation of material, and the entire absence of any indication of tidal action greater than that of the present day.

The same phenomena teach the same lesson in the records of the Upper Silurian, Devonian, and later geological ages. In the Devonian rocks we have another witness against extraordinarily high tides, for here are coral reefs rivalling those now forming in the tropical seas. Unless the reef-building polyps of the Devonian age were altogether different in habit from those now living, these coral reefs must have been formed in water less than two hundred feet in depth. Here high tides would have wrought the rapid destruction of the whole race of reef-building animals, at the ebb exposing them to the air for hours, and at the flood burying them too deeply for their continued existence. Nearly the same thing is taught by many of our great limestone beds. They are largely made up of mollusks, corals, &c., which inhabit a littoral zone, and it is evident that a tide hundreds of feet in height, sweeping to and fro over that zone, would have rendered it uninhabitable by them.

The sea-weeds now living in our oceans, chiefly occupy

the immediate shore, and most of them grow in a depth of water not exceeding forty feet. It is easy to see that if the present oceans were affected by a movement similar to that described by Prof. Ball, the zone of seaweeds would be the scene of the greatest mechanical violence, and they would be alternately left to dry in the sun, or be torn with irresistible force from their anchorage, and scattered over the land washed by the flood tide. But on every old beach, of which we find so many in the geological series, the casts of the fronds and stems of seaweeds are as plainly discernible as on our present shores. Indeed we may say that of the thousand forms of animal and vegetable life which have their home along the shores of continents, the seaweeds, the boring annelids, the lingulas, the oysters, the barnacles, in short the vast majority of mollusks and all the shore-loving fishes and crustaceans, none could possibly have existed while tides such as have been described prevailed; for that which is now their chosen habitat and the zone of greatest vital activity on the globe, would have been a scene of constant and terrible destruction.

It may also be said that if, as we suppose, the precipitation of ocean waters took place before the corrugations of the earth's surface had assumed any considerable magnitude, and it was nearly or quite covered with water, tidal waves five hundred or more feet in height sweeping over the earth in rapid succession would have worn away the emerging land as fast as it appeared, would have prevented the formation of continents, and have precluded the existence of land animals or plants. And farther, since marine vegetation is practically confined to shallow water, high tides would have rendered the growth of algæ impossible; and as they have supplied the pabulum for marine animal life, it follows that, with tides six hundred feet in height, our globe would have been a lifeless one.

For the reasons cited above, and others that might be given, we are compelled to conclude that the high tides which formed the subject of Prof. Ball's lecture have had no existence during the time covered by the geological record; and further, that since the beginning of that record the order of nature has been essentially what it is to-day. The testimony of the rocks on this subject is so full and conclusive, that it really leaves no room for discussion; and hence the astronomers have been in error in regard to the genesis of the moon, and she never formed a portion of the earth's mass, or the separation took place at a period so remote that she had receded to nearly her present distance before the dawn of life on the earth.

J. S. NEWBERRY

EASY STAR LESSONS

Easy Star Lessons. By Richard A. Proctor. (London: Chatto and Windus, 1881.)

WE have been repeatedly struck by the comparative (it might have been said, more than comparative) ignorance which prevails, even among educated people, as to the nomenclature and position of the stars. There are many who would be grievously scandalised at the idea of not being able to call trees or flowers by their right names, but who seem very little concerned by having to admit a similar incompetency as to the beautiful luminaries of the skies. They would be indignant at the supposition that they did not know an oak from an ash, or could possibly mistake a cowslip for a primrose; but they have no hesitation to confess that they do not know the difference between the two dogs that have been for so many ages keeping guard in the heavens; and if possibly the pre-eminent brilliancy of Sirius, or the magnificent configuration of Orion, may have awakened enough of curiosity to ascertain what they are called, they would still be at an utter loss to discriminate between Capella and Arcturus, or to say in what constellation or at what time they are to look for the Pleiades, whose existence they can hardly ignore. It is not easy to account for such a degree of uninstructed heedlessness. One reason possibly may be, that the knowledge of natural objects which makes its way by such gentle and imperceptible approaches into the minds of intelligent children is acquired by day rather than by night, and that their rambles with parents and nurses in sunshine hours familiarise them insensibly with many things of which they would remain ignorant if they were visible only during their hours of rest. But, however we may try to explain it, so it is, that what was termed in a previous generation the "diffusion of useful knowledge," seems not to have included a popular acquaintance with the sky, and that the maps which were published under that title and to promote that object have been much more serviceable to the express student of astronomy than to educated society in general. Whether such a state of ignorance or *insouciance* may be equally prevalent in other countries we never had an opportunity of ascertaining; but there can be no doubt of it among ourselves, and as little question can be made that it is a discredit to the professed intellectual progess of the age.

Nor can a plausible excuse be fabricated from the want of adequate and familiar help. We pity those indeed who were obliged in former days to gain—or toil after—such knowledge from "exercises" on the celestial globe. Exercises indeed they were, to no common extent, of attention and patience, when some poor child had first of all to learn that left did not mean left, but right, and that she must fancy herself inside the globe to rectify what was drawn all wrong on its outside. This disagreeable and circuitous road to knowledge had indeed its advantages in the solution of problems which are probably less understood in its absence by a subsequent generation; but it was very troublesome, not to say expensive in its machinery, and passed away, to be succeeded by planispheres and delineations of various kinds, and of easier attainment, any of which would have done much towards giving the requisite information, had they been used, or we may say cared for. There was help enough had the want of it been felt as it should have been. But now that astronomy is so decidedly in the ascendant, and takes rank among the prevailing tastes of the age, an opportunity is offered for a fresh attempt, with a fairer prospect of success; and we are glad to find that it has been laid hold of by an author whose name is a sufficient guarantee for his accurate knowledge both of the objects to which he would introduce us, and of the means of delineating them as naturally, and with as little derangement of position, as may be. For it is not every one that knows—though any one may readily convince himself by a trial with the rind of a halved orange—how great is the difficulty of exhibiting a hemisphere on a plane surface, or how much ingenuity is required in arranging a number of planes to

accomplish this end as smoothly and intelligibly as possible. No man has been more successful in this undertaking than Mr. Proctor, whose atlases for telescopic work are well known to observers; and he has now applied the same method to the production of a popular work, the object of which is to give full instruction for the naked eye (if for the eye of childhood, so much the better) as to the position of every constellation, with all its leading stars, in every quarter of the sky, for every month and practically every night in the year: and adapted not only to our own country, but to a corresponding and more extensive zone in North America also. This is a step in the right direction. It will not only offer material aid in removing the stigma of general ignorance, but prepare the youthful mind by familiar knowledge of what may be reached by the naked eye, for a more easy and unhesitating employment of the telescope in future years. Because we wish so well to Mr. Proctor's undertaking, we shall venture to point out some changes that, in our view at least, would be improvements. We can quite understand his desire of rendering his maps as full as possible; and his own eye would not be in the least embarrassed by that crowding of detail which we fear might perplex or even dishearten a beginner. But it would certainly be an advantage if there were more open space. The names of the constellations might be rendered less prominent, or abridged, or indicated by letters or symbols, and those of the principal stars might be transferred to the separate diagrams; much would be gained by an increase in the size of the stars, and greater clearness by the adoption of the easily-explained word "zenith" in place of "the point overhead." In matters of detail, a transposition may be pointed out in the diagram on p. 12; and the "sickle," on p. 90, and the "dumb-bell," on p. 176, require improvement. The text contains a great deal of interesting and amusing as well as instructive matter; but tastes may differ as to the desirableness of introducing so many remarks, however ingenious, on other ways of arranging stars in constellations, when the beginner may have enough to do in comprehending and recollecting them as they are, and will always remain. We are inclined to think that the name of the "Great Bear" is as common in England as the "Plough," and had better have been more frequently employed. On p. 108, γ and ϵ Cassiopeiæ stand instead of γ and δ, as pointers to the great cluster in the sword-hand of Perseus—described again, by the way, on p. 125—which most eyes, we believe, with Argelander and Heis, would see double. We have failed to find any notice in the text of the conspicuous nebula in Andromeda's girdle; and the Dumb-bell, invisible without a telescope, is not fortunately chosen as an instance of spectroscopic results, its light, according to Huggins, exhibiting only a single line. A little haste is probably traceable in these defects, which we hope the author may have an opportunity of rectifying.

OUR BOOK SHELF

Die Pflanze. Vorträge aus dem Gebiete der Botanik. Von Dr. Ferdinand Cohn. 8vo. pp. 512. (Breslau: Kern, 1881.)

THIS book may be placed by the side of Schleiden's "Die Pflanze und ihr Leben," which was published in 1847, and ran to at least six editions in German, besides being translated into English, French, and Dutch. The English edition was translated by Henfrey, and was published in 1848; and it soon became a popular book, as it dealt with various aspects of plant-life in language intelligible to every one, without any loss of scientific accuracy and without any mixture of fable and fiction.

Taking date for date, the present work does not suffer by comparison with its evident prototype; and, although there is no attempt to traverse the whole region of botany, this covers a much wider field. It is intended, as the author informs us in his preface, to be a guide to those who wish to participate in the intellectual life that pervades modern botany. Like Schleiden's work, it is based upon a number of lectures, delivered, in this case, in different parts of Germany during the last twenty years, and published in their original form in various journals. With few exceptions, however, they have been remodelled and revised, partly with the object of bringing the subjects therein treated up to the present state of knowledge, and partly with the object of eliminating repetitions and correcting inequalities of style. Each lecture is complete in itself, yet naturally a connecting thread runs through all. The opening lecture in the present arrangement, which is not a chronological one, is entitled "Botanical Problems" (noticed in NATURE, vol. xi. p. 261); and it appropriately takes precedence, because it is an historical sketch of the progress of botanical discovery. Altogether there are sixteen lectures bearing such descriptive titles as: "From the Pole to the Equator," "Life in a Drop of Water," "Invisible Foes in the Air," "Insectivorous Plants," "From the Sea Level to Eternal Snow," and so on. There is also one on Bacteria—of which organisms the author has made a special study; one on the Rose; one on the Grape Vine; and the last is on Ancient and Modern Gardens. Systematic botany, however, seems to be regarded by the writer as the particular branch to avoid teaching, for he has no lecture on the classification of plants. Perhaps he found it less easy to treat this in a popular style, or perhaps he fears that a knowledge of classification encourages the craze for collecting and learning the technical names of plants that is still far too prevalent? Anything that tends to discourage the mere collector is praiseworthy. Nevertheless, we think the principles of classification are at least of equal importance with the subjects treated. Yet in this case we are hardly justified in complaining because the author has not given more, especially as he has not promised to; and he has done so very well what he has done. There is no doubt that these lectures will be widely read, and they deserve to be, for they contain much interesting information, and they are written in an easy graceful style without superabundance of adornment. They are almost devoid of technical terms, and in all cases where they exist popular names are used in preference, though the Latin ones are given with other annotations at the end of each lecture. The book is well printed on good paper and embellished with some original and appropriate head and tail-pieces.

W. BOTTING HEMSLEY

La Lumière Électrique, son Histoire, sa Production, et son Emploi. Par Em. Alglave et J. Boulard. (Paris: Firmin-Didot et Cie., 1882.)

THE great success of the Electric Exhibition at Paris of 1881 has not failed to produce an effect upon the demand for books dealing with electrical science, and particularly with the practical applications of electricity. The wide extension of electric lighting, and the continued growth of popular interest in the subject are producing a perceptible effect also on the book market of this country. Text-books of electricity were never so greatly in demand as to-day, and we were recently informed that one of the

newest-published text-books of the science is being bought by the public at the rate of a thousand copies a month. Under these circumstances it would be remarkable if all the works put before the public were of equal scientific merit, for such a demand cannot but tempt into the field the semi-scientific bookmaker who is ever ready to produce something to meet a popular taste. The work before us must, we fear, be classed with the semi-scientific. Its authors, so far as we are aware, are gentlemen who have yet to make their mark in the scientific world, and who, though not ill-informed in a general kind of way as to the applications of the science, cannot be said to have added by their present work to the scientific knowledge of the subject. The work opens with an account of the history of lighting in general from the days of Greece and Rome; and it devotes no inconsiderable part of its pages to the early history of electric lighting. We observe, by the way, that the authors fall into the error of putting Davy's discovery of the voltaic arc so late as the year 1813, when he experimented with his large battery of 200 cells. But he had discovered the arc at least nine years before that date. The manufacture of carbons for electric light claims half a dozen pages. Not too much when there is so much dependent on the quality of the carbon, and when carbons are as bad as they are. But we were not aware that those of M. Napoli were so superior to all others as to deserve a monopoly of description. The process of covering the exterior of the carbon-rods with an electrodeposited coating of copper is stated by the authors to have been first adopted in 1875 by M. Reynier, whose semi-incandescent lamp and modified Daniell's battery are described in effusive detail, though neither of these inventions can be said to be of capital importance. The chief feature in the book is that part which deals with the various systems of electric incandescent lamps. These are described very fully and with copious illustrations. The authors appear to prefer the system of Edison, for whom they have a great admiration, of whom they give a portrait (an honour shared by M. Gramme only), and concerning whom they narrate very naïvely several gossipy tales—how he and his assistants were nearly poisoned by mercury vapour when they first tried to work Sprengel pumps, and how he sent an expedition south for the metal thorium. The section devoted to dynamo-electric machines is also well illustrated, and fairly descriptive, though the style of exposition is of the "popular" order. The work concludes with a notice of the application of electric light to lighthouses, to naval and military warfare, and to the stage. With respect to the first of these applications, the authors attribute to Fresnel the application of dioptric lenses to lighthouses. Is it ignorance, or is it patriotic bigotry that is to blame for their obliviousness of the fact that Brewster suggested this very application in 1812, ten years before Fresnel, and that in 1820 he had already taken steps to urge the matter upon the notice of a too deliberate officialism? Many excellent woodcuts adorn the pages of the work of MM. Alglave and Boulard, which will doubtless make it a welcome book for many a library table where popular science is in request.

An Elementary Treatise on the Tides based upon that of the Late Sir J. W. Lubbock, Bart., F.R.S.; to which is added a newly-devised Method of Computation of the Heights of High Water at Liverpool, with Factors for other Ports, and Tables adopted by the Admiralty. By James Pearson, M.A., F.R.A.S. (London: J. D. Potter; Fleetwood: W. Porter and Son, 1881.)

THIS Treatise on the Tides, by the Rev. J. Pearson, M.A., F.R.A.S., contains an interesting historical sketch of tidal theories, extending from an early period to the present time; and while referring to the slow progress made in our knowledge of tidal phenomena, assures the inquirer of the interest attending the investigation. The researches of Newton, Bernouilli, La Place, and others, had gradually established a theory which, from the discussion of many observations made at ports in the United Kingdom by Sir J. Lubbock, brought into practical use a series of tables by which the times and the heights of high water at certain places, mainly on the shores of the United Kingdom, could be computed with an accuracy sufficient for the requirements of seamen, and others interested, especially the proprietors of docks. Based on the general results of Sir J. Lubbock's labours, the author, from observations extending over several years, has introduced tables auxiliary to those heretofore employed, for computing the heights of high water at Liverpool, where the tides have occasionally the great range of thirty-three feet. The results of these predictions (as compared with observation) show that the course of the "diurnal inequality"—previously disregarded—has by their aid been successfully traced. On the coasts of Great Britain generally, the diurnal inequality is not so important a factor as it is at Liverpool, at which place it amounts at times to one foot or more. The treatise cannot fail to be received with interest and to encourage attention to the subject.

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.*]

The Movements of Jupiter's Atmosphere

The reference to the belts of Jupiter contained in my article on the geological activity of the tides (NATURE, vol. xxv. p. 213), was perhaps superfluous, for the subject is only collaterally connected with the points there under discussion; but as Mr. Mattieu Williams has commented on what I said, I should like to make a few remarks on his letter. Notwithstanding what he says I am still inclined to hold that the time-honoured explanation of the belts of Jupiter is the true one. In that explanation the terms trade and anti-trade winds are, I conceive, used in a somewhat extended sense as a consequence of thermal causes, and without reference to the existence of a solid nucleus, a current is supposed to set upwards in equatorial regions and then to spread out into higher latitudes; here the fluid has more moment of momentum than is adapted for the latitude in which it finds itself, and accordingly moves relatively to the subjacent matter in the direction of the planet's rotation, and forms an anti-trade wind. Conversely the trade winds arise from fluid moving into lower latitudes, when it has a deficiency of moment of momentum. Such an explanation seems to serve equally to explain the unequal rotation of the surface of the sun in different latitudes, and the Jovian belts.

The trade and anti-trade winds are essentially a thermodynamic effect, and in my paper I expressed an opinion that they might be partly due to the heat of the Jovian nucleus. It seems to be generally assumed that the great rapidity of that planet's rotation is a sufficient cause for the great violence of the supposed trade-winds which produce the belts. But my chief object in referring to the matter was because rapidity of rotation is not a sufficient explanation, without a statement as to the mode of reinforcement of the thermodynamic causes. Now the great distance of Jupiter from the sun largely weakens those causes, and it seems to me that there are only two ways in which they can be strengthened, viz. first by the large amount of gas on which the solar radiation has to work, and secondly, by the heat of the nucleus.

With regard to the deductions to be drawn from the low specific gravity of Jupiter, I may mention that in 1876 I pointed out that the observed ellipticity of the planet's figure can only be explained on the assumption of great density of the central portions of the planet. Taking indeed the best data attainable, I showed that the mean density of Jupiter must be about 70 times as great as the superficial density, if we follow Laplace

as to the nature of the law by which the density increases internally.[1] In the article in *Nature*, I adduced the argument on which Mr. Williams comments, as a slight corroboration of the conclusions as to the physical constitution of the planet, which have been derived from telescopic inspection, and from observation of the ellipticity of figure.

From the latter part of Mr. Williams's letter I must beg leave to dissent. If one were to describe the oceanic tides on the earth as a reeling motion of the solid earth within the sea, it would surely be a somewhat obscure description of the facts, but the reeling of the Jovian nucleus *can* only be a tidal phenomenon.[2] Now the masses of the Jovian satellites are so small, that they can only raise very small tides, except indeed on one hypothesis, of the truth of which we have no evidence, and which would not tend to explain the belts if it existed. The tide raised by a small satellite can only be large when the "free" period of oscillation of the gaseous or liquid ocean is nearly the same as the "forced" period. If this were the case with one of Jupiter's satellites, it certainly would not be so with the others. Although tides accompanied by *fluid friction* do tend to produce a longitudinal current adverse to the planetary rotation, yet no current of a millionth part of the velocity requisite for the production of the belts could possibly be occasioned by the tidal friction due to Jupiter's satellites.

For these reasons I quite dissent from Mr. Williams's explanation of the belts, and of the unequal solar rotation.

Sir William Thomson has recently pointed out, in a paper read before the Physical Society of Paris, a probable cause of the reinforcement of an atmospheric tide in the earth, due to an approximate agreement of free and forced periods of oscillation. He remarks that the semi-diurnal constituent of the barometric oscillation is nearly everywhere very much larger than was to be expected, and he shows that the sun and earth together constitute a thermodynamic engine whereby the earth's rotation is accelerated. Rough numerical calculations are given, wherefrom it appears that the amount of this acceleration may not be entirely negligeable, when we consider the degree of refinement to which modern astronomy has arrived. G. H. DARWIN

R.M.S.S. *Medway*, Southampton, Feb. 2

The Search for Coal under London

IN a recent communication to this journal I dwelt upon the importance of a systematic search being made for the Carboniferous rocks under London, by a series of borings running from north to south, and only a few miles apart; but I pointed out at the same time that much of the expenditure required for such a search might be saved by a judicious selection of sites for the first two or three borings. I then quoted the opinions of Mr. Godwin-Austen and Prof. Prestwich as to the localities at which such explorations might be undertaken with the greatest chance of success. My friend, Prof. Prestwich, has written to me expressing general agreement with the views I have put forward on the subject, but calling my attention to some other suggestions of his as to the points at which borings might be executed, with fair hopes of success. Writing in the Reports of the Coal Commission in 1870 (p. 162), Prof. Prestwich expressed himself as follows:—

"The direction of the great underground coal trough is, we think, likely to be on a line passing through North Wilts, Oxfordshire, thence across Hertfordshire, South Essex, the north-east extremity of Kent, onwards towards Calais, near to which place it is thrown out by the rise of the underlying rocks, but resumes again at Thérouanne. Or in case of the anticlinal axis taking a more southern course we should look for the coal basin or basins along a line passing from Radstock, through the Vale of Pewsey, and thence along the North Downs to Folkestone and near to Calais."

Some years later Prof. Prestwich wrote as follows:—

"In short, while there is every reason to hope that on the *south* of London we may yet find in the *Lower Greensand*, beneath the Tertiary Strata and Chalk, a source of large and valuable water-supply for metropolitan purposes, there is strong reason to believe in the probability of the discovery to the *north* of London of *Carboniferous Strata*, including possibly productive Coal-measures." . . . ("On the Range of the Lower Greensand and Palæozoic Rocks under London," by J. Prestwich. From *Quart. Journ. Geol. Soc.* for November, 1878, p. 911.)

The discovery of Upper Devonian strata, both at Turnford and at Tottenham Court Road, in both cases dipping at high angles, lends not a little support to the view that a trough of Carboniferous strata may exist between those two localities. Prof. Prestwich authorises me to state that what he would now recommend would be a boring "a mile or two north of Kentish Town, not directly north, but north-east or north-west, so as to avoid the hills—say about Edmonton on the one side, or near Edgware on the other." On the south side of London he would prefer to avoid the Lower Greensand, and would recommend a boring "just beyond its outcrop at Red Hill—somewhere between there and Horley." But he thinks that if Coal-measures were found to extend beneath the Lower Greensand, means might be found to sink through the latter, by the new appliances of which the Belgian engineers have so largely availed themselves. JOHN W. JUDD

Researches on Animals containing Chlorophyll

1. DR. BRANDT'S observations (*Sitz. d. Berlin Physiol. Gesellsch.*, Nov. 11, 1881) are upon the green bodies of *Hydra*, *Spongilla*, a fresh-water planarian, and numerous infusors. He finds that these green bodies are masses of hyaline protoplasm, containing a nucleus and a chlorophyll-granule. Sometimes two to six are present, these he considers are states of division. He regards these facts as proving that those bodies are unicellular algæ, and erects the genus *Zoochlorella*. He finds them survive isolation, and even develop starch in light. Specimens from Spongilla were taken in by infusors, but were either digested or ejected: those from a dead Hydra were, however, retained by *Paramœcium*, *Coleps*, &c. He believes that the chlorophyll never belongs to the animals, but always to algæ.

My observations deal with the yellow cells of quite different animals. I have, however, ventured the opinion that in most of the above cases, the green bodies do belong to the animals, and are not algæ, and I do not yet see sufficient reason for withdrawing that view.

2. For the yellow cells of Radiolarians and Cœlenterates (for the alga nature of which Dr. Brandt so ably argued in his former paper) he proposes the genus *Zooxanthella*. Here Dr. Brandt has doubtless priority.

3. He observes that large Radiolarian colonies show no signs of digesting foreign bodies, that these and also Spongilla can be kept best in filtered water, and that the latter will not live in a half darkened room. These facts are doubtless new.

4. Dr. Brandt concludes that the algæ maintain their hosts; that so long as the animals contain few or none, they feed in the ordinary way, but when sufficient algæ are present, they are nourished like plants. He indicates an analogy to lichens (an hypothesis which, as I also state in my paper, was first ventured by Semper), and yet points out a distinction, since in a lichen there is an association of an alga with a true parasite, here a "Symbiose" of algæ with animals accustomed to independent life, which they, however, give up, and take in no further nutriment. Thus in a morphological sense the algæ, in a physiological sense the animals are the parasites.

While welcoming Dr. Brandt's interesting paper, and while not desiring to lay too much stress on such awkward facts for his view as that *Hydra*, *Anthea*, *Velella*, &c., are quite as voracious as their congeners unprovided with chlorophyll, or that the animal may possess its chlorophyll from development, and while giving him and his predecessors all due credit for their valuable observations and theoretic insight, I must point out that (1) the *demonstration* of the truth of the view that the yellow cells of Radiolarians and Cœlenterates are algæ, (2) the development of the hypothesis of the lichenoid nature of the alliance between alga and animal into a theory of mutual interdependence, and (3) the transference of that view from the region of probable speculation into that of experimental science, remain with my paper. For it will not do to ignore, with Dr. Brandt, such weighty opposing evidence as (1) the recent direct statement of Hamann that the yellow cells of Cœlenterates are not algæ, but unicellular glands, (2) the observation of Krukenberg that *Anthea viridis* did not evolve oxygen, or (3) the failure of himself and others to prove the presence of cellulose and chlorophyll, or even to

[1] Monthly Notices of R.A.S. Dec. 1876, "On an Oversight in the Mécanique Céleste, and on the Internal Densities of the Planets."

[2] The expression "reeling" would at the first glance lead one to suppose that a diurnal tide is referred to, in which the fluid parts are carried relatively to the nucleus in the direction of the disturbing satellite, but without change of superficia form, technically a spherical harmonic deformation of the first order. But it is well known that this class of displacement must be non-existent, and therefore it must be presumed that Mr. Williams does not intend this.

confirm Haeckel's discovery of starch in Radiolarians; objections which rendered the whole matter so utterly dubious that no botanist had ever accepted it, although its importance, especially to disciples of Schwendener, is obviously great. Nor is my theory of reciprocal accommodation entitled to supersede that held by Cienkowski, and formerly by Brandt, of simple parasitism of the yellow bodies, until it has been proven (1) that animals containing algæ are actually successful beyond their fellows in the struggle for existence, (2) that the starch is rapidly consumed, and (3) that the algæ are of importance in the function of respiration, for which, again, it is necessary to show (*a*) the evolution of oxygen by the algæ, (*b*) the absorption of a large percentage by the animal, and (*c*) the displacement of the respiratory pigment by the algæ when the former is normally present.

Such being the points of Dr. Brandt's paper, and of my own as compared with it, Prof. Moseley will doubtless be the first to see that he has been mistaken in assuming, from his perusal of their abstracts, that the main points of the latter have been anticipated. I must, however, sincerely thank him for so courteously calling my attention to my ignorance of Dr. Brandt's interesting paper, which I regret having failed to review in its proper order, especially as I should then have avoided the employment of a new generic name.

It is perhaps scarcely necessary to add that although its publication has unfortunately been delayed, my paper, together with other new material, was forwarded from Naples on October 26 last to the medical faculty of this University, as trustees for the quinquennial Ellis physiology prize. PATRICK GEDDES

Botanical Laboratory, University of Edinburgh, February 11

MY friend Prof. Moseley's communication in NATURE, vol. xxv. p. 338, induces me to send you the following remarks on Mr. Patrick Geddes' interesting and important paper with the above title which appeared in NATURE, vol. xxv. p. 303, and which I should otherwise have deferred noticing until I could publish a fuller account of the whole subject.

As mentioned by Geddes, Cienkowski in 1871 clearly pointed out that the yellow cells in some Radiolaria were parasitic algæ (using this adjective in the sense of living within other animals or plants, or their tissues, *i.e.* taking up house-room). Geza Entz of Klausenburg, in 1876 (February) seems next to have called attention to the subject, but, as he mentions in the *Biologisches Centralblatt* for January 20, 1882, his paper being published in the Magyar tongue, has been hardly known or indeed accessible to the scientific world outside of his Fatherland. Touching on the views of Ehrenberg, Fred. Cohn and Stein, as to the nature of the green granules in Infusoria, Entz shows by a series of observations the chemical nature (by reagents) of some of these green bodies, and that some continue to live after the death of their hosts, growing and developing until their total evolution proved them to be forms of unicellular Algæ, such as Palmella, Gloeocystis, &c., &c, and justified the suspicion that they were "independent organisms that had forced their way into and temporarily enjoyed the hospitality of their hosts." He also shows that colourless Infusoria supplied with Palmellaceous cells rapidly become infected. In a note added to the translation of his paper in the journal above quoted, Entz mentions his later discovery of "nuclei" in these cells, and very correctly reiterates that they are but stages in the evolution of Algæ, and not species in the ordinary acceptation of that word. In 1877 (February), in ignorance of Prof. Entz's paper, I published an account of a green alga living as a guest in the fronds of other algæ, and also described its minute spores entering into and growing within the structures of Epistylis and Vaginicola, even figuring some adult forms within the lorica of *V. crystallina* and throughout the frond of the bright red *Polysiphonia urceolata*, and I ventured to suggest that these observations might throw some light on the Lichen-gonidia question. In 1881 (November) K. Brandt read a paper giving the result of a series of observations on the symbiosis (*Zusammenleben*) of algæ and animals before the Physiological Society of Berlin, an abstract of which was published in the *Biologisches Centralblatt* (December 15, 1881). Lastly comes the valuable paper of Mr. P. Geddes, in which he to a large extent confirms the observations of the previous labourers in this field of research. It may not be out of place to this very short historical sketch to add that investigations in reference to the minute alga, referred by me to Cohn's genus Chlorochytrium, now for several years continued—have enabled me to add many fresh instances of its spores finding house room in the bodies of animals, and of their accommodating themselves to the various circumstances of their "surroundings," when small they are generally greenest, and often the function of assimilation seems carried on in them to that extent as apparently to check their function of development. These observations I look forward to publishing in the *Transactions* of the Royal Irish Academy, where my earlier memoir appeared.

I make no reference here to the occurrence of chlorophyll bodies in animals apparently quite independent of the presence of vegetable cells, as brought to our notice by the researches of Sorby, Lankester, Moseley, and others. This, I take it, is not Symbiosism. E. PERCEVAL WRIGHT

On an Experimental Form of Secondary Cell

THE following description of a lead secondary cell exhibits so beautifully the part performed by the coating of red oxide of lead covering the new-made plates of Faure's accumulators, in forming them and in afterwards charging and discharging them, that I have no doubt that a trial of its experimental construction will interest those of your readers by whom improvements of the Faure's cell, in respect of retentiveness and capacity, and especially of durability, are regarded as useful objects of search, and as an important desideratum.

About four ounces of No. 5 lead-shot, cleaned and amalgamated to brightness, are placed at the bottom of a 10-oz. glass cell or beaker, so as to cover it to a depth of about half an inch, a loop of stout and clean lead wire having already been laid there flat, with its long straight part reaching vertically up the inner side of the cell to serve as a terminal for a binding screw. The straight part of the wire is lacquered in the manner usual with instrument-makers (while hot) thickly with shell-lac varnish to protect it down to the point where it turns into a loop, from acid action. The counter-plate of the cell is a thin horizontal lead one, suspended about an inch over the surface of the shots below by a strip of sufficient breadth and strength projecting from it up the inner face of the cell, to be bent over the top edge, as a carrier, and there provided with a binding screw. Before introducing it, one or two ounces of powdered minium, or red-lead, are thrown into the dilute sulphuric acid of the cell, and by a little gentle stirring, followed by very quick subsidence, this powder spreads itself evenly over the shot. When the liquid is clear, the counter-plate is introduced and the cell is coupled up to two small Grove's cells in series, so as to make the shots its anode, by connecting them with the platinum extremity of the exciting battery.

The action of the dilute sulphuric acid upon the red lead when immersed in it, besides disengagement of a little heat, and of a little contaminating carbonic acid, is partly to separate and partly to convert it into a mixture of the binoxide of lead and white lead sulphate, the two forming together a sombre red-brown powder forming a protecting layer over the stratum of metallic shot. Hydrogen is given off on the counterplate, but no oxygen gas makes its appearance at the bottom of the cell as the action of the exciting current proceeds; the nascent activity of the strongly ozonised oxygen of the pair seems to be entirely spent in oxidising the lead-sulphate already existing, and in converting it into lead-binoxide. The whole of the red powder-layer in the mean time grows uniformly and very slowly darker, until in about half-an-hour its ruddy brown colour has been completely toned down and deepened into that of the dark puce-coloured lead binoxide.

At the same time a singular action is proceeding among the metallic shot. A sort of snow of white lead-sulphate is forming on their summits and falling off them by its weight, as if showered down upon them out of the murky mass above; and there is no doubt that the presence of the minium layer serves to produce, through the medium of the lead-sulphate already there, a true corrosion of the lead, mainly conducted, as it would seem, by the acid which the process of binoxidation displaces from the superjacent sulphate. Out of contact with the incumbent powder, the bright metallic surfaces of the shots are only slightly dimmed and tarnished with a thin film of white sulphate, and it is the most remarkable feature of the process that this white film and the white caps of sulphate formed upon the upper shots are not at all discoloured, whereas without the overlying red lead protection, the lead surfaces would be immediately sooted and beclouded over with a dark-brown coat of lead-binoxide.

The nascent energy of the oxygen is evidently suppressed, and it would seem that the current takes its way by preference

through the solid sulphate, which it oxidises and decomposes, to reach the lead, to the total exclusion of the liquid channel through which it ordinarily attacks it, although liquid contact may very possibly be needed with the sulphate at its oxidation point.

Another unexpected feature presented itself, which perfectly confirms this view. My current source being a hand-gramme machine, turned by a water-turbine, which permits easy regulation of the current strength and tension by adjusting the water-tap, it was kept low at first, let the discharge of oxygen-bubbles from the lead shot should project upwards some of the settled powder into the liquid, and disturb its clearness. But no such ill effects having occurred while the current's strength was cautiously increased during the first half hour, it was then finally raised to the full charging power of the turbine, taking up a wheel-speed, and tension of the current showing a slightly greater resistance in the cell than one of the same size made with rolled up plates would have offered to the machine-current. With this full tension of two or three Grove's cells, bubbles of oxygen soon formed round the shots, but instead of this gas escaping turbulently through the powder, it collected under it until of sufficient volume to find an intermittent passage round it at one corner of the cell, and through an accidental hole or crevice in the middle of the layer, without producing the least turbidity in the cell's quite recently deposited contents! The layer's uneven surface was also not at all disturbed by a little agitation of the cell, showing that it had acquired considerable consistency by the action of the charging current. Of this effect of the treatment, the passage of a current into and through the sulphate of the layer, during its process of oxidation, would, it seems probable, be a sufficient explanation. No return-current could at this stage be extracted from the cell, which is also the case at the outset in forming, by a constantly directed exciting current, a Faure's accumulator. The charging-current was therefore left running for the night, the shot-layer having well imbued itself in a froth of white particles under the dark roof above. The effect of current-reversal was, however, first tested, with the result, after a short duration, of dissipating the white sediment, and exposing again the bright surfaces of the amalgamated shot, while the counter-plate above acquired as usual, under such conditions, a thick Planté's coating of dark oxide. This was discharged, as may always be done when it makes its appearance, as a secondary current of some strength ringing a call-bell for no inconsiderable portion of a minute. The shots remained bright, and exhibited no visible alteration. The charging-current was reinstated, and they soon covered themselves again with the mantle of white froth and powder as described.

On the following morning a great transformation had occurred. Only a few specks of white sulphate remained undecomposed in the corners of the cell; the rest had all blackened, nearly hiding the shots, and separated by no definite line of demarcation from the now clod-like layer of what had been the minium-coat above. The latter really resembled grey and black earth-clods mixed together, the black or dark humus brown ones forming continuous extensions of the similar converted sulphate underneath, and the grey admixture being apparently the originally separated binoxide of the minium layer placed in the cell at starting. A secondary, or return current was obtained from the cell in this condition, which rang a call-bell strongly for seven minutes. No visible alteration of colour or other change of appearance in the materials furnishing this current at the bottom of the cell could be perceived while it was being extracted from them.

The charging-current was then applied again, and remained in constant action (during which time it was not visited) for twenty-four hours. On this second morning the blackening was so complete, that not only were the shots hidden, but the nether line of the top coat of minium was no longer distinguishable. The dark humus-like transformation of the sulphate enveloped the former, and penetrated the latter, leaving only some large insular grains and clods of the grey substance of the upper layer still unaffected, as if untraversed by the current's charging or compacting action. The duration, however, of the secondary current now yielded by the cell was still only seven minutes, as before; and no increase of storage capacity was therefore given to it by this long additional, and to all appearance strongly operative period of oxidising direct-excitation. The materials as before underwent no visible change of aspect during the extraction of the secondary current.

The cell, evidently quite formed, was now once more filled to test its retentiveness. After a few hours of charging, the rough dendrites of humus-coloured substance acquired frond-like form and much greater compactness as they shrank asunder and approached apparently the ceramic and brittle state of consolidation which the coating of the Faure accumulator plates exhibits when they have been once or twice recharged. The shot-cell proved perfectly retentive of its charge, and although only a poor substitute for one of folded or rolled up plates, in storage capacity and in freedom from resistance it is yet a very fairly efficient accumulator. From the simplicity of its construction, and from the easy inspection which it permits of the several stages of the process of red-lead primary excitation, I can commend its use to those who are busily engaged, like myself, in the difficult and complicated study of the question of secondary battery improvements.

The tendency to cohere and harden which binoxide of lead possesses when formed by and submitted to a current, is well proved by the iridescent hues which it exhibits when deposited in the form of Nobili's rings on some bright metals, such as clean platinum and german silver, the optical explanation of which points to the existence of a good reflecting surface in the film. A similar reflecting surface is found to exist, for oblique incidences of light, in the opaque layer of soot of a candle-flame on smoked glass; and it may be that this optical character of such deposits which cannot be perceived by the microscope to be granular, is not physically unconnected with the electrical properties of the film which, in the case of binoxide of lead, give it capacity for storage in the chemical form of the energy of the secondary current. And yet it is not only by enlarging the area of the coherent binoxide film, and extending the surface of lead over which it is spread, that increase of storage capacity can be given to corrugated or to spongily and otherwise roughened lead elements; but it appears also to be attainable, at least in some degree by increasing the thickness of the film; for on reversing the exciting current of the lead-shot cell, for the second time only, so as to oxidise the counter-plate, the secondary or return current taken from this plate rang the call-bell continuously for twenty minutes, which denoted a storage capacity in the little exposed surface of the small lead-plate nearly three times as large as any before arrived at in the thick layer of shots at the bottom of the cell.

A. S. HERSCHEL

College of Science, Newcastle-on-Tyne, January 28

P.S.—It appears to be the hydrogen occluded in the positive plate as much as the oxygen stored up on the negative one that gives the Planté and the Faure cells their secondary voltaic power; for on trying several metals as the positive plate in the shot-cell, after charging it again directly to its full capacity, I found their order as regards the strength of the secondary, or return current obtainable with them from the charged cell to be as follows:—

Clean lead: a feeble current, only traceable with a galvanometer. Amalgamated lead gave the same.

Copper: a pretty strong current, which easily rings the call-bell.

Hydrogenised lead (the counterplate used in charging the cell directly): a strong current, ringing the bell loudly, and giving a spark between its wires.

Hydrogenised platinum (prepared like the last lead plate): at first a strong current like the last, but degrading gradually, and not inferior in duration or storage capacity to that of the last lead-plate!

Amalgamated zinc: a very powerful current, far exceeding the preceding ones, and capable of maintaining the motion of the Gramme machine and water-wheel when the water was turned off, which only a well-made Faure cell of twenty-five square-inch plates rolled together had enabled me to accomplish before. Yet the area of the zinc strip used as a counterplate in this cell was scarcely so much as two square inches!

It is, no doubt, to the insignificance of the clean-lead current and to the consequent practical suppression of local currents on the negatively-charged plate, that lead secondary cells owe their astonishing retentiveness. It also deserves attention that, from the proof of these experiments, a provision for fixation of hydrogen on the positive plate of lead cells must be made, equal in storage capacity to that which the binoxide furnishes for oxygen on the other plate. Both lead and platinum, it seems however, are equally capable of furnishing this lodgment for hydrogen without any special preparation by a previous conversion to the spongy state.

M. Antoine Breguet's Appropriations

ON looking through the recent *brochure* on the Gramme machine by M. Antoine Breguet, I observe that the author has appropriated, without acknowledgment, a large number of the beautifully executed Magnetic Figures which Prof. Silvanus Thompson has long since published, both in your columns (November 28, 1878) and elsewhere. So far as the eye can judge, M. Breguet's illustrations are printed from *clichés* of the very blocks used in Prof. Thompson's papers. If—as I understand was the case—M. Breguet's attention was called to the omission when he employed a similar illustration in a paper of his, which appeared some little time ago in the *Ann. de Chimie et de Physique*, the present oversight ought not to pass without some protest—the more emphatic as some of Prof. Thompson's figures are entirely new and of much theoretical and practical importance.

W. F. BARRETT

Royal College of Science, February 4

On the Clenching of the Hands from Emotional and other Causes in the Two Sexes

I SHOULD like to invite the attention of readers of this paper to the above subject when they have the opportunity of making personal observations, believing myself to have noticed a curious distinction. The number of my own cases, though sufficient to warrant me in broaching the topic, is not large enough to enable me to form definite conclusions. Whether the clenching of the hand be the result of mental emotion, of hysteria, or other nervous convulsion, of acute poisoning or of tetanus, women always seem to lay the thumb across the palm and fold the fingers over it, frequently wounding the skin of the ball of the thumb by the pressure of the index and middle finger-nails; while men invariably flex the fingers acutely first, now and then digging all four nails into the palm, and turn the thumb outside, across the back of the middle phalanges. About four years ago I witnessed a case of idiopathic tetanus in a black woman in Barbados; the disease had reached that advanced stage where the muscles of the extremities begin to be affected during the paroxysms, and it was interesting to observe, before actual clenching ensued, that the *thumb* first began to twitch inwardly, while the fingers were motionless. Possibly, this may be the unconscious result of habits acquired during life; I have had no opportunity of noting the phenomenon in children. Perhaps those who read this in the tropics, where there is usually plenty of tetanus, hydrophobia, and other convulsive maladies, will kindly communicate their experience.

ARTHUR STRADLING

Parhelia in the Mediterranean—The Weather in Switzerland

THE parhelia of January 27, which Mr. Ch. H. Allen in Mentone describes, has also been observed at several places in Switzerland: for instance, at Glaris and at Basle. The phenomenon has here been more completely developed; the sun appeared surrounded by two lightly-coloured halos of 46° and 92° in diameter. Owing to the sun's low altitude, little more than the semi-circumference of them was visible. Each of these halos had on its summit a tangent arc, turning its convexity towards the sun, the arc on the greater circle shining, as usual, in brilliant colours. On the inner halo, in the same altitude with the sun, two mock suns of a reddish tint were seen; a third appeared at the summit of the same circle at the junction with the tangent arc. All circles turned their red side to the sun. That part of the sky was covered with faint cirrus. The spectacle lasted from 2 to 4 p.m. In the evening of the 27th and also of the 29th the common halo of 46° diameter was seen round the moon. During the night of the 30th to the 31st some snow fell (melted 2·8 mm. in the rain-gauge), the first in this year.

On January 29, at 3.2 p.m., a brilliant meteor with a bluish trail was observed falling in a south-easterly direction; it vanished about 15° above the horizon. The same meteor was noticed at Scanfs in the Engadine, where a heavy detonation was heard.

The Basle section of the S.A.C. ascended Mount Pilate, near Lucerne, on January 28. The extreme transparency of the air afforded a view more splendid than is to be seen in summer. The minutest details of the Jura, and of the Black Forest and the hills of the Höhgan near the Lake of Constance, could be perceived; only the Vosges Mountains were a little dimmed. An ocean-like fog spread over the low parts of the country at a level of about 650 m. above sea. On the summit of Mount Pilate the thermometer marked −4° C. (25° F.) during the night, and +1° C. (34° F.) before sunrise. Over the surface of the Lake of Lucerne the air temperature was, at noon of the 29th, −2°·5 C. (27°·5 F.); above the fog an hour before, +4° C. (39° F.).

ALBERT RIGGENBACH

Basle, February 11

On the Climate of North Northumberland as Regards its Fitness for Astronomical Observations

I HAVE looked again at my observations (p. 317), and can assure Mr. Joseph Lingwood of their entire accuracy. For astronomical purposes the sky is "completely overcast" when not a star is visible. As the observations in question referred to the year 1881, I do not see what the "weather since taken" has to do with the question, unless it be contended that the weather in January, 1881, was precisely similar to the weather in January of the present year. As a general rule the observations would refer to a later hour than 6 p.m.

JEVON J. MUSCHAMP PERRY

S. Paul's Vicarage, Alnwick, February 13

Jago's "Inorganic Chemistry"

THE kind tone of the first part of the notice, in your issue of December 15 (vol. xxv. p. 150), of my work on Inorganic Chemistry leads me, with your permission, to reply to some questions asked by the reviewer in the latter portion of his remarks. He first inquires "Why should he (the student) begin his chemical career by learning that 'combining weight' is synonymous with 'atomic weight'?" To this I answer, Because in our best standard works on chemistry these terms are applied indifferently to the same series of numbers; and further that the combining weight, a number deduced from experiment, is according to the atomic theory the relative weight of the atom of that particular element. To the query "Why should he draw from the statement of Avogadro's law the *erroneous* conclusion that the molecules of all gases are of the same size?" I reply by pointing out that Frankland states that the bulk of any elementary molecule, in the gaseous condition, is the same as that of hydrogen; and that Roscoe, Miller, and Tilden affirm that all gaseous molecules occupy the same volume. The phrase "are of the same size" is simply intended to convey, the same meaning as the term "occupy the same volume." I have not deemed it necessary in such a work as that under review to point out that the volume occupied by a molecule consists in part of intermolecular space; neither do the works of the chemists quoted when explaining the same law.

My own experience of teaching chemistry has convinced me that a knowledge of the "atomicity" of the most important elements is a vast help to even young students, as thereby they learn to write formulæ and equations not merely from memory, but in accordance with certain definite rules. The value of graphic formulæ is considerable, and with sufficient space at my disposal I should be quite prepared to demonstrate that the formula referred to of nitrous oxide does afford a reasonable hypothesis of the molecular constitution of that compound. Although I hold these opinions I have however carefully pointed out (p. 106) that the so called laws of atomicity are not always obeyed, and have dealt at some length with the notable exception, nitric oxide NO.

I regret to thus trespass on your valuable space, but in justice to myself and the work thus reviewed I ask you to kindly insert this letter.

WILLIAM JAGO

School of Science and Art, Brighton

["Combining weight" is not synonymous with "atomic weight," *e.g.* 4·6 parts by weight of nitrogen combine with 1 part by weight of hydrogen, but the atom of nitrogen is 14 times heavier than the atom of hydrogen; 8 parts by weight of oxygen combine with 1 part by weight of hydrogen, but the atomic weight of oxygen is 16, that of hydrogen being 1. In some cases, *e.g.* chlorine, the combining and atomic weights are represented by the same number. I admit that the terms in question are applied to the same series of numbers, in many standard books on chemistry, but I maintain that they are applied erroneously.

I cannot admit that because "equal volumes of gases contain equal numbers of molecules" therefore "all gaseous molecules

occupy the same volume." From experiments on friction of gases, velocity of gaseous diffusion, &c., conclusions have been drawn as to the sizes of different molecules; Avogadro's law, however, says nothing as to the relative dimensions of molecules: the conclusion drawn by the author from Avogadro's law is therefore I think rightly called an "erroneous" conclusion, apart from any considerations as to the accuracy of the statement, "the molecules of all gases are of the same size."

A knowledge of the "atomicity" of the most important elements would, I admit, be of much importance. But when the evidence on which this or that value is assigned to the "atomicity" of these elements is examined, it is found in most cases to be very slight: a great structure has been raised on a shifting foundation. A student who has committed to memory the assertion that the "atomicity" of the nitrogen atom is five is probably ready to receive with gratitude the formula for nitrous oxide referred to; had he asked for the evidence on which the assertion as to the atomicity of nitrogen rests, and for an explanation of the assertion itself, he would I think hesitate before accepting the graphic formula in question as in any way affording "accurate and well-grounded information."—THE WRITER OF THE NOTICE.]

The Recent Weather

REFERRING to the leading article on "The Recent Weather" in a former number, perhaps the following proverb, prevailing I think in Norfolk, may possess some interest:—

"When Martinmas ice will bear a duck,
The winter will all be mire and muck."

Martinmas Day is on November 11. Bearing in mind that Martinmas, like Christmas, connotes a season rather than a particular day, and still more, that cold weather would usually come earlier in Scotland than in the eastern counties, the proverb seems to be entirely in unison with Sir Robert Christison's prognostic. CHARLES J. TAYLOR

Toppesfield Rectory, Halstead, Essex

FATHER LOBO'S "ABYSSINIA."—A correspondent asks if there is any trustworthy evidence that Lobo's "History of Abyssinia" was ever published in Portuguese, as stated in most biographies. The extracts translated by Sir Peter Wyche and published by the Royal Society in the end of the seventeenth century, were made from the manuscripts, as was also Legrand's translation in the beginning of the eighteenth, from which Dr. Johnson made his epitome. In Barbosa-Machado's "Bibliotheca Lusitana" there is no mention of a Portuguese edition.

ON THE WHALE FISHERY OF THE BASQUE PROVINCES OF SPAIN[1]

MY attention was drawn to the Basque Whale-Fishery by observing, during my study of Arctic literature, and especially while editing the voyages of William Baffin, that the first English whaling vessels were in the habit of shipping a boat's crew of Basques to harpoon the whales. I was informed that a whale, the *Balæna biscayensis*, had frequented the coasts of the Basques provinces from time immemorial; but that it had become nearly extinct in the seventeenth century, when the Basques began to extend their voyages further north, and across the Arctic Circle. Hence the Basques had become dexterous whale-fishers long before any other European people had entered upon that perilous occupation.

I found that several naturalists had investigated the history of the Biscayan whale, notably Eschricht and Reinhardt in Denmark, M. Fischer in France, and Prof. Flower in this country. Full information respecting these investigations is contained in Eschricht and Reinhardt's memoir, published by the Ray Society in 1866; and many interesting particulars have since been brought to light respecting the whale-fishery so far as it relates to the French Basques, and to the ports of Bayonne, Biarritz, Guétary, St. Jean de Luz, and Ciboure. But in looking through the books and papers on the subject, a list of which was kindly furnished to me by Prof. Flower last June, I did not find any particulars respecting the Spanish ports, where the Basque sailors are more numerous than in France, and inhabit a more extensive line of coast. I therefore thought it possible that, by visiting those ports and making inquiries respecting the literature of the provinces in which they are situated, and the local traditions, I might be able to collect some further information touching the whale-fishery of the Basques. It has now been suggested to me that such particulars as I have succeeded in bringing together, from their bearing on the history of the *Balæna biscayensis*, a nearly extinct animal, would be interesting to the Zoological Society. I therefore have pleasure in communicating the following notes on the subject.

The coast which I personally visited this summer extends from the French frontier to the Cabo de Peñas, including the Basque provinces of Guipuzcoa and Vizcaya, and the purely Spanish provinces of Santander and the Asturias. It is for the most part bold and rocky, with lofty cliffs of cretaceous limestone, having strata hove up at great angles. Occasionally there is a stretch of sand, generally at the mouths of rivers, and here and there a rocky little boat-harbour. Forests of oak and chestnut clothe the mountains, with occasionally open spaces of fern and heather and bushes of arbutus and myrtle. In some places the chestnut-groves come down almost to the water's edge. Along this coast there are many small fishing-towns. Fuenterrabia, on its picturesque hill, overlooks the French frontier. Following the coast to the westward the next port is Pasajés, and then comes the city of San Sebastian, which was the centre of the old whale-fishery. Zarauz is a town stretching along the shores of a sandy bay. Guetaria is built in a cleft of rocks which are sheltered behind the island of San Anton. Zumaya and Deva are are at the mouths of rivers; and Motrico is a picturesque little town built on steep slopes like Clovelly, overlooking a rocky bay. These are the ports of Guipuzcoa.

Ondarroa, at the mouth of its river, where small schooners are still built, is the first port of Vizcaya, coming from the east. Lequeitio is a large and more important place, sending out about a hundred fishing-boats. Next come Mundaca, at the mouth of the river of Guernica, Bermeo, another populous fishing-town with as many boats as Lequeitio, Plencia, and Portugalete and Santurce in the bay of Bilbao. These are the principal Vizcayan ports. The province of Santander has Castro-Urdiales, Laredo and Santoña on the shores of a large harbour, Santander itself, and San Vicente de la Barquera. In the Asturias are the ancient ports of Llanes, Rivadesella, Villaviciosa, the important town of Gijon, Candas, and Luanco. From the little village of Luanco to the end of the Cabo de las Peñas is a walk of eight miles, and this was the most western point I reached.

The Basque fishermen are a handsome race. They go away on their fishing-voyages for many days, and are brave honest, and industrious; while both men and women are always cheerful and light-hearted. They belong to a people who, for centuries, have repelled foreign invasion, have enjoyed free institutions, and made their own laws. The Basque fishermen are the descendants of the old whalers, and retain their traditions. They have, from time to time, produced naval worthies whose names are historical. Among them are Sebastian del Cano, a native of the little fishing-town of Guetaria, who was the first circumnavigator of the globe; Legaspi, the conqueror of the Philippine Islands; Machin de Munguia, the Spanish Grenville; and Churruca, whose gallantry at the battle of Trafalgar won for him the admiration of his English foes.

Such men were the product of the whale-fishery, which was for the Basques, as it has since been for the British, an admirable nursery for seamen.

My first inquiries had reference to the antiquity of the

[1] By Clements R. Markham, C.B., F.R.S. Read at the Zoological Society, December 13. Revised by the Author.

Basque whale-fishery. The following facts show that it was a well established trade in the twelfth century, so that it probably existed at least two centuries earlier. King Sancho (the Wise) of Navarre granted privileges to the city of San Sebastian in the year 1150 A.D. In this grant there is a list of articles of merchandise with the duties that must be paid for warehousing them: whale-bone has a prominent place in the list. "*Carga de boquinas-barbas de ballenas . . . . 2 dineros.*" The same privileges were extended by Alfonso VIII. of Castille to Fuenterrabia in 1203, and to Motrico and Guetaria in 1204. Ferdinand III., in a royal order dated at Burgos the 28th September, 1237, gave similar privileges to Zarauz; and this document contains further proof of the antiquity of the whale-fishery. For a claim is made that, in accordance with custom ("sicut forum est") the King should have a slice of each whale, along the backbone, from the head to the tail. The custom here referred to indicates the antiquity of the fishery. At Guetaria it was the custom to give the first fish of the season to the King, who usually returned half.

Another proof of the importance of the whale-fishery on the northern coast of Spain, and probably also of its antiquity, is the fact that no less than six of the towns have a whale for their coat of arms. This charge is in the arms of Fuenterrabia. Over the portal of the first house in a steep old street of Guetaria there is a shield of arms consisting of a whale amidst waves of the sea. At Motrico the town arms consist of a whale in the sea, harpooned, and a boat with men holding the line. The same device is carved on the wall of the Town Hall of Lequeitio. The arms of Bermeo and Castro-Urdiales also contain a whale. I was assured that *vigias* or look-out posts were established on the headlands, and high up the mountains overlooking the fishing-towns, whence notice was given directly a whale was seen spouting in the offing; and soon the boats were in pursuit. On the mountain of Talaya mendi ("Look-out mountain") above Zarauz, there are some ruined walls which, according to Madoz, are the remains of one of these watch-towers, whence warnings were sent down the moment a whale was in sight. In some of the towns there are records which throw light on the whale-fishery, but (chiefly during the French occupation) most of the ancient archives have been destroyed or are lost. Fortunately this is not universally the case. In the town of Lequeitio eight of the "*libros de fabrica*" or fabric rolls of the church, commencing from the year 1510, have been preserved, which contain much interesting information.

The most ancient document relating to whales in the Lequeitio archives is dated September 11th, 1381. It is there ordered and agreed by the *Cabildo* that the whale-bone taken shall be divided into three parts, two for repairing the boat-harbour, and the third for the fabric of the church. The same order is repeated in another document dated 1608. In the *Libros de fabrica de la iglesia de Lequeitio* there is a list of the whale killed, in various years, by the boats of Lequeitio, from 1517 to 1661.

1517. Two whales killed. 1525. Returns in money value. 1531. January and February, two large and one small whale killed. 1532. None killed. 1536. Two large whales and one small. 1538. Six whales killed. 1542. Two whales killed. 1543. One whale wounded by the Lequeitio people, but captured at Motrico. Divided between the two towns. 1543. Two whales killed, mother and young. The Mayor-domo working all day at the whalebone, and received 2 rials. 1546. February 24, a whale killed in front of St. Nicholas Island. The bone yielded 9½ ducados. 1550. Two whales killed. 1570. One whale killed. 1576. One whale killed. 1578. One whale killed. 1580. Three and a young one. 1608. One whale killed. 1609. Three whales killed. 1611. Two small whales killed, in concert with the men of Andarroa, which led to a law-suit. 1617. One whale killed. 1618. One whale killed. 1619. One whale killed. 1622 One whale killed with its young. 1649. Two whales killed. 1650. Two whales killed. 1657. Two whales killed and two young. 1661. One whale killed.

In the *Libro de Fabrica* including the years from 1731 to 1781 there is no mention of a whale, nor in the two succeeding books. The sailors went long voyages in search of them. But in 1712, fifty years after the last entry in the books, there were boats and apparatus for catching whales. In 1740 it was said that there were no sailors in Lequeitio, all having gone on long whaling voyages. In a record of a marriage at Lequeitio on July 15th, 1712, among the goods of the bride are mentioned a whale-boat with sails, lines, harpoons, and apparatus complete. Of the bridegroom it is said that "he was clothed decently, having four coats of London cloth, a good chest to keep his clothes in and another for travelling, a mattras, pillow, and blanket, and needful clothes for going to sea." So that between them they were well prepared for a whaling expedition.

These entries at Lequeitio indicate that, during the sixteenth century, the whales were abundant; for if this was the catch of only one village out of at least twenty along the coast, we may fairly multiply it by at least ten for the average yield of the fishery.

In the books of the *Cofradia de Mareantes* of Zarauz there are similar records, from which it appears that between the years 1637 and 1801 as many as fifty-five whales were killed by the Zarauz people, whose prowess was known throughout the Cantabrian coast. There is one noteworthy tradition at Zarauz, to the effect that two young sailors, without any help, chased, harpooned, and killed a large whale, and brought it safely to the beach. This deed is immortalised on imperishable stone. Over the portal of a house in Zarauz, No. 13 Calle de Azara, there is an inscription, now in the greater part rendered illegible by time, but with letters of the shape and style used in the sixteenth century. To the left of the inscription there is carved a harpooned whale, with the line fastened to a boat, in which are two men. Don Nicolas de Soraluce, the learned historian of Guipuzcoa, told me that an old resident in Zarauz, named Belaunzarán, had often spoken to him of the feat recorded on this stone slab; adding that he used to hear his grandmother explain that the carving represented the harpooning and killing of a whale by two young sailors in a single boat. This deed was considered worthy of being handed down to posterity, and the stone was therefore placed over the door of the house of these two brothers, or, as some say, a father and son.

There are some other records as to the disposition of the whalebone. By an order dated November 20th, 1474, the town of Guetaria gave half the value of each whale towards the repair of the church and of the boat-harbour. In San Sebastian, according to an ancient custom, the whalebone was given to the *Cofradia* (brotherhood) *of San Pedro.*

It is clear that the whales, close along the coast, became very scarce in the middle of the seventeenth century, when the entries at Lequeitio cease, and that the Basque sailors then began to seek the means of exercising their special craft by making long voyages, even to the Arctic regions. Such voyages were occasionally made at a still earlier period. It is stated by Madoz that a pilot of Zarauz, named Matias de Echeveste, was the first Spaniard who visited the banks of Newfoundland; and, according to a memoir written by his son, that he made twenty-eight voyages from 1545 to 1599, the year of his death. In the accounts of the first English whaling voyages to Spitzbergen, in the collection of Purchas, we read of Basque ships from San Sebastian frequenting those Arctic seas in search of whales, and of the overbearing way in which their captains were often treated by the English. Nevertheless, the English were glad to

obtain the help of the Basque sailors to do for them the most perilous and difficult part of the work, namely, the harpooning and killing of the whales.

I gather from Eschricht and Reinhardt's memoir, that this Biscayan whale was known to the French Basques as the *Sarde*, and was the same as the *Nordkaper* of the Dutch and North Germans, and the *Sletbag* of Iceland, a whalebone whale, but smaller and more active than the great Greenland whale. The *Konge-speil* (an ancient Norwegian record) has a passage to the effect that "those who travel on the sea fear it much, for its nature is to play much with vessels." Belonging to the temperate North Atlantic, it is described as much more active than the Greenland whale, much quicker and more violent in its movements, more difficult and dangerous to catch. It is smaller and has less blubber than the *Mysticetus*, the head shorter, and the whalebone much thicker, but scarcely more than half as long.

For centuries the Basques had attacked and captured this formidable Cetacean; and they, in fact, monopolised all the experience and skill which then existed in connection with the craft and mystery of whale-fishing. To the sailors of all other nations it was an unknown business, appearing all the more perilous from their absence of knowledge. So it was natural that the hardy and intrepid fishermen from the Cantabrian coast should be in requisition as harpooneers, as soon as the English and Dutch entered upon the Arctic whale-fishery, early in the seventeenth century. With their services, we also borrowed their words. Harpoon is derived from the Basque word *Arpoi*, the root being *ar*, "to take quickly." The Basque *Harpoinari* is a "harpooneer."

There is a letter still extant at Alcala de Henares, from James I. of England to the king of Spain, dated 1612, in which permission is asked to engage the services, on board English vessels engaged in the Arctic whaling-trade, of Basque sailors skilled in the use of the harpoon. The fact that Basque boats' crews were frequently shipped seems to show that this request was granted. In the whaling fleet fitted out for Spitzbergen in 1613, under the command of Benjamin Joseph, with Baffin on board the general's ship as pilot, twenty-four Basques were shipped. Orders were given that "they were to be used very kindly and friendly, being strangers and leaving their own country to do us service." The English seem to have adopted the fishing rules of the Basques, as well as to have benefited by their skill and prowess. Thus we read of an order being given because "the order of the Biscaines is that whoso doth strike the first harping-iron into him, it is his whale, if his iron hold." The Basques went out to attack the whales in the offing, while the English got ready for boiling-down. We read:—"News was brought to us this morning that the Basks had killed a whale; therefore we hasted to set up our furnaces and coppers, and presently began work; which we continued, without any want of whales, till our voyage was made"—thanks to the Basques. In another place Baffin calls the Basques "our whale strikers." Of course the English, in due time, learnt to strike the whales themselves; but the Basques were their instructors; and it is therefore to this noble race that we owe the foundation of our whaling trade.

In travelling along the coast, I found a universal tradition of the whale-fishery; and often the families of fishermen had the harpoons hanging in their houses, which had been there for generations. They still have occasion to use them when porpoises come within range; and on board one of the Gijon steamers there was a man with unerring aim. But many harpoons hang on the walls as relics of the old whaling days. At Laredo the fishermen brought me a harpoon of peculiar construction. The point was narrow and very slightly barbed, but there was a hinge half-way up the point, which was kept in line with the shaft by a ring. When the harpoon entered a whale, the ring slipped, the hinge turned, and the point came at right angles to the shaft, making it impossible for the harpoon to come out again. Baron Nordenskiöld informs me that this kind of harpoon is used by the Norwegians to kill the white whales.

At Llanes, in Asturias, I found a large palatial house which was formerly the "*Casa de Ballenas*," or house where business connected with the whale fishery was transacted. At Gijon there is also a "*Casa de Ballenas*," and also a street called Whale-lane. These names, with the coats of arms and traditions, are all relics of the old whaling days. At San Sebastian, too, there are enormous *tinajas*, or earthenware jars, in which the oil was stored.

It was at one time supposed that the *Balæna biscayensis* had become quite extinct; but this is certainly not the case. Whales are seen on the Cantabrian coast at intervals of about ten years. In 1844 a whale was seen off Zarauz. Boats went out and it was hit, but it broke the lines, and got away with two harpoons and three lances in its body, after having towed the boats for six hours. On the 25th of July, 1850, early in the morning, a whale appeared off Guetaria. Boats quickly pursued it, but the harpooneer missed his aim, and the whale went off, heading N.W. In January 1854 a whale and her two young entered the bay of San Sebastian. One of the young whales was singled out for attack, but the mother made desperate efforts to defend it, and once broke the line. Eventually the mother and one calf escaped, while the other was secured. Of course, with proper boats and apparatus, and if the fishermen had had a little of their ancestors' experience, all three would have been caught. It is the skeleton of this young whale that Professor Eschricht purchased at Pampluna. It is now at Copenhagen.

While I was at Gijon, in the Asturias, I was told by an old fisherman that a whale had been caught, about twenty years ago, by the villagers near the lighthouse on Punta de Peñas. The story was not believed by merchants and others of whom I made inquiries, so I thought it best to investigate the matter myself. I, therefore, went westward to the little fishing-village of Luanco, and next day proceeded on foot across a wild mountainous country to the lighthouse of Punta de Peñas; a distance of sixteen miles there and back. There, in the court-yard of the lighthouse, was a whale's jaw-bone, and the man in charge corroborated the story. But he added the curious statement that the whale was dead and half flensed, drifting in under the land, when the villagers first saw it, and went out in their boats to tow it on shore. I also found parts of the rib-bones in the granary of a farm-house at Viodo, a hamlet near the lighthouse.

The last whale of which I obtained intelligence was sighted between Guetaria and Zarauz on the 11th of February, 1878. Many boats went out from these two places, and one boat from Orio. The first harpoon that kept fast was thrown by a smart young sailor of Guetaria, the countryman of Sebastian del Cano, the first circumnavigator of the globe. He is now in the Spanish navy. Eventually the whale was killed and towed on shore. No one derived any benefit, because there was a law-suit tried at Azpeitia. It appears that the harpoon was of Guetaria, but that the line belonged to Zarauz. Meanwhile the whale became unpleasant and had to be blown up. The authorities of San Sebastian, however, through the intervention of Don Nicolas Soraluce, secured the bones, and the skeleton is now carefully set up in the small museum in that city. It is 48 feet long, and part of the whale-bone remains in the jaw. There are also bones of a whale found in the sands at Deva in the same museum. I was given part of a whale's rib dug up on the Lequeitio beach, and a jaw-bone which was long in the court-yard of the palace of the Count of Revillagigedo at Gijon, is now preserved in the Jovellanos Institute, in the same town. Of course there must be any number of

bones buried in the sand of the beaches where so many hundreds of whales have been flensed in former centuries.

In 1878 the accomplished historian of Guipuzcoa, Don Nicolas Soraluce, printed a pamphlet at Vitoria on "the origin and history of the whale and cod fisheries," which contains much interesting information. I may add that Señor Soraluce is preparing some additional chapters on the whale-fishery, and that he expects to obtain copies of interesting documents relating to the same subject from the archives of the Ministry of Marine at Madrid.

A SYSTEM OF METEOROLOGICAL OBSERVATIONS IN THE CHINA SEAS

IN a recent article in NATURE we referred to the proposal to establish an observatory at Hongkong under the superintendence of Major Palmer, R.E., and expressed a hope that Mr. Hart, of the Chinese Maritime Customs, would be successful in his efforts for the establishment of a number of meteorological stations along the coast of China. The China seas, on account of their numerous currents and destructive typhoons, are especially dangerous to shipping, and the value, in a material sense, of a thorough and accurate series of observations of this kind can hardly be overrated. Moved by these considerations, the Shanghai General Chamber of Commerce, the most numerous and influential foreign mercantile body in the Far East, has taken the matter in hand, and at a recent meeting, reported in the *Celestial Empire*, discussed "the feasibility of organising a system of meteorological reports from the China coast and the interior, with the view of improving the knowledge of the origin and direction of storms, and warning mariners of their approach." The Chamber wisely consulted the Reverend Father Dechevrens, director of the Jesuits' Observatory at Siccawei, not far from Shanghai, who recommended that the object of the system should be twofold:—(1) To give shipmasters a sufficient knowledge of the meteorology of Chinese and Japanese waters to enable them at all times, and especially at critical moments, to recognise the best routes to follow in order to reach their destinations as speedily as possible, and emerge with credit from storms which they have been unable to avoid; and (2) to give vessels about to leave the port notice of the winds and weather they will probably meet during the subsequent twenty-four hours. The Siccawei Observatory will be able to accomplish both these ends, provided it receives the co-operation of the various shipmasters resorting to the coast of China. It is recommended that every vessel should be provided with a register in which at stated intervals during the day the conditions of the barometer and thermometer, the direction and force of the wind, and the quantity of rain are accurately recorded. In addition to these the various lighthouse keepers and officers at Custom stations along the coast should keep a similar register. The director of the observatory will have in these numerous observations a basis on which to work, and his investigations and the result will be made public as widely as possible.

Father Dechevrens then proceeds to describe what is already known of the meteorology of the China seas. Two kinds of storms prevail there, those from the north, which may be called the storms of winter, or the northern monsoon, and the typhoons, which are, properly speaking, storms of summer, or the southern monsoon. The first come from the interior of Asia and travel towards the North Pacific from west to east, while the second generally remain confined to the neighbourhood of the Philippines, Formosa, and the Gulf of Tonquin. In order to study these storms more effectually, the observatory should receive, twice daily, meteorological observations from Manila, Hongkong, Amoy, Tientsin, Nagasaki, and Vladivostock. By these means warnings can be rapidly conveyed to and from Shanghai of storms coming either from the north or south. The observatory at Siccawei, moreover, should be connected by telephone with the foreign concession in Shanghai, and Father Dechevrens offers the services of one of his observers for the Shanghai end of the line. The Director concludes his Report with the observation that the work will not be one of a day, for everything is yet to be done. "The meteorology of these countries must be commenced at its foundation."

The recommendations contained in this Report were all adopted by the Chamber of Commerce, the members taking on themselves all the financial and business management of the undertaking. The owners of vessels and the Chinese Customs were called upon to supply the instruments necessary for observing, which were those recommended by the Meteorological Office in London, and already in use in some British mail steamers. The agent of the Great Northern Telegraph Company has promised to transmit the daily reports free of charge, and it is anticipated that the Chinese authorities and the local underwriters will contribute the funds necessary for carrying out the project.

Taken in conjunction with the establishment of a complete observatory in Hongkong, for which, as we have already mentioned, the Colonial Government has liberally provided, the scheme above described is one of much scientific and practical importance. Although several observatories are already in existence at various parts of the China seas, no combined attempt has been made to study systematically the meteorology of these regions. The project which has now been adopted by the Shanghai Chamber of Commerce helps to bring to a focus a number of observations which, taken singly, are of small value, but when collected and examined by competent scientific men, cannot fail to produce beneficial results

THE AURORA [1]

II.

AS we have said, it was not uncommon at the *Vega's* winter quarters to see two or more auroral-arcs, one of which was generally the "common arc." The second was nearly parallel to it and separated from it by an unlighted space which was sometimes crossed by rays of light. It would be most important for a thorough knowledge of auroræ to know the true mutual position of the arcs; but here again simultaneous measurements at two distant places are necessary, and not having such, Nordenskjöld remarks that three suppositions may be made. First, that the two arcs have irregular positions with regard to one another; secondly, that they are superposed on one another, having their centres on the same axis perpendicular to the surface of the earth; and third, that their centres are on the same radius of the earth, and that they are situated in about the same plane. In all three cases the aspects of the arcs would be quite different. The observations at the *Vega's* wintering place prove that the last case is the rule, and that arcs irregularly situated with report to one another, or crossing one another (which would correspond to the first and second supposition), are exceptions; and Nordenskjöld arrives at the conclusion that the auroræ-arcs which were seen from the *Vega*, were usually in about the same plane. It might be asked, however, if it were not more natural to suppose that both rings are at the same distance from the earth's surface, their centres being situated on the same radius of the earth? But on March 14 two parallel arcs appeared, and soon joined together into a broad belt, the interior edge of which was 5°, and the exterior one was 15° above the horizon, both edges being quite concentric,

[1] A. E. Nordenskjöld, "Om norrskenen under *Vegas* öfvervintring vid Berings Sund, 1878-79," in "*Vega* Expeditionen Vetenskapliga Arbeten." (The Scientific Work of the *Vega* Expedition, part 1, pp. 401-452.) Continued from p. 321.

and the belt showing a tendency to divide into parallel bands, whilst its brilliancy remained the same towards the lower and upper edges; Nordenskjöld considers therefore as most probable that all the luminous sheet afforded by these arcs was in the same plane.

The rays which sometimes, but rarely, appeared during the arc-aurora also confirms the supposition. They were usually cast from the interior arc towards the exterior and reached its edge, but never went beyond it. On the contrary, when the aurora was intense, new rays were cast

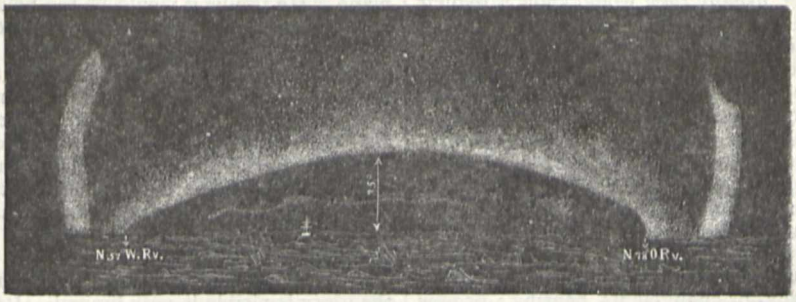

FIG. 3.—Aurora at the *Vega's* winter-quarters, March 3, 1879, at 9 p.m.

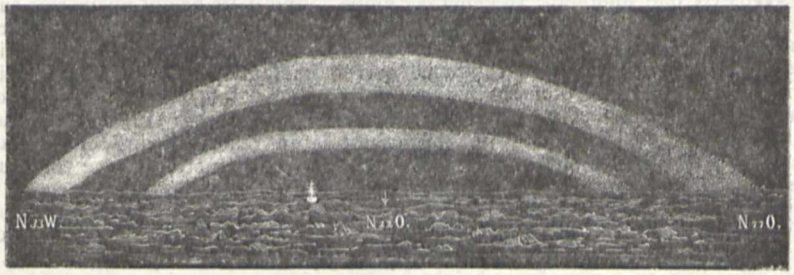

FIG. 4.—Double aurora-arcs seen on March 20, 1879, at 9.30 p.m.

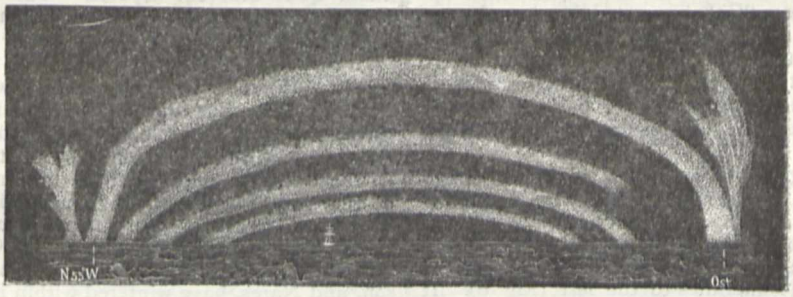

FIG. 5.—Elliptic aurora seen on March 21, 1879, at 2 15 a.m.

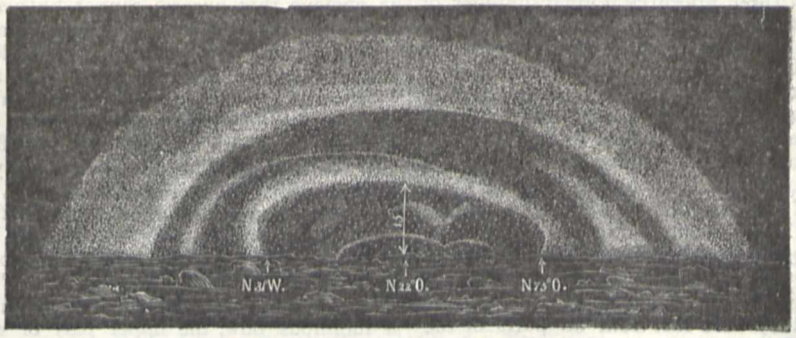

FIG. 6.—The same, at 3 a.m.

from the exterior arc, as well towards the interior one, as in the upper space. These phenomena render it most probable that these rays (which must not be confounded with those which form the draperies during strong auroræ) are in the same plane which passes through both luminous circles. If these two circles were situated in the same upper strata of our atmosphere, it would be reasonable to suppose that the rays which flow from one to

another are also in the same strata. In this case they could not be rectilinear, but must flow upon curves drawn by a radius equal to the distance from the crowns to the centre of earth; therefore, when seen from the *Vega's* winter quarters, the rays which were cast 50° or 60° from the edge of the luminous arc, would appear only exceptionally as straight lines; usually they would show a regular curvature of several degrees. But neither at Kolutchin Bay nor at other places did Nordenskjöld remark such a curvature, and he concludes that the common aurora-glory must be produced in a plane perpendicular to the earth's radius, which passes through the aurora-pole. But it is possible also that the long exterior rays may have quite another direction than those which connect together aurora-rings; and whilst these last are cast in the plane of the aurora-glory, the former may be launched in the direction of the inclination-needle.

A drapery-aurora was seen but once at the *Vega's* winter-quarters. But sometimes the common arc rose more above the horizon, or changed its bearing; or new arcs, quite different from the common one, appeared. Sometimes, as, for instance, during the night of March 3 to 4 (Fig. 3), the bows crossed one another. In general the feeble auroræ were quite regular, whilst the more intense afforded more or less irregularity. But even these latter usually began with the appearance of the common faint arc; this soon increased, divided into pieces by the appearance of brilliant knots—not divided, however, into rays—and flame-like knots maintained for a long time the same position, sometimes in the neighbourhood of the arc, but mostly in the north-eastern part of the sky, sometimes also in the zenith. From these knots were thrown flames of equally diffused light (not divided into rays), often, as it seemed, perpendicular to the plane of the glory, and in such case spreading to a very great height above the surface of the earth. The aurora of March 3 to 4 was remarkable for the number of arcs which appeared; towards 9.30 p.m. they crossed one another at their north-western extremities, but disappeared after eleven o'clock, so that at midnight only the common arc was seen. But about one o'clock another series of arcs appeared towards the west, the outer being tangential to the common arc near the horizon, much like to a double solar halo.

Another interesting aurora was seen on March 20 to 21 (Figs. 4, 5, and 6). It was remarkable by the extension and great size of the arcs, by their elliptic shape, and by the circumstance that the short axes of the ellipses were not vertical above the horizon, but inclined, sometimes to the right (Fig. 5) and sometimes to the left (Fig. 6). It seems as if the plane of the glory was slowly oscillating for some 4° or 5° on both sides of its usual position.

On March 30 to 31 there appeared a great number of arcs, which were seen all at the same time. Of six arcs, only two were in the north-eastern part of the sky, whilst the summit of the third was nearly at the zenith, at a height of 80° and three others were beyond the zenith, their summits being respectively 105°, 125°, and 135° distant from the north-eastern horizon.

It is most important to determine where, and under what aspect, the aurora-glory is visible in different parts of our globe, and Nordenskjöld gives special attention to this subject. The second (outer) ring and its rays can be seen over a very great surface of the northern hemisphere. If the rays which were seen from the *Vega* as flowing from this ring to the zenith were cast in the plane of the glory, and if they were cast from all parts of the ring, they must have been seen over a circle drawn from the aurora-pole by a radius measuring 5000 kilometres on the surface of the earth. This circle would include North America as far as California, England, France, and the northern parts of the Iberian Peninsula, Austria-Hungary, Crimea, Siberia, and Northern Sakhalin. But the rays often passed beyond the zenith of the *Vega*, and thus the region of their visibility must be still further increased, including Mexico, Spain, Morocco, Greece, Asia Minor, a part of Turkestan, and Mantchuria; that is, even such tracts where auroræ very rarely occur. But Nordenskjöld does not maintain that all auroræ observed in Europe were due to rays cast from the glory in its plane. He thinks it would be too bold an assertion, as it would mean that thousands of observers were in error as to the idea they got of the direction of rays. But it is probable that a certain part of radiant auroras observed in Europe are due to rays cast in the plane of the glory, and not to rays cast in the direction of the inclination-needle. As to the drapery-aurora which was seen once during the *Vega's* wintering, it seemed to have had its seat nearer to the surface of the earth. Such auroræ are obviously in the same relations to the common arc as the irregular winds and storms of the north are to the regular trade-winds of the south.

On the contrary, the space where the common ring of the glory is visible is very limited. Its projection on the earth's surfacce would be a circle drawn from the aurora pole by a radius of 18°, measured on the surface of our globe. And if its height above this surface is 0·03 radius of the earth, it must be seen above the horizon in a belt 14° wide on both sides of this projection. But to be observed its faint arc must have a height of at least 4° above the horizon, and so the belt of visibility of the common glory-ring is still less. Besides, if the aurora-glory is in reality a ring of light of small thickness situated 200 kilometres above the surface of our globe, it will not be visible in those parts of the earth where it appears in the zenith; there it would appear as a too faint diffused girdle of light about 60° wide, and most probably would not be perceived.

Therefore we must have five different regions situated around the aurora pole, where the glory would appear under quite different aspects. These five regions are represented on the map, Fig. 7, which is a reduction of Nordenskjöld's map.

In the first circular region around the aurora-pole (I. on our map), inscribed in a circle drawn from the aurora pole with a radius measuring 8° on the surface of the earth, the glory is visible only as a luminous mist, or as a very low bow, in a direction opposite to the aurora-pole. As the projection of rays within the common arc seems to be very rare, the aurora phenomena is very rarely to be seen in this region. Very many Arctic explorers have visited this region: Parry, Ross, McClintock, Kennedy, Osborn, Saunders, Belcher, Hayes, Kane, Hall, Stephenson, and Nares, have wintered within it; but among their careful and varied observations auroræ occupy quite an insignificant place—a circumstance very remarkable, as it is obvious that auroræ cannot be overlooked by Arctic travellers, being the only variety during the long Arctic nights. Parry saw auroræ as a feeble diffused light in the south-west; Hayes saw but three auroræ; and Capt. Nares says: "Light flashes of aurora wera occasionally seen on various bearings, but most commonly passing through the zenith. None were of sufficient brilliancy to call for notice. The phenomena may be said to have been insignificant in the extreme, and, as far as we could discover, were totally unconnected with any magnetic or electric disturbance."

The second region (II.) is inclosed between two circles drawn from the aurora pole by radii 8° and 16° long. The common ring of aurora must be seen in this region as a luminous bow, the upper part of which is situated in a bearing opposite to that of the aurora-pole, that is, about the magnetic south. Ross, Parry, McClure, Mac Clintock, Koldewey, and Nordenskjöld (1872-73) have wintered in this region. Ross, on September 23, 28, and 29, 1818, saw vertical rays in the southern part of the horizon, and Parry, on September 15, 1825, saw a bow 5° or 6° high, which lasted, nearly unchanged, for two or

three hours in the south-east. The observations of the Swedish expedition at Mussel Bay (Spitzbergen) were but very incompletely published, but they were also in accordance with the present views of Nordenskjöld. The interior circle of the bow which was seen from the *Vega*, and which was but 5° above the horizon, must be seen from Mussel Bay, close by the zenith, and therefore nearly invisible; while the exterior part of the common arc appeared as a bow of regularly spread light in the magnetic south. Rays of light were spread from it towards the interior circle, and gave rise to the beautiful draperies which so often were seen at Mussel Bay. When the aurora became still stronger, rays of light were sent out even in the interior circle, from the zenith towards the magnetic north, and then a crown appeared, whose rays seemed to meet together at the place where the inclination needle was directed.

The third region (III of the map) is situated between two circles drawn from the aurora-pole by radii 16° and 20° long. In this region the common arc must be in the zenith, and, as has already been pointed out, it must be less often seen as a bow than as a diffuse light spread upon the sky; but this light is so small in comparison with the ray-auroræ which begin in this region, that it must draw but little attention. The second interior circle of the glory must appear in this region as a bow in the magnetic south, and the common, or the interior one, as a luminous arc in the magnetic north, and both arcs must cast rays to one another through the zenith, from north to south, or *vice versâ*. The region comprises the northern parts of British America, the middle parts of Davis Strait, a part of Southern Greenland, Southern Spitzbergen, and Franz Joseph Land; Maguire, Tobiessen, and Payer wintered in this region. As is known, Weyprecht has given a very good *résumé* of the meteorological observations of the expedition, which correspond to a maximum year of auroræ. There were, during 1872-74, fifty-eight arc-auroræ, thirteen of which had the summits of their arcs

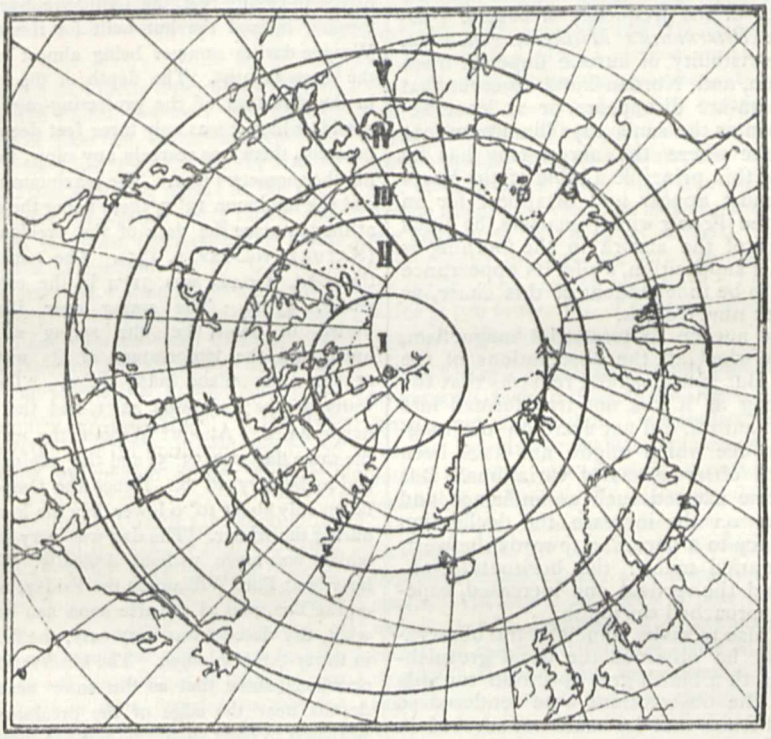

FIG. 7.—Map showing the visibility of the common aurora-glory in the northern hemisphere (reduced from Nordenskjöld's map).

in the magnetic north, and twenty-eight in the south, whilst the arcs of seventeen other auroras passed through the zenith, or communicated by rays through the zenith from north to south, or *vice versâ*. Besides, the aurora often began with a diffused light which Weyprecht has described as *Nordlichtdunst* (aurora-mist), and which spread over great parts of the sky. Weyprecht draws special attention to the arc-auroræ, and says: "Separate rays are not seen in them. The arc has but a moderate brilliancy, which is equally distributed throughout its surface. Intense auroræ never appear in the shape of arcs. The arc characterises the regular and quiet form of the phenomenon."[1]

The fourth region (IV. of Fig. 7) is a belt drawn by two radii 20° and 28° long. It passes through Northern Siberia, British America, the southern extremity of Greenland, Iceland, Northern Scandinavia, and Novaya Zemlya. In this region the auroræ usually begin with a luminous bow in the magnetic north, out of which spread radiant beams of more or less intense light, either into free space or to another ring parallel to the former, but lying higher above the earth's surface. The observations of Wrangel and Anjou, and those of the *Vega* were made in this region, as well as those made in Iceland, Southern Greenland, and in the middle parts of British America; but Nordenskjöld did not have these last at his disposal. Wrangel has given much attention to auroræ and, so far as can be judged from the incomplete information published in his "Travels" and in Parrot's account of Wrangel's physical observations, they confirm the existence of a permanent luminous ring around a certain point of the earth's surface, in the neighbourhood of the magnetic pole. During his travels on the shore east of the Lena mouth, Wrangel mostly saw bow-shaped auroræ, the summit of which was in the direction N. 12°–22° E. (true).

The fifth region (V. of our map) is inclosed between the

[1] "Die Nordlicht Beobachtungen der Österr. Ung. Arct. Exped.," in the "Denkschriften der Math.-Wiss. Classe der k. Acad. der Wiss., Wien," Bd. xxxv., 1878.

foregoing and a circle drawn around the aurora-pole by a radius 28° long. The interior circles of the glory are not seen in this region, but we see sometimes their rays and the exterior rings, less common and less regular. The quiet aurora is rare in this region, but the aurora-storms and the beautiful drapery-auroræ are most usual.

It is obvious that the frequency of auroræ must be different in the different regions represented on the map (Fig. 7). They must be most frequent in region IV., as in this we may see both the common glory and the drapery-auroræ, which arise at a greater distance from the aurora-pole, and probably nearer to the surface of the earth. Towards the north this region is bordered by a belt where auroræ must be less frequent, and which, in its turn, includes another belt of a maximum frequency of auroræ, where the arc-aurora must be most common; but the drapery-auroræ are below the horizon. In the circular region around the aurora-pole itself, even the common arc is below the horizon, and therefore auroræ must be rare. Therefore Nordenskjöld observes that his map is much like that of the frequency of auroræ published by Prof. Fritz (*Petermann's Mittheilungen*, 1874, p. 374). Besides, the visibility of auroræ depends upon the position of the sun, and Nordenskjöld observes that it seems that the aurora-arc disappears, or at least becomes invisible, as soon as the sun's rays illuminate that part of our atmosphere where the aurora-ring has its seat. Calculating on this principle a table of the hours when the aurora-arc must appear and disappear for an observer stationed at the *Vega's* winter-quarters, he finds that the disappearance of the aurora in the morning is in accordance with this supposition, whilst its appearance in the evening seems to be independent of this cause, as it used to appear about nine o'clock.

As to the relation of auroræ to terrestrial magnetism, this will be better seen when all the observations of the *Vega* are published. But Nordenskjöld remarks that the "common arc," so long as it was not transformed into more intense forms of aurora, did not exert on the magnetic needle any influence which might not have been included in the usual observations of variations. But the more intense auroræ exerted such an influence, and when the aurora was on the increase, the declination showed a small tendency to a deviation towards the west, whilst the intensity varied much: the horizontal component diminished, and the vertical one increased, especially as the auroræ approached the zenith.

Nordenskjöld tried also to make some spectral observations on auroræ, and he observed the usual greenish-yellow line, together with a bluish-grey spectrum towards the violet end. But the observations were rendered so difficult by the fearful frosts that he could not succeed in making more detailed measurements.

He concludes his most interesting memoir on auroræ with the following words:—"When writing this contribution to our knowledge of the position of auroræ in space, I had at my disposal but few former works on this subject. I must especially regret that our very rich library of travel did not contain the works of Mairans, Bravais, Fritz, Loomis, &c. After returning home I discovered that a method of determining the height of auroræ similar to mine was proposed by Fr. Chr. Mayer (Comment. Acad. Scient. Petropolitanæ, part 1, p. 351, St. Petersburg, 1728), and applied, among others, by Torbern Bergman (*Kgl. Vet. Akad. Handlingar*, xxv., Stockholm, 1764, pp. 193 and 249; xxvii. 1766, p. 224). But Bergman arrived at uncorrect figures, as he supposed that the centre of the aurora ring is situated on the radius of the earth which passes through the pole. Besides, he had no observations upon the *common arc*, and had only measurements of the larger, less regular arcs which are seen from more southern regions. Knowing how little time remains for personal investigation to one who returns from a long exploration in unknown tracts, I have preferred to publish at least a general account of the most important features of the observations I made at the *Vega's* winter-quarters than to postpone the publication for an indefinite time. The want of a larger perusal of former literature upon the subject will probably be excused to some extent by the circumstance that, when writing this, I had the opportunity of continuously comparing the sketch I have tried to draw with the natural phenomena themselves." P. K.

NOTES

THE second ascent of Ben Nevis for the winter was made on Saturday last by Mr. Livingstone, Fort William, to read the thermometer at the station of the Scottish Meteorological Society on the top of the mountain. The depth of snow was found to be much greater at the top than on the occasion of the previous visit. On the edge of the precipices the snow lay to a depth of fifteen to twenty feet, the Ordnance Survey Cairn barely overtopping it, and the hut built for the accommodation of Mr. Wragge during summer being almost completely buried under the snow-wreaths. The depth of the snow rapidly diminished in the direction of the protecting-cage for the thermometers, outside which it was only three feet deep. Inside the cage, fortunately, there was scarcely any snow, thus leaving the registering thermometers free. The maximum thermometer read 32°·1, and the minimum 13°·2, these being the extremes of temperature at the top since the date of the previous visit on December 3 (NATURE, vol. xxv. p. 135). The temperature at the time of the visit, 1 p.m., was 31°·4 in the cage, and by *thermomètre froide*, 33°·1. The spring near the summit was deeply buried in snow, but the spring at 2500 feet high was open, and the temperature of its water was 37°·3, the air at the same place being 41°·0. The temperature of the water of the Lake was 42°·1, and that of the air at the same height 44°·8. At Fort William the maximum temperature for the same day was 53°·5, and the minimum in December 23°·5, and in January 26°·8. Hence the temperature at the top had fallen only about 10°·0 lower than the lowest at the level of the sea during the winter. The day was very favourable for the ascent, which was made without difficulty. Though it had rained heavily at Fort William on the Friday, no fresh snow had fallen on the Ben, and as the afternoon sun softened the snow somewhat, the descent was very easy, the first 2000 feet being done in thirty-three minutes. The observations made on these two occasions show that as the snow accumulates to such great depths near the edge of the precipice, the observatory it is proposed to erect should be built at some distance from it.

THE death is announced, on February 8, of Prof. Joseph Decaisne, the eminent naturalist, at the age of seventy-five years.

WE regret to announce the death of Adam von Burg, vice-president of the Vienna Academy; he died on February 1, aged eighty-five. He was well-known by his mathematical and mechanical papers, especially by his "Compendium der höheren Mathematik" and "Compendium populæren Mechanik und Maschinenlehre."

LET us remind our readers that in connection with Captain Abney's lectures there is an interesting Exhibition of Photographic Apparatus and Appliances at the Society of Arts, of which a Catalogue has been issued. The exhibition will be open till February 25 from 10 to 4, and on Wednesday evenings from 6 to 10. Any one interested in photography may obtain admission by applying to the Secretary of the Society of Arts. To-night there will be a demonstration of photography with artificial lights likely to be of great interest.

COLONEL BROWNE and Mr. Simmons have decided to attempt a balloon journey across the Channel from Canterbury, on March 2, or as soon after that date as the wind permits.

THE Mineralogical Museum of the Florence Institute for Superior Studies has become possessed of two remarkably fine specimens of tourmaline and beryl from the granite vein of San Piero, in Campo in Elba. These are represented by chromo-lithograph plates in the *Rivista Scientifico-Industriale* (January 15). The one granitic piece, 30 cm. long, and 18 cm. broad, has 50 tourmalines (mostly of bottle-green colour) implanted in it, all of large size (some 62 mm. long and 12 mm. thick); there are also two beryls and a small crystal of zircon. The other specimen is larger, measuring 40 cm. by 20 cm.; it has 132 tourmalines, 9 beryls, and 3 zircon groups, besides a large quantity of orthoclase, quartz, and albite crystals.

A NEW feature of the journal just named is the addition of summaries, in French, German, and English, of the papers in that portion of the review called the "Giornale del Naturalista." The English, we may remark, is of a somewhat entertaining nature.

AN ascent was made from the La Villette Gasworks, Paris, on Thursday, February 9, with the *Vulcan* balloon. The balloon having ascended to an altitude of 3000 feet, the thermometer, exposed in the sun, showed a temperature of 20° C., and the reading was published in the *Ville de Paris* and other papers of the 10th. It has elicited some astonishment, the weather being rather cold and cloudy. But on the 11th the grass thermometer of Montsouris Observatory exhibited a temperature of 17° C., and a total change of weather was observed. Rain fell in the night of the 11th-12th for the first time after a space of thirty-five continuous days of uninterrupted and unprecedented dryness. The navigation of the Seine had become difficult owing to the low level of the water. During this extraordinary period the electrometer of Montsouris gave without any interruption low readings, and with the exception of a very few instances it had been always positive, although the weather had been foggy for twenty-two days.

AT the annual general meeting of the Teachers' Training and Registration Society, and of the Bishopsgate Training College the other day, Prof. Goldwin Smith took laudable advantage of the opportunity to impress on those present what science teaching really means. "In respect of the teaching of science," he said, "he had constantly brought before him the wide gulf fixed between the two different kinds of what persons call knowledge. The one was a mere learning to repeat a verbal proposition, and the other was knowing the subject at first hand—a knowledge based upon a knowledge of the facts. That which they had constantly to contend against in the teaching of science in this country was that teachers had no conception of that distinction, for they thought it quite sufficient to be able to repeat a number of scientific propositions and to get their pupils to repeat them as accurately as they themselves did. If he might offer one suggestion to the governing body of the college, it was that so far as they taught science at all they should aim at giving real and practical scientific instruction; that it should be confined to those things about which there was no dispute; and that the teacher should be instructed that his business in teaching was to convey clear and vivid impressions of the body of facts upon which the conclusions drawn from those facts were based."

UNDER the auspices of the Dundee Naturalists' Society, a Gilchrist Course of Science Lectures for the People, is now being delivered in Dundee, Perth, Brechin, Montrose, and Kirkcaldy; and in several instances the audiences have only been limited by the size of the lecture-halls. At Dundee and Perth, Mr. Wm. Lant Carpenter's lectures on the Transmission of Power by Electricity were practically illustrated (1) by the Northern Electric Light and Power Company, and (2) by Messrs. Pullar, of the Perth Dye-works, who employ ten dynamos for electric lighting.

ATTENTION has recently been drawn to the commercial value of the Quillaia Tree (*Quillaya saponaria*), a native of Chile, the bark of which has been known for a considerable time both in this country and on the Continent, for the saponaceous principle which it contains. In consequence of the trees having been cut down to obtain the bark there is much reason to fear that the supply may fail, particularly if the demand increases. Quillaia bark, it seems, is very extensively used by wool and silk manufacturers both in this country and in France, in consequence of its efficacy as a powerful cleansing agent. Our contemporary, the *Colonies and India*, in drawing attention to this tree, remarks "that a decoction prepared by placing a small piece of this bark and soaking it overnight in water will remove in a minute or two grease from articles of clothing and leave the cloth clean and fresh as if it was new. It may also be used for cleansing hair-brushes and other similar purposes, under conditions in which soap and other alkalies are powerless. It is also suitable for a hair-wash, and is said to be largely used by French hairdressers, though the mode of preparation is kept secret. Such a tree ought to be invaluable in Australia, New Zealand, Cape Colony, and other colonies where wool growing is a staple industry." Among the uses to which this bark is put may be mentioned tha of a preparation for giving an artificial froth or head to ales, a very small quantity put into beer that has become dead causing it to be covered with froth. The bark occurs in commerce in two forms, that of irregular pieces as taken from the tree, and in the form of powder.

THE Clarendon Press will publish very shortly a "Treatise on Rivers and Canals, relating to the Control and Improvement of Rivers, and the Design, Construction, and Development of Canals," by Mr. L. F. Vernon-Harcourt, M.A., C.E. The author describes the physical characteristics of rivers; the methods and formulæ for measuring their discharge; and the various works, structures, &c., for improving rivers and for forming canals. It contains an account of some of the most important inland canals, and descriptions of celebrated ship-canals. The causes and means of prevention of floods in river-valleys are fully discussed. The past and present conditions of several of the most important rivers at home and abroad are described, together with the successive works of improvement carried out on them, and the results achieved. Each of the various subjects treated of is concluded by a consideration of the value of the different works or methods referred to, and the principles upon which they are based. The book is copiously illustrated with woodcuts and twenty-one large lithographed plates showing most of the works, &c., described.

UNDER the title of "Land and Freshwater Mollusca of India," Col. Godwin-Austen proposes to publish lithographed plates of species of land and freshwater mollusca inhabiting India, Burmah, and adjacent islands in the Indian Ocean. The plates are intended to be of the same size (quarto) as the "Conchologia Indica" of Messrs. Theobald and Hanley, and thus will form a supplement to it. It will include species not published in that work and the numerous species that have since been discovered. Many of the minute forms that have not been sufficiently enlarged in the above work, and which are of little use for identification (for example, those in the genera *Alycæus*, *Diplommatina*, &c.), will be reproduced. Whenever it is possible, drawings of the animals will be given, together with the anatomy of such parts as the odontophore, generative organs, &c., which it is hoped will lead eventually to a better classifica-

tion of the land shells of the region. Each plate will be accompanied by an explanatory page of letterpress. With each issue of the plates, full description of the genera and species, with synonomy and their distribution, will be given in separate pamphlets, 8vo, similar in type to the *Proceedings* of the Zoological Society of London. Col. Godwin-Austen hopes to secure the co-operation of Messrs. H. F. and W. T. Blanford, Sylvanus Hanley, William Theobald, Geoffrey Nevill, Dr. J. Anderson, and others interested in East-Indian conchology. The work cannot be brought out at regular intervals; but whenever a few plates are ready a part will be issued, and it is hoped that at least two parts may be completed during the year. Intending subscribers should communicate with Col. Godwin-Austen, Deepdale, Reigate, Surrey.

In the January number of the *Archives des Sciences* Professors Dufour and Amstein describe a simple registering barometer, now in use in the Meteorological Observatory of Lausanne. It depends on displacement of the centre of gravity of a glass tube containing mercury. The form of the tube may be described as that of an L leading down to a U by a vertical portion. The lower end is open. The tube swings in the plane of its angles on a horizontal axis placed above the centre of gravity; with increased barometric pressure it inclines to the right, with decreased pressure to the left; and these movements are recorded by means of a style attached to the U part and applied to a moving strip of paper. By a simple contrivance the pendulum of a clock is made to impart a slight shock every second swing to the tube, so as to destroy any adherence of mercury. The instrument is easily made, and proves very sensitive and reliable.

Müller's imitation of the phenomena of geysers, by means of a vertical tube filled with water and heated in the bottom and about the middle, is open to the objections that we may not assume two places of heating in the actual geyser, and that the eruption of water is only producible once. Herr G. Wiedemann has, therefore, contrived what seems a more suitable apparatus (*Wied. Ann.*, No. 1). It consists of a flask attached to a stand, and having a caoutchouc stopper which supports two glass tubes; one tube 1 cm. wide (beginning flush with the under-surface of the stopper) reaches upwards about 70 cm., projecting through a small basin, and ending with an aperture of diminished section. The other tube (about 3 mm. to 4 mm. wide) passes obliquely upwards, and enters the side of a jar which is about on a level with the top of the vertical tube; at the other end it passes through the stopper, and is bent a little upwards near the bottom of the flask. The cistern is filled with water, and, a Bunsen burner being brought under the flask, the varied action of geysers is very well imitated

Mr. Ernest Satow, Secretary to our Legation in Tokio, and Lieut. Hawes, have recently produced a work of very great general value on Japan. Although it is entitled "Handbook for Travellers in Central and Northern Japan," and is written after the model of Murray's celebrated Guide Books, it will be found useful to persons who never intend visiting that country. It will be found indispensable to compilers of encyclopædias, gazetteers, and other works of reference. Besides the dry details of routes for travellers, it gives the history of the principal towns and statistical information respecting each. The large mixture of history and legend makes the book tolerably amusing reading even for those unacquainted with Japan. The difficulty of writing a work of this kind for a Japanese scholar cannot be great, as Japanese literature has from time immemorial possessed voluminous guide-books and topographical works. Every Japanese province and district has its own guide, generally containing statistical, geographical, historical, and legendary information. These are illustrated with rude woodcuts representing the principal scenes, temples, idols, &c. The great guide to old Yedo, called the "Yedo Meisho," is an exhaustive work in about fifty volumes. In addition, every road has its little map giving the distances between the various places, the principal inns, the places of interest near the route, and other information of use or interest to travellers. These are either given *gratis* at the inns, or are purchased for about a halfpenny. A tolerably extensive collection of Japanese guide-books is to be found in the British Museum. Although Messrs. Satow and Hawes doubtless used such works as these; the various routes and places mentioned in their volume are evidently described from personal knowledge.

In a note that appeared in the last number of the Russian Chemical and Physical Society's *Journal*, Mendeleeff points out that Berthelot's hyposulphuric acid is formed under the conditions that generally yield peroxides, peroxide of hydrogen being formed at the same time. It appears to have all the properties of true peroxides, and even combines with water in a similar manner to Barium peroxide. As it does not give salts with bases, the name of acid which is given to it is inexact, and this inexactitude has arisen from a general deficiency of our nomenclature of oxygenated compounds. It is usually admitted that—as in the case of manganese—we have, first, bases, then peroxides, and then anhydrids of acids. But it is well-known that the bioxides of manganese, lead, and others, do not have the characters of peroxides; thus it would be better to call them simply bioxides; true peroxides belong to the type of the peroxide of hydrogen, as true bases and acids belong to the type of water. The highest known oxygen compound of sulphur, S_2O_7, corresponding to Cr_2O_7, which should be termed peroxide of chromium, should be termed sulphurperoxide. Regarded in this way the peroxides generally are bodies in a more oxidised condition than that in which they yield either bases or anhydrides of acids. The peroxides of Barium, sulphur, and hydrogen are the extreme oxidised compounds of these bodies known, and have comparatively neutral qualities.

Some interesting facts regarding the influence of heat on the molecular structure of zinc are given in a recent paper by Herr Kalischer to the Berlin Chemical Society. Rolled zinc becomes crystalline when strongly heated, and the author recommends as a lecture experiment dipping a heated strip of zinc for half a minute in concentrated sulphate of copper solution, then washing off the precipitated copper with water, whereupon distinct signs of crystallisation appear. The effect is not merely superficial; plates $\frac{1}{20}$ mm. to 5 mm. thick (no thicker were tried) proved crystalline throughout. The mode of cooling (quick or slow) has no marked influence. Zinc when heated, loses its ring, and if bent gives a sound like the "cry" of tin; this fact, with the crystallisation, confirms the view that the cry of tin is also due to crystalline structure. Zinc must be heated over 150° C. to show crystallisation on corrosion, but the "cry" is perceptible at about 130°, and increases with the temperature. As the tenacity of rolled zinc diminishes with crystallisation, and the cry undoubtedly proves incipient crystallisation, some important deductions for technical work are indicated. Herr Kalischer finds the ratio of the specific gravity of zinc in crystalline to that in ordinary state is 1·0004 : 1 or an increase, for the former of about $\frac{4}{10}$ per cent. The ratio of electric resistance of zinc wire ordinary to crystalline = 1·0302 : 1, or a decrease for the latter of about 3 per cent. Herr Kalischer was unable to prove so fully crystallisation in copper, brass, iron, and aluminium, but here were indications of it in some of these.

The French Commission appointed by the Gambetta Cabinet to report on the position of artistic industries, has not been kept in operation by the new government, but transferred from the French Board of Trade to the Minister of Public Instruction; M. Ferry has been appointed its president. The Commission will appoint special committees, which will visit the principal cities of France.

EARTHQUAKE-SHOCKS were felt on January 23 at Schattwald (Tyrol) at 10.45 a.m., direction west-east, and at Vils, Tannheim (Tyrol), and Oberdorf (Bavaria), at 8 p.m. A shock of earthquake occurred at Bucarest in the night of January 25-26, at 12.30, and at Tecucin and Marasesci (Roumania) on January 26 at 12.25 a.m. On February 5 a shock of earthquake was experienced at Nagy Iglod and Dees (Hungary) at 3 45 p.m., direction north-east-south-west.

THE additions to the Zoological Society's Gardens during the past week include a Malbrouck Monkey (*Cercopithecus cynosurus* ♂) from East Africa, presented by Mr. R. A. St. Leger; a Chacma Baboon (*Cynocephalus porcarius* ♂) from South Africa, presented by Mr. W. F. Battersby; an Amherst Pheasant (*Thaumalea amherstiæ* ♂) from Szechuen, China, presented by Mr. John Biehl; two Crocodiles (*Crocodilus*, sp. inc.) from South Africa, presented by Capt. D. King, R.N.; a Californian Quail (*Callipepla californica* ♀) from California, deposited; two Eagle Owls (*Bubo*, sp. inc.) from South Africa, on approval; a Red-fronted Lemur (*Lemur rufifrons* ♂) from Madagascar, a Common Otter (*Lutra vulgaris*) from Ireland, four Warty-faced Honey-eaters (*Meliphaga phrygia*), two Wattled Ducks (*Biziura lobata* ♂ ♂) from Australia, a Pink-footed Goose (*Anser brachyrhynchus*), European, purchased; a Hybrid Tapir (between *Tapirus roulini* ♂ and *Tapirus americanus* ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE ACADEMY OF SCIENCES, PARIS.—At the annual public sitting of this body on February 6, recommendations of a committee consisting of MM. Faye, Lœwy, Mouchez, Janssen, and Tisserand, with respect to the award of the astronomical prizes of 1881, were adopted by the Academy. The Lalande Prize was awarded to Mr. Lewis Swift, of Rochester, New York, who in the course of four years has discovered seven comets, one of them of short period. The committee remarked that we have now a family of seven periodical comets, of which the aphelion distances do not differ much from the mean distance of Jupiter, and this great planet appears to have drawn them into our system. There are doubtless interesting researches to make on this point of theoretical astronomy: "La première chose à faire est de recueillir de nombreux matériaux; aussi convient-il d'encourager les travailleurs qui consacrent leurs veilles à la recherche des comètes."

The Valz Prize was awarded to Mr. David Gill, H.M. astronomer at the Cape of Good Hope, for his researches on solar parallax, and more especially for the results of his expedition to Ascension, for the observation of Mars at the close opposition of 1877. Mr. Gill has twice applied what is known as *the diurnal method* (first employed by Cassini two centuries since) to observations of Mars with the heliometer. The Ascension expedition is pronounced to have been a great success, twenty-two series of observations of Mars having been obtained, each of which affords a value of the parallax. The discussion of the observations proves that they were made with a high degree of precision, and the committee conclude that "la valeur qui en résulte pour la parallax du Soleil paraît devoir être l'une des plus exactes."

The prizes offered for the year 1882 are those founded by Lalande (a gold medal of 540 francs), by Valz (460 francs), and that instituted in 1863 by the Baronne de Damoiseau. The latter is continued for the same subject as on several previous occasions, when no adequate response was received, and the terms are thus stated:—"Revoir la théorie des satellites de Jupiter; discuter les observations et en déduire les constantes qu'elle renferme, et particulièrement celle qui fournit une détermination directe de la vitesse de la lumière; enfin construire des Tables particulières pour chaque satellite." Competitors are desired to give particular attention to one of the conditions—that relating to the determination of the velocity of light. The value of the prize is 10,000 francs; memoirs received till June 1, 1882.

THE TOTAL SOLAR ECLIPSE OF MAY 17.—It appears that astronomy is to be once more indebted to the scientific spirit and munificence of M. Bischoffsheim, the banker of Paris (a valued friend of the late M. Leverrier), who, according to the *Times*, has undertaken the expense of a mission to Upper Egypt, for the observation of this phenomenon. Upper Egypt is about the only accessible locality available on this occasion, and in that district the duration of the total phase will be less than $1\frac{1}{4}$ minute. It will therefore be necessary for the observer to be situate close upon the central line of eclipse to secure a sufficient duration for any useful purpose. Hansen's Lunar Tables, as is well known, require correction at this time, but it happens that the Lunar Tables adopted in the "American Ephemeris" give the moon's place in pretty close agreement with that resulting from Hansen's, with Newcomb's corrections applied, and the track of total eclipse given in detail in that Ephemeris may be taken as almost as reliable a prediction as it will be possible to make. We extract as follows:—

Greenwich Mean Time	N. Limit Long.	E. Lat.	N.	Central Line. Long	E. Lat.	N.	S. Limit. Long.	E. Lat.	N.
h. m.	° ′	° ′		° ′	° ′		° ′	° ′	
May 16 ... 18 20	... 28 39·9	... 25	17·5	28 55·8	... 25	8·0	29 11·7	... 24	58·5
18 25	... 31 21 4	... 26	42·5	31 37 0	... 26	31·9	31 52·6	... 26	21·3
18 30	... 33 50·8	... 28	0·6	34 6·1	... 27	48·9	34 21·4	... 27	37·2
18 35	... 36 11·5	... 29	12·8	36 26·4	... 29	0·2	36 41·3	... 28	47·6

The duration of totality upon the central line, assuming the sun's semi-diameter 15′ 50″·8, and the moon's geocentric semi-diameter 15′ 51″·9, will be at the above Greenwich times respectively, 1m. 6·3s., 1m. 12·0s., 1m. 17·1s., 1m. 21·8s.: an observer proceeding beyond the intersection of the central line with the Nile, say to Ras Mahomed at the extremity of the peninsula of Sinai, will not therefore secure an increase of ten seconds in the length of the total obscuration. We hear reports of an intention on the part of several American astronomers to visit Egypt for the observation of the eclipse, and hope this country may not be unrepresented.

THE TRANSIT OF MERCURY, NOVEMBER 7, 1881.—This phenomenon appears to have been well observed in Australia. If the times of internal contacts are founded upon Leverrier's tables of sun and planet, and the semi-diameters he deduced from a discussion of the transits of Mercury to 1845, the Melbourne observations indicate that the computed time of first internal contact is too early by 24·5s., and that of last internal contact by 26·0s. According to the observations of that able amateur, Mr. Tebbutt, at Windsor, N.S.W., these errors are respectively 20·8s. and 27·3s. The calculations of the American ephemeris, where Leverrier's old theory of the planet (*Connaissance des Temps*, 1848) is adopted, exhibit much larger errors, at least as regards the exterior contacts, for which alone the formulæ of reduction for parallax are given. The experience is therefore the same as at the previous transit on May 6, 1878.

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday last, Sir Richard Temple delivered a lecture which nominally dealt with the geography of the birthplace and cradle of the Mahratta power in Western India, but practically became rather a disquisition on the history of the race, and much of the information furnished will, no doubt, have been familiar to readers of Meadows Taylor's work.

SOME further fragments of news have come from the rescued members of the *Jeannette* expedition. Every effort is being made to find Captain De Long and his companions, but at this season, and in such a region as the Lena mouth, the searchers have a hard task before them. Lieut. Danenhauer sends some interesting notes on the course taken by the *Jeannette*:—"We discovered Jeannette Island May 16, 1881 (?), in lat. 76° 47′, long. 158° 56′ E. It was small and rocky, and we did not land upon it. Henrietta Island was discovered May 24, in lat. 77° 8′, long. 157° 43′ E. We visited it, and found it to be an extensive island, animals scarce, many glaciers. A very large island, found in lat. 76° 38′, long. 148° 20′ E. was named Bennett Island. On it we found many birds, old horns, driftwood, and coal; no seal or walrus; strong tidal action; bold and rocky. The south cape we named Emma. The general health of the crew during twenty-one months was excellent, no scurvy. We used distilled water, bear and seal meat twice a week, but no rum. Divine service was held regularly. We took plenty of exercise, and everybody hunted. Game was scarce, but we got thirty bears, 250 seals, and six walrus; no fish or whales seen. All possible observations were made during the

drift, the result showing north-westerly course, the ship heeling over, and being heavily pressed by ice most of the time. The mental strain was heavy on some of us. The result of the drift during the last five months was 40 miles by tidal movement of ice; very rapid drift the last six months. Soundings pretty even—18 fathoms near Wrangel Land, which often visible 75 miles distant. The greatest depth was 80 fathoms; average depth, 35; bottom, blue mud; shrimps plentiful; meteoric specimens got from bottom; surface water temperature, 20° above zero. The extremes of temperature of air were—cold, 58° below zero (Fahrenheit); heat, about 44° above. During the first winter the mean temperature was 33° below zero, second winter 39° below. During first summer mean temperature was 40° above zero. The heaviest gale showed a velocity of 50 miles an hour, but such gales were not frequent. Barometric and thermometric fluctuations were not great. There were disturbances of the needle coincident with the auroras. Telephone (?) wires were broken by the ice movements. Winter's growth of ice was 8 feet. The heaviest ice seen was 23 feet thick. During the first week of the retreat from the *Jeannette* we drifted back 27 miles more than we could advance. The snow was nearly knee-deep. The naturalist's notes were saved, but the photographic collection was lost with the ship. Lieut. Chipp's 2000 auroral observations were also lost." Thus it would seem that the *Jeannette*, like the *Tegetthoff*, was caught in the ice soon after she entered on her task, and was drifted about in it for many months. The islands discovered are doubtless part of the Arctic archipelago which surrounds the Polar area, and of which Franz-Josef Land, the New Siberian Islands, &c., are outliers. The full record of scientific observations promises to be of some value.

We understand that the Admiralty are unwilling to send a national expedition in search of Mr. Leigh Smith and the *Eira* Expedition, but have at the same time expressed their readiness to propose a grant of 5000*l.* towards the expense of a private expedition.

Dr. Schweinfurth is said to have had a letter from the Marchese Antinori, telling him that he has heard in Shoa of the existence of a race of pigmies to the south-east of Kaffa. They are called Dakos by the Kaffa people, and Jukis by the Gallas. From their reported position it is thought probable that they belong to the same race as the Akkas.

M. Joseph Martin has on exhibition at the French Geographical Society a collection of photographs, maps, mineralogical specimens, &c., which he has made during a long sojourn in Siberia, where he has been engaged in examining gold, silver, and other mines. During his journey he traversed the Ural, where he was chiefly occupied at the Beresofski gold-mines, visiting also several mines of precious stones, iron, &c. He next went to the Ob, where he examined the mountains round Tomsk, afterwards visiting the gold and silver mines in the Altai. Having visited the Upper Yenisei, he made a geological examination of the Baikal region, and then descended the Lena to the mouth of the Aldan, up which he went for some distance. He also visited the Olekma and Vitim rivers, where gold-mines are being worked, and then made some mineralogical researches in the Stanovoi Mountains. He visited the Transbaikal region and a part of Mongolia, and then followed the Chinese frontier from Kiachta to Vladivostock, after which he spent some time in mineralogical investigations on the Amur and the Ussuri, and in other parts of Russia, and Chinese Manchuria. M. Martin intends in April to start on a journey of exploration in the Kamchatka peninsula.

The Dépôt de la Guerre at Paris has just published the first four sheets of a map of Africa, which, when finished, is to consist of sixty sheets. This map has been prepared by Capt. Lannoy.

In a paper which he has read before the French Geographical Society, Col. Veniukof, the well-known Russian traveller, estimates that a third of Asia, as well as a thirtieth part of Europe, still remains to be explored.

The Lisbon Geographical Society has founded a section in the Azores.

During the past year the agents of the London Missionary Society in New Guinea have paid some attention to the previously unknown Maiva district, lying some distance to the west of Port Moresby. In June the Rev. James Chalmers started a second time to visit the region, landing at Miria's village on the Maiva coast. After going to several villages on the coast and in the interior, he determined to visit Madu, the chief of Motu Lavao. Starting from the bight, he ascended a large creek with dense mangrove on both banks—a veritable bed of fever—and then walked through the deserted village of Paitana to Motu Lavao, the path leading through a narrow tract of good country, with dense swamps on both sides. The village was found to be large, with clean and well-kept houses, but situated in a most unhealthy locality. At the end of July Mr. Chalmers again re-visited the Maiva district, in company with the Rev. W. G. Lawes and his wife.

The Society which was formed at Milan for the commercial exploration of Africa, has already examined the Barka plateau, and founded two stations at Bengazi and Derna, and this year it proposes to send agents to accompany an Arab caravan from the Mediterranean to Wadai, across the desert, and through the oases of Anjila, Jalo, Kufra, and Wanianga. The Society also hopes to obtain the necessary firmans from Constantinople to enable it to establish an agricultural colony to the east of the Barka plateau, and if possible, an attempt will even be made to explore the routes leading from Abyssinia towards Assab, the Italian settlement on the Red Sea.

PHYSICAL NOTES

M. Planté has found that the long process of "forming" his accumulators is shortened if they are warmed during charging. The temperature best for this purpose is between 70° and 80°, at which limit the opposing electromotive force is somewhat less than when cold, and the resistance a great deal less. He does not find it advantageous to exceed this limit. We venture to suggest that the reason is that at boiling-point the oxygen and hydrogen are evolved in normal conditions, no ozone being produced. The electromotive force of oxygen against hydrogen is less than that of peroxide of lead against metallic lead, and far less than that of ozone against "nascent" hydrogen.

Prof. Andrea Naccari has re-examined the question of the unequal heating of the electrodes of a Holtz's induction machine by the passage of sparks. After carefully tabulating his results, he comes to the conclusion that in every case the negative electrode is less heated than the positive; that the heat developed in the spark is not affected by the nature of the metals of the electrodes; that with a constant striking-distance between the ends of the electrodes the heating effect in each electrode is proportional to the quantity of electricity that passes in unit time; and that the quantity of heat thus developed by the passage of the electricity between the electrodes is very considerable.

Prof. Manfredo Bellati and Dr. R. Romanese have investigated the rapidity with which light modifies the electric resistance of selenium. The question has a practical bearing upon the construction of the photophone, since, if the time required to produce this change were considerable, the most rapidly vibrating sounds would become confused or inaudible in transmitting them. When light falling on a selenium cell was interrupted 1250 times per second, the resistance was practically the same as with a far less rapid interruption giving equal average illumination. All the experiments of these gentlemen led to the result that selenium behaves sensibly, as if the variation of resistance by the incidence of light were effected instantaneously.

M. Lippmann has applied his capillary electrometer to the study of the electric conductivity of shellac, gutta-percha, turpentine, petroleum, and other bodies, which, though insulators, when cold, begin to conduct as their temperature is raised. This subject was investigated in 1875 by Sir W. Thomson and by Mr. (afterwards Professor) Perry, more particularly in the one case of hot glass. In M. Lippmann's experiments a battery of one to forty voltaic cells was placed in a circuit in which the capillary electrometer was included, and in which the substance to be examined was interposed between two platinum plates. At ordinary temperatures the electrometer gave no indication, but moved forward as the temperature was raised to 100° C. As the temperature fell, the substances examined resumed their former state as insulators. A paper on the same subject has, we observe, been recently communicated by Mr. T. Gray to the Royal Society.

M. H. Dufour has made an interesting observation of no small importance in the theory of gaseous absorption of radiant

energy. A mixture of chlorine and hydrogen gases diluted with air or oxygen combines slowly in light. Without air the mixture is exploded (as Tyndall has shown in well-known experiments) by exposure to white light, the chemical rays being most efficient. M. Dufour has examined the behaviour of this mixture as to its power of yielding radiophonic and photophonic sounds when illuminated by intermittent beams of different kinds, as in the researches of Graham Bell and Tainter. He finds that the loudest sounds occur when violet and ultra-violet rays are employed, no sound whatever being produced by red rays.

We notice in the last number of the *Journal* of the Russian Chemical and Physical Society (vol. xiii.), a paper, by M. Kraevitch, on the limit of rarefaction which might be obtained by means of mercury-pumps. M. Kraevitch affirms that in such a pump the tube will always remain filled with vapours of mercury, the elasticity of which, at ordinary temperatures, is no less than 0·02 millimetre; the use of desiccative substances cannot make these vapours disappear, as new vapours are immediately formed again. He contests therefore the idea that Mr. Crookes might have obtained in his experiments so low a pressure as 0·00004 metre; and observes that M'Leod's gauge can measure the elasticity of a permanent gas (admitting that the law of Mariotte were true at such low pressures), but that it does not give the elasticity of the vapours of mercury. After a sketch of different air-pumps, he recommends that of Prof. Mendeleeff, with some modifications of his own, the most important of which is intended to eliminate the inconvenience which Mendeleeff's pump has in common with that of Sprengel, namely, the adhesion of an air-film to the glass-tube at low pressures. The rarefaction of the air, he says, can be carried in this pump so far as to reduce the elasticity of the permanent gas to 0·0002 millimetre, the pressure of the vapours of mercury always remaining, however, no less than 0·02 millimetre at the usual temperature of our rooms. In a few hours the rarefaction may be produced as to show the fluorescence of glass at the negative pole and the other phenomena described by Mr. Crookes, and even to stop the transmission of electricity.

THE PRIZES OF THE PARIS ACADEMY

The following is, in brief, a list of the prizes offered in connection with specified subjects in 1882 and following years:—In 1882: Grand prize of the Mathematical Sciences (medal worth 3000 fr.): Theory of the decomposition of whole numbers in a sum of five squares. Extraordinary prize of 6000 fr.: Progress increasing the efficiency of the naval forces. Plumey prize (medal, 2500 fr.): Improvement of steam-engines, or of steam-navigation otherwise. Damoiseau prize (medal, 10,000 fr.): Revision of the theory of Jupiter's satellites. Grand prize of the Mathematical Sciences (medal, 3000 fr.): Experimental and theoretical study of the elasticity of one or several crystalline substances. Bordin prize (medal, 3000 fr.): Origin of atmospheric electricity and cause of phenomena in thunderclouds. Desmazières prize (medal, 1600 fr.): Best work in cryptogamy. Vaillant prize (medal, 4000 fr.): Inoculation as a prophylactic in contagious diseases of domestic animals. Grand prize of the Physical Sciences (medal, 3000 fr.): Distribution of marine animals on the French coast. Du Gama Machado prize (medal, 1200 fr.): On coloured parts of the tegumentary system of animals, or on the fecundating matter of animated beings. Breant prize (interest on 100,000 fr.): Cure of Asiatic cholera. Godard prize (medal, 1000 fr.): Anatomy, physiology, and pathology of the genito-urinary organs. Lallemand prize (1800 fr.): Work on the nervous system. Gay prize (2500 fr.): Marine lacustrine and terrestrial deposits on the French coasts in the present period, and especially since the Roman epoch. In addition, there are the Montyon prize in Mechanics, the Lalande and Valz prizes in Astronomy, and several others. Then in 1883: Fourneyron prize (500 fr.): Different modes of transmission of force to a distance. Grand prize of the physical sciences (medal, 3000 fr.): Geological description of a region of France or Algeria. De la Fons Melicoque prize (300 fr.): Botanical work on the North of France. Bordin prize (3000 fr.): Influence of medium on the structure of vegetating organs; variations of terrestrial plants grown in water, and of aquatic plants in air; explain by direct experiments the special forms of some species of maritime flora. Bordin prize (medal, 3000 fr.): Palæontology of France or Algeria. Grand prize of the physical sciences (medal, 3000 fr.): Histological development of insects during their metamorphoses. Alphonse Penaud prize (3000 fr.): Aërial locomotion. In 1884: Sener prize (7500 fr.): On genera embryology applied as much as possible to physiology and medicine. In 1885: Dusgate prize (2500 fr.): Diagnostic signs of death and means of preventing precipitate inhumation. In 1886 the Jean Renaud prize will be awarded for the most meritorious work during five years.

SYMBIOSIS OF ALGÆ AND ANIMALS

A correspondent sends us the following as an epitome of K. Brandt's experiments on the green bodies found in the bodies of *Hydra*, *Spongilla*, *Stentor*, &c.:—

When the green bodies are removed from these organisms by crushing, they are found not to be entirely and uniformly green like the chlorophyll-bodies of plants; in addition to the green substance they consist also of colourless protoplasm. Treatment with hæmatoxylin always reveals a definite cell-nucleus; and the same is the case if first killed by 0·2 per cent. chromic acid or 1 per cent. superosmic acid, then freed from chlorophyll by alcohol, and finally treated with solution of hæmatoxylin. These green bodies do not therefore correspond to the chlorophyll-bodies of algæ, but are themselves independent organisms, unicellular algæ. To those found in the animals named above the author gives the generic name *Zoochlorella*, to those which occur in the Radiolaria, Actiniæ, &c., the name *Zooxanthella*. Experiment proved that they are capable of carrying on an independent existence after removal from the animal in which they are found, and are able to produce starch-grains. They can also enter into the bodies of other animals which feed on those that contain them. The physiological function of these algæ was investigated in the case of those which form the well-known "yellow cells" of the Radiolaria. These were found to be of service in supplying food to the host, which thrives best in perfectly pure filtered water. So long as the animals contain few or no green or yellow algæ, they are nourished, like true animals, by the absorption of solid organic substances; but as soon as they contain a sufficient quantity of these algæ, they are nourished, like true plants, by assimilation of inorganic substances. In the latter case the algæ which live in the animals perform altogether the function of the chlorophyll-bodies of plants. Finally the author compares the mode of life of these *Phytozoa* (as he terms the animals which subsist on the algæ contained within them) with that of Lichens. With the Phytozoa there is, however, this remarkable peculiarity, that morphologically it is the alga, physiologically the animal which is the parasite.

NOTES ABOUT SNAKES

A serpent's first instinctive impulse of self-preservation, like that of every other animal, lies in escape; probably a more nervous creature does not exist. If surprised suddenly, or brought to bay at close quarters, it may be too terror-stricken to attempt flight; then it *bites*, following a curious general rule which seems to obtain throughout nearly the whole animal world, from a passionate child downward, no matter what the natural weapons of offence may be. Young *Felidæ* will keep their talons sheathed until they have exerted all possible force with their soft milk-teeth, and a lizard will seize the hand which restrains it with its insignificant little jaws, when its tail or claws might inflict far more injury. The *Boidæ* never use their constrictive powers in self-defence (unless they are gripped), and it seems probable that if a venomous snake's fangs lay in its tail, it would use its teeth *first* when attacked before bringing them into play. Indeed it must be remembered that very few animals are provided with exclusively defensive weapons, and that the python's enormous strength in constriction, the viper's poison apparatus, the lion's teeth and claws, and the electric discharge of the gymnotus are given them primarily for the purpose of securing their food.

A snake *runs* away, walking along on the points of its numerous ribs with a rapidity which can only be appreciated by those who have seen a long one—*Herpetodryas*, for instance—escaping in the open or over the bushes when alarmed, its speed being further increased by the body being drawn up at intervals into folds, which, being extended, shoot the head forward. This is the swiftest mode of progression of which a snake is capable, and is, as I have said, difficult to be realised from the spectacle of these reptiles in cages; the Brazilian neck-marked snake (*Geopytas collaris*), at the Zoological Gardens, will perhaps con-

vey some idea of it, being certainly the most agile denizen of the Reptile House. But this movement is only an increase of the same action which is observed in one creeping slowly along, displayed to best advantage when it is gliding from a plane to a raised surface. When a snake is in imminent danger, however, it adopts a remarkable motion for the purpose of eluding injury or capture, which motion, though it may be termed, *par excellence*, "serpentine," has, singularly enough, been very little commented upon by ophiologists.

The body is thrown laterally into a series of deep curves, which alternate so quickly from convexity to concavity that it is extremely difficult to touch or aim a blow with precision at any part of it, the lateral movements covering a square of ground, the side of which would be represented by at least two thirds of the snake's length. This motion is clearly protective in its object, and is only exhibited when the straight-onward movement is felt to be insufficient to avoid peril, since the reptile's speed in travelling is greatly retarded by it—necessarily so, as the head turns alternately from side to side at an angle of fully a hundred and twenty degrees to the line of its course, thus describing the major part of the circumference of a series of circles which the body and tail follow. Even a small one on a table will not be picked up without two or three ineffectual efforts, when it wriggles in this way, and I have seen a tiny *Oxyrrhopus doliatus* defend itself so for some moments against the lightning "dabs" of a serpentivorous bird; while a lively whip-snake, which was cruelly thrown to a peccary in my presence, actually twined away among the hog's feet and escaped into the jungle, in spite of the hungry and active animal's attempts to secure it. I was walking in the Botanical Gardens of Rio de Janeiro some time ago, when a lady called my attention to something going away among the ferns. Not being able to see it from where I stood, I jumped down the bank and found myself literally upon an immense green tree-snake, at least nine or ten feet long; I was almost treading on it, but notwithstanding my most energetic efforts to catch such a magnificent specimen with my hands, feet, and the crooked handle of an umbrella, it succeeded in crossing an open space two yards wide, and disappeared into a clump of bamboo, solely by virtue of this lateral movement. I noticed that the intensity of the curvatures caused the ventral plates to be exposed, so that the yellowish under-colour was visible at each contortion; owing, no doubt, to the interlocking of the vertebræ, and consequent expenditure of the excess action in rolling.

This serpent, of course, was harmless, so that there would have been no danger in grasping it; but it emitted a curious sound in its terror, such as I have never heard before or since. It *screamed*, and so loudly, that some people near, who saw nothing of what was going on, thought they heard a child cry. A snake's hissing, the only vocal expression of which the *Ophidia* are naturally capable, is produced simply by the rush of air through the narrow chink by which the trachea communicates with the pharynx, without any complex vibratory apparatus such as exists in mammals, though this may be prolonged for a considerable time on account of the enormous capacity of its single lung. I infer, therefore, that this one had just swallowed something, and that either its windpipe was not properly retracted to its normal position, or that the glottis was partially occluded by a pellet of mucus or (more probably) a filament of some extraneous material, which thus converted the hiss into a sort of whistle—just as boys produce a hideous screech by blowing forcibly on a blade of grass held edgewise between the applied knuckles of their two thumbs. Serpents make all sorts of noises besides hissing, according to their different kinds; Crotali spring their rattles; the carpet-viper (*Echis carinata*) rubs the imbricated scales of its adjacent coils together; the fer-de-lance (*Trigonocephalus lanceolatus*) is said in St. Lucia to give out a series of little taps with its horny extremity; and many others—such as the rat-snake (*Spilotes variabilis*) of South America—certainly indicate their presence when angry by quivering their tails against the ground; but a crying snake would have been a decided novelty in one's collection.

ARTHUR STRADLING

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The date of the commencement of the examination for the Burdett-Coutts Scholarship has been postponed from Monday, February 27, as announced, to Monday, March 6.

SCIENTIFIC SERIALS

The Quarterly Journal of Microscopical Science for January, 1882, contains: H. Marshall Ward, B.A., report on the morphology of the fungus of the coffee disease of Ceylon (*Hemileia vastatrix*, Brk. and Br.), plates 1, 2, and 3. This fungus probably belongs to the Uredines; still some structures, such as the curious spore-bearing head and the long-necked haustoria are opposed to this alliance. The history of the adult fungus from the uredospore, and the formation of the teleutospores, are described and figured.—Dr. F. M. Balfour, on the nature of the organ in adult Teleosteans and Ganoids, which is usually regarded as the head-kidney or pronephros. It would seem probable that, though found in the larvæ or embryos of almost all the Ichthyopsida, except the Elasmobranchii, this is always a purely larval organ, which never constitutes an active part of the excretory system in the adult forms.—Dr. K. Mitsukuri (Japan), on the development of the supra-renal bodies in mammalia (plate 4).—Pat. Geddes, observations on the resting stage of *Chlamydomyxa labyrinthuloides*, Archer (plate 5), some very characteristic figures of the resting stage of this strange protean form are given.—J. T. Cunningham, a review of recent researches on Karyokinesis and cell division (plate 6).—Dr. Reuben T. Harvey, a note on the organ of Jacobson.—Prof. E. Ray Lankester, on *Drepanidium ranarum*, the cell-parasite of the frog's blood and spleen (Gaule's Würmchen). This very interesting memoir is illustrated with several woodcut illustrations.—G. F. Dowdeswell, M.A., on the micro-organisms which occur in Septicæmia (plate 7).—Prof. Bayley Balfour, Pringsheim's researches on chlorophyll, translated and condensed (plates 8 and 9).

Journal of Anatomy and Physiology for January, 1882, contains:—J. G. Smith, M.A., observations on the histology of fracture-repair in man (plates vi. and vii.); Dr. H. S. Gabbett, colloid degeneration of the non-cystic ovary with associated vascular changes (plate viii.); Dr. G. E. Dobson, the phalanx missing from certain digits in the manus of Chiroptera; Dr. G. Thin, the histology of *Molluscum contagiosum;* Dr. W. Osler, case of obliteration of the portal vein; Dr. A. H. Young, on the muscular anatomy of the Koala (*Phascolarctos cinereus*), with notes; Dr. M. Hay, on the action of saline cathartics; Dr. J. J. Charles, some researches on the gases of the bile.—Anatomical notices.

The Journal of Physiology, vol. iii., Nos. 3 and 4, January, 1882.—Contents: H. N. Martin and W. T. Sedgwick, observations on the mean pressure and the characters of the pulse-wave in the coronary arteries of the heart (plates 8-10).—H. Sewall, on the polar effects upon nerves of weak induction currents.—E. A. Schäfer, on the temperature of heat-coagulation of certain of the proteid substances of the blood.—F. W. Mott and V. Horsley, on the existence of bacteria or their antecedents in healthy tissues (plate 11).—S. Ringer, the action of hydrate of soda, hydrate of ammonia, and hydrate of potash on the ventricle of the frog's heart (plates 12-13).—C. S. Roy, the physiology and pathology of the spleen (plates 14-16).—W. R. Gowers, loss of taste from disease of the fifth nerve.—H. P. Bowditch and W. F. Southard, a comparison of sight and touch (plate 17).—J. N. Langley, on the destruction of ferments in the alimentary canal.—On the histology of the mammalian gastric glands and the relation of pepsin to the granules of the chief cells.—E. A. Schäfer, simple method of demonstrating the alkaloid reaction of the blood.—C. E. Webster, note on the production of the heart-sound.

Morphologisches Jahrbuch. Eine Zeitschrift für Anatomie und Entwickelungsgeschichte, vol. vii. part 3, 1881, contains—Dr. Hans Gadow, a contribution to the myology of the posterior extremities of the reptiles (plates 17-21).—Dr. G. von Koch, on the anatomy of *Clavularia prolifera*, sp.n., with notes on the buds in some Alcyonaria; on *C. ochracea;* on the connection of the buds with the stem in the colony of *C. prolifera;* and on the relationship of the spicules to the ectoderm (plates 22 and 23).—Dr. J. E. V. Boas, on the conus arteriosus and the arch of the aorta in the amphibians (plates 24 to 26).

Niederländisches Archiv für Zoologie.—Supplement Band i. Part 2 (Leiden, 1881), contains the first half of a very valuable paper by Dr. R. Horst, of Utrecht, on the Gephyrea collected during the first two voyages of the *Willem Barents.*—On *Hamingia glacialis*, n.sp., plate i, and a memoir on *Proneomenia sluiteri*, gen. et. sp. nov., with remarks upon the anatomy and histology of the Amphineura, by Dr. A. A. W. Hubrecht,

plate 2 to 4. (This large form of Neomenia from the Barents Sea, measuring from 105 to 148 millim., has afforded the author the opportunity of writing a very exhaustive treatise on its anatomy, in which he acknowledges the generous assistance of Dr. Spengel, Prof. v. Graff, and Ray Lankester).

Revue internationale des Sciences biologiques, December 15, 1881, contains—Elie Reclus, ethnographic studies.—M. Thulié, on the buttock-hump and apron of the Bochiman women.—M. Wagner, on the formation of species by segregation.—Dr. Graham, on the chemistry of panification.

January 15, 1882.—Prof. P. Budin, on a very peculiar disposition of the ova in twin pregnancies.—Moritz Wagner, on the formation of species by segregation (end).—A. Hovelacque, on Buffon as an anthropologist.—L. Dollo, on the toothed birds of the Far West; on Archæopteryx; and on the affinities of the birds.—M. Barral, on the application of electricity to agriculture.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, February 2.—Chas. B. Clarke, M.A., vice-president, in the chair.—The Rev. B. Scortechini and Mr. J. Marshall were elected Fellows of the Society.—Mr. Thos. Christy exhibited various vegetable fibres and the manufactured pulp obtained therefrom by Mr. C. Ekman's process, whereby excellent paper can be made quickly and economically from all sorts of coarse plant fibre.—An extract of a letter from Mr. Thos. Edward, A.L.S., of Banff, was read and a fragment shown of a supposed rare marine animal got by a fisherman in deep water. Dr. Murie identified it as belonging to the Nemertean worms, viz. *Cerebratulus angulatus*, a marine form found chiefly in the northern parts of the British coasts, but nevertheless seldom seen alive by naturalists. Mr. E. M. Holmes exhibited specimens of a new blistering insect from Madagascar, belonging to the genus *Epicauta*, and allied to *E. rufiicollis*.—Mr. Holmes afterwards drew attention to specimens of Cinchona bark cultivated in Bolivia, belonging to the "*Verde*" and "*Morada*" varieties of Calisaya, which hitherto have not been cultivated in the Colonies, but notwithstanding deserve notice on account of the large yield of bark and good percentage of quinine; they therefore pay the Bolivian planters better than the well-known *Ledgeriana calisaya*.—Mr. J. R. Jackson exhibited a specimen of the Australian native "Pituri" bag, their constant companion and solace in travel. Formerly the leaf of the plant was only known, but Baron von Mueller has lately shown from other evidence that it is derived from the *Duboisia Hopwoodi*.—A note by Mr. Otto Tepper on the medical use of *Melaleuca uncinata*, R. Br., was read. He says the dried leaves chewed and the saliva swallowed are a specific in cases of colds, sore throats, and bronchitis, the flavour being aromatic.—A communication from Major-General Benson was read; this referred to Dr. Cobbold's use of the name *Fasciola Jacksoni* for certain flukes obtained from the elephant, the same having been described by Major-Gen. Benson in the *Rangoon Times*, 1867. Dr. Cobbold thereupon explained that the initials of the author having alone been appended to the article in question, it consequently had received less attention than it would otherwise have had. To Major-Gen. Benson certainly belongs the credit of having first directed attention to the elephant mortality from the said species of fluke, though the worm was first discovered by Jackson twenty years before the Rangoon letter appeared, viz. in 1847.—There followed a paper by Mr. Robert Fitzgerald, botanical sketch in connection with the geological features of New South Wales."—Afterwards a paper was read, on animal intelligence, by Mr. Otto Tepper. He described instances under his own observation, of cats regularly unfastening the latch of a door to obtain entrance, and in the case of certain species of ants, their mode of communicating with each other, &c., therefrom adducing a power of reasoning usually attributed to instinct.

Mathematical Society, February 9.—S. Roberts, F.R.S. president, in the chair.—Mr. J. H. Tompson, Science Master in the Auckland College, New Zealand, was elected a member, and Mrs. Bryant was admitted into the Society.—Mr. Tucker read an abstract of a paper by H. M. Jeffery, F.R.S., on plane curves of the fourth order with quadruple asymptotes.—The chairman communicated some results connected with Euler's formula connecting the sum of the divisors of a number with the pentagonal numbers, and remarked that the formula really expressed the equality of the sum of the divisors to the sum of the mth powers of the roots of a certain equation.—Mr. J. Hammond and Mr. Tucker also made short communications.

Chemical Society, February 2.—Prof. A. W. Williamson in the chair.—Dr. Odling delivered a lecture on the unit weight and mode of constitution of compounds. The lecturer had originally proposed to bring forward three questions for discussion and consideration—(1) Is there any satisfactory evidence deducible of the existence of two distinct forms of chemical combination, atomic and molecular; (2) Is the determination of the vapour density of a body alone sufficient to determine the weight of the original molecule; (3) In the case of an element forming two or more distinct series of compounds, *e.g.* ferrous and ferric salts is the transition from one series to another necessarily connected with the subtraction of an even number of hydrogenoid atoms. The lecturer limited himself to a great extent to the first question, touching incidentally on the third, and omitting the second altogether. A large portion of the lecture was occupied with a consideration of the valency or adicity of the elements and the effect thereon of other elements in the molecule. From various considerations the lecturer concluded that there is no evidence founded on facts to show that there is any difference between atomic and so-called molecular combination, but that the one passes imperceptibly into the other. There is also no necessary connection between the valency of an element and its chemical condition in forming two series of compounds: thus tin in the stannous compounds is not necessarily a dyad. The lecturer also devoted some time to the consideration of chemical formulæ, and especially to the use of condensed or contracted formulæ.

Geological Society, January 25.—Mr. R. Etheridge, F.R.S., president, in the chair.—John Blaikie, M. Ernest Jobling, and the Rev. Stanley A. Pelly, B.A., were balloted for as Fellows of the Society.—The following communications were read:—On the fossil fish-remains from the Armagh limestone in the collection of the Earl of Enniskillen, by James W. Davis, F.G.S. The author described in this paper a large collection of fossil fish-remains at present at Florence Court, Enniskillen, but which will soon be removed to the new Natural History Museum in the Cromwell Road. The collection comprises, besides specimens collected by the Earl of Enniskillen from the Carboniferous limestone of Armagh, a large series acquired from the famous collection of the late Capt. Jones, M.P., the remaining portion of which is in the Geological Museum of Cambridge. Several genera and species were described by Prof. Agassiz in his "Recherches sur les Poissons Fossiles" (1833-43), and again referred to by J. E. Portlock, F.R.S., in his "Report of the Geology of Londonderry and parts of Tyrone and Fermanagh" (1843). In 1854 Prof. M'Coy described many new genera and species in his work on the "British Palæozoic Rocks and Fossils," principally derived from a study of the portion of Capt. Jones's collection deposited in the Cambridge Museum. Prof. Agassiz paid a visit to Florence Court in 1858, and appended names to some of the fossil teeth in Lord Enniskillen's cabinets, intending to describe and figure the new forms, and to revise the whole of his former work. His death prevented this intention from being carried into effect. As far as possible the determinations of Prof. Agassiz have been adhered to in the present paper. The detached and isolated condition in which the remains are found renders any appreciation of the relationship of the teeth and spines, or even of the teeth only, to each other extremely uncertain and difficult. Some speculations as to the probable organisation and characteristics of the Carboniferous fishes which they represent, evolved during a long consideration of the specimens, have therefore been postponed to a future opportunity.—On an extinct Chelonian reptile (*Notochelys costata*, Owen) from Australia, by Prof. Owen, C.B., F.R.S. The fossil reptilian remains hitherto transmitted to the author from Australia have been limited to parts of the skeleton of *Megalania prisca*, Ow. The present specimen, sent last year by Prof. Leversidge, is the first fossil Chelonian. The specimen was found in a formation at Blinder's River, Queensland, of which the nature and age are not stated. It is, however, petrified. The fossil consists of the anterior porton of the carapace and of the plastron, brought into unnaturally close contact by posthumous pressure. A minute description of the several parts was given, from which the author concluded that though the characters of the carapace might be interpreted as identifying the Chelonian with a true turtle (*Chelone*), those of the plastron

show the well-marked distinctions of *Trionyx* and *Chelys*. On the whole, however, the modifications, especially of the carapace, show a nearer affinity to the marine turtles (*Chelone*) than the known Chelydrians exhibit, and indicate a more generalised type.—On the upper beds of the Fifeshire Coal-Measures, by the late E. W. Binney, F.R.S., and James W. Kirby.

Anthropological Institute, January 24.—Anniversary Meeting.—Major-General Pitt-Rivers, F.R.S., president, in the chair.—The following gentlemen were elected Officers and Council for the year 1882:—President, Major-General Pitt-Rivers, F.R.S.; Vice-Presidents: Hyde Clarke, John Evans, F.R.S., Prof. W. H. Flower, F.R.S., F. Galton, F.R.S., Dr. Allen Thomson, F.R.S., E. B. Tylor, F.R.S.; Director, F. W. Rudler, F.G.S.; Treasurer, F. G. H. Price, F.S.A.; Council: Lieut.-Col. H. H. Godwin Austen, F.R.S., J. Beddoe, F.R.S., S. E. B. Bouverie-Pusey, E. W. Brabrook, F.S.A., Prof. Geo. Busk, F.R.S., C. H. E. Carmichael, M.A., W. Boyd Dawkins, F.R.S., W. L. Distant, A. W. Franks, F.R.S., Prof. Huxley, F.R.S., A. H. Keane, B.A., A. L. Lewis, Sir J. Lubbock, Bart., M.P., R. Biddulph Martin, M.P., J. E. Price, F.S.A., Lord Arthur Russell, M.P., Alfred Tylor, F.G.S., C. Staniland Wake, M. J. Walhouse, F.R.A.S., R. Worsley.—The president delivered his annual address, in which he reviewed the work of the past year.

Victoria Institute, February 5.—A paper by Mr. Callard, F.G.S., "On Breaks in the Continuity of Mammalian Life in Certain Geological Periods, Adverse to the Darwinian Hypothesis," was read. A discussion took place, in which Mr. J. E. Howard, F.R.S., Mr. D. Howard, F.C.S., Mr. S. R. Pattison, F.G.S., Mr. J. Mello, F.G.S., Mr. Charlesworth, F.G.S., and other geologists took part.

EDINBURGH

Royal Society, January 16.—Sir William Thomson, hon. vice-president, in the chair.—Mr. Patrick Geddes read an interesting paper on the nature and functions of the "yellow cells" of Radiolarians and Cœlenterates, a full abstract of which we have given (p. 303).—Sir William Thomson, in a paper on the thermodynamic acceleration of the earth's rotation, drew attention to a solar action which tends to accelerate the earth's rotation, or more strictly to diminish the retardation effect of the tides. In ordinary tidal action the viscosity of the fluid, supposed distributed uniformly over the surface of the earth, has the effect of so shifting the line of crests as to make the couple due to the action of the tide-producing body upon the protuberant mass to act upon the earth in a direction contrary to that of the earth's rotation, and consequently to retard this rotation. From consideration of observed barometric changes at various stations all over the earth's surface, it is found that the well-known semi-diurnal barometric oscillation has its maxima, on an average, at 10 a.m. and at 10 p.m., and its minima at 4 p.m. and 4 a.m. This barometric oscillation must be due to the action of solar heat; though why the well-marked diurnal temperature oscillation with the superposed feeble semi-diurnal oscillation should result in a large semi-diurnal oscillation of pressure with a small diurnal oscillation superposed upon it, is not easy to explain, unless it be that the period of free oscillation of the atmosphere agrees more closely with the smaller period. However this may be, the existence of an atmospheric tide is proved by barometric observations, and the line of crests, *i.e.* the axis of maximum pressure, so lies with respect to the line joining the earth's centre and the sun that the couple due to the sun's attraction upon the ellipsoidal mass of air acts in the direction of the earth's rotation, and therefore accelerates it. The energy of this acceleration is of course derived from the sun's heat, and hence the appropriateness of the name *thermodynamic acceleration*. Its value, as estimated by Sir William Thomson, is about one-tenth of the tidal retardation.—Mr. Ferguson of Kinmundy communicated notes on a cist discovered near Parkhill, Dyce, Aberdeenshire, in 1881, with a description by Dr. Fife Jamieson of the bones found in it. Besides the bones, which, for the most part were human, and indicated a fairly muscular man with well-developed skull and lower limbs, there was found in it a small urn (5½ inches high, 4½ inches wide), of graceful shape and elaborate carving. There were also present fragments of the bones of the fore-limbs of a boar and some charcoal—two rare features, the occurrence of the charcoal being apparently a survival of the Pagan custom of cremation.—Mr. T. Muir read a paper on permanent symmetrical functions, representing them by a notation similar to the determinant notation, and indicating some of their properties as well as their relations to alternate numbers and determinants.—Prof. Tait communicated two optical notes, the first of which was a simple geometrical construction of the curve formed by rays of light from a straight slit falling on a screen after passing through a bull's-eye shaped irregularity on a window-pane, such as is frequently met with in old panes. Under favourable circumstances this curve may have a cusp, or even a loop. The second note dealt with the difficulty pointed out by Airy in his Tracts regarding the nature of common light, and showed how it can at once be got over by looking at things from the modern statistical point of view which has been so useful in its application to the kinetic theory of gases.

VIENNA

Imperial Academy of Sciences, January 19.—L. T. Fitzinger, in the chair.—The following papers were read:—A. Wassmuth, on electromotive bearing powers.—C. Koelter, on the action of an electro-magnet on different minerals, and its use for the mechanical separation of them.—H. Weidel, contributions to the knowledge of tetrahydrocinchoninic acid.—S. Exner, on the function of the musculus crumptonianus.—F. Woehner, results of the observations and studies made on the earthquake of Agram of November 9, 1880.

February 3.—L. T. Fitzinger in the chair.—The following papers were read:—A. Adam Riewicz, on the blood-vessels of the spinal cord of man, Part ii., the vessels of the surface of spinal cord.—S. Mayer, contributions to histological technics.—S. Exner, on atrophy and innervation of the muscles of larynx.—F. Lippich, on polaristrobometric methods.—Studies on caffeine and theobromine, Part 3, by R. Maly and F. Hinteregger; Part 4, by R. Maly and R. Andreasch.—T. M. Eder and G. Ulm, on the action of iodide of mercury on hyposulphite of sodium.—C. Langer, on the structure of bones.—V. Hochstetter, report on the researches made by Szombathy in the caves Lettenmayer-hoehle, near Kremsmünster (Lower Austria), Vipustex-hoehle, near Kiritein (Moravia), Lautscher-hoehle, near Littau.—F. Steindachner, contributions to the knowledge of the fishes of Africa, Part 2.—Description of a new species of Paraphroxinus from the Herzegovina, by the same.—T. Herzig, on the constitution of guaiocol.—G. Goldschmidt and T. Herzig, on the action of the lime-salts of the three isomeric oxybenzoic and anisic acids at dry distillation.—G. Goldschmidt, a note on the occurrence of succinic acid in a bark-covering of *Morus alba*.—C. Senhofer, on naphthalene-tetrasulphonic acid.—M. Margules, on the rotatory oscillations of liquid cylinders.

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