THURSDAY, MAY 28, 1874

THE AFRICAN ECLIPSE OF 1874

IT is often said that Science is a thing of slow growth, and it must indeed be confessed that if one turns aside from the advancement of Science as a whole to the advance of any one particular branch of it, the statement is too true. Over and over again one gets instances in which crucial experiments suggested by previous work are separated by decades or even by centuries. One cause to which this slow march is undoubtedly to be attributed is the apathy of men of Science themselves. To any science in which they do not themselves excel, and especially to any newly-opened-up branch of their own technic, the attitude of many men, and especially of *official* men, of Science, is not merely one of passive resistance; it is the attitude of the Schoolmen in the time of Galileo over again. We grant that these cramped minds are fortunately in a minority, but the minority is often a powerful one, for the reason, among others, that it is composed of men as a rule advanced in years, far removed therefore from the sympathies, unselfishness, receptivity, and unbounded horizon of youth.

It is a good sign of the times, therefore, when we find a scientific official large-minded enough, and with genius enough, to help on with his whole heart new studies as well as the old; and from this point of view we are especially anxious to draw attention to the fact not only that the total eclipse of April 16 of this year has been admirably observed, but that it has been observed by the Astronomer Royal of the Cape, Mr. Stone, himself, who has thus increased the debt of gratitude which both the mechanical and the physical sides of astronomy owe to him, careless, we doubt not, of the opinion held by a very high authority here in England that the spectroscope—the instrument he employed—is not an astronomical, nay, is not even an optical, instrument!

The line of totality of the eclipse in question struck land near Port Nolloth, on the west coast of Cape Colony, somewhere about 250 miles from Cape Town, and passed over the southern extremity of Africa in a curved line with the convexity turned towards the north, ending at sunset about half way across. There were three points whence the totality might be observed: Port Nolloth on the coast, O'okiep at the opposite extreme inward, a hundred miles away; and Klipfontein, about half way between. The last-mentioned spot was very fortunately the one selected by Mr. Stone. It is known locally as the "Cottage," forming the country or picnicing residence of Mr. Hall, an engineer, and on the brow of a hill rising at least some 2,000 ft. above the level of the sea. On the day of the eclipse down at Port Nolloth there was a cloud through which, as at Port Elizabeth and Graham's Town, the phenomena of the eclipse were all but utterly invisible. Up at Klipfontein the weather and the sky were all that could be desired.

Although full particulars of Mr. Stone's observations have not been received, the *Cape Argus* of April 25, a copy of which has been forwarded to us, contains extracts from private letters received from Mr. Stone, which place us *au courant* with the main points of the observations. The most complete account is as follows:—

"I observed the eclipse from Klipfontein. The day was most favourable, not a cloud being visible. The sight with the naked eye during the few moments I could spare from my work was grand and impressive beyond conception. The eclipse, however, appeared to me to differ a good deal from those lately observed.

"The rose-coloured flames extended very nearly around the moon, although of course of unequal heights at different parts. The corona appeared much less complicated. I saw no outlying brushes, and I should without hesitation express an opinion that all the corona I saw was of the same character throughout and belonged to the sun. The less complication of the corona may, however, have been connected with the purity of the atmosphere and the absence of clouds. I used a four-inch telescope lent me by Mr. H. Solomon. My spectroscope was one of two dense flint glass of 60°. The slit was opened as wide as could allow of a clear sight of Fraunhofer's lines. This was done to insure my being able to see the spectrum of the corona, which was expected to have been very faint. During the partial eclipse I examined most carefully the spectrum near the moon's limb, and away from the limb, to see if any fresh lines could be seen near the moon's limb. None appeared, and consequently there cannot be any medium capable of producing sensible absorption of light around the moon. As the totality drew near, the portion of the sun's disc uncovered was kept half way across the slit. At the instant of the totality the whole field appeared full of bright lines. I believe that all the principal Fraunhofer lines were reversed, and seen as bright lines. One of these lines I am certain was the red line B, but no sooner had I begun to count the lines than the spectrum changed into that of hydrogen gas. This spectrum being well known as that of the rose-coloured flames, I did not care to spend the few moments available upon it; but just glancing at the eclipse to see the brightness of the corona, I turned the telescope upon a bright portion of this beyond the rose-coloured light. The spectrum was much fainter than that of the rose-coloured flames, but there was an ordinary spectrum of some brightness, and across this I feel certain Fraunhofer's lines were still visible, although seen with some difficulty on account of the faintness of the general spectrum. There was also a discontinuous spectrum near the green of one very bright line, and two very faint lines of less refrangibility. I then turned the telescope of the spectroscope over the whole spectrum, from the red to the extreme violet, but I could see no other bright lines than those near the green. My time was now nearly run out, and I turned the telescope again upon the brightest of the lines, and brought the wire of the micrometers to fix its position. The telescope remained untouched until after the totality, when the micrometer was read and the position of the line referred to the Fraunhofer's line near it. This bright line appears to agree in position with the one observed by Young. I am satisfied with the results obtained, considering the instrumental means at my disposal. I have made magnetical observations at three stations, and hope yet to reach the Orange River for the same object. Mr. Carson and Mr. Hall have been kind to an extent that I could never have expected, and have thrown all manner of facilities in our way."

It will be seen that the results obtained by Mr. Stone confirm in an important manner several observations made on the eclipses of 1869, 1870, and 1871. The position of the coronal line 1474 scarcely required confirmation, but the two less refrangible coronal lines observed by Pogson in 1868 have been again seen. The coronal atmosphere was apparently, as might have been expected at this period of minimum sun-spots, smaller than in 1871, while the dryness of the air reduced the atmospheric

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corona to a minimum. The spectrum of the reversing layer was again seen, thus confirming Young's and Pye's observation of 1870, and the hydrogen lines were seen high up, as in 1870 and 1871. The most important observation, perhaps, made by Mr. Stone is that referring to visibility of the Fraunhofer lines in the spectrum of the coronal atmosphere, showing thereby that that reflects the light of the photosphere.

In a letter to Mr. Solomon, written the day after the eclipse, Mr. Stone states on this point :—" The corona presented a spectrum of a mixed character. I have a strong opinion, amounting almost to certainty, that traces of Fraunhofer's lines were visible, but very difficult to observe, on account of the faintness of the spectrum. The other part of the spectrum of the corona was discontinuous, consisting of three bright lines."

The fact that Mr. Stone has been fortunate both in his weather and in his observations, makes us regret all the more that, the observatory station being so accessible, more efforts were not made in other directions, especially in the direction of photography. A series of photographs taken during the totality, which lasted over 3½ minutes, would have been a precious boon to Science, as the coronal condition of the sun at the periods of maximum and minimum sun-spots could then have been compared. In solar physics, however, we must at present be thankful for small mercies. We willingly agree that a Transit of Venus is a phenomenon to be observed at all cost, but we also affirm that a total eclipse of the sun is, in the present state of knowledge, a phenomenon not second in importance, and we trust that our scientific leaders will not forget that there is a very favourable recurrence of the phenomenon next year.

We are sorry to see that there is a chance of Mr. Stone being left to defray, out of his own pocket, the expenses of an important series of observations, undertaken on his Eclipse journey, on terrestrial magnetism. The *Cape Argus* properly points out that they should be defrayed out of Colonial funds. They are a contribution to Colonial knowledge, and we cannot doubt that the Colonial Government will readily place on the estimates the amount required to meet the cost of transport, which is all that is asked. Mr. Stone gives his own invaluable services and scientific skill without charge ; the cost of his journey, so far as the eclipse is concerned, goes to Imperial account ; and all that is asked from the Colony is his expenditure on additional journeys, viz. as far as the Orange River, for the magnetic observations referred to. We were very much surprised to hear that any hesitation should have been shown by Government in giving their sanction to the application when first made, and are almost still more surprised to find that it has not been formally acceded to since then. We admire economy, but do not admire parsimony ; and we are perfectly certain that no sort of vote would be passed more heartily and unanimously by Parliament than that for the paltry amount of some sixty or seventy pounds sterling required to defray the expenses of these magnetic observations.

The same number of the *Cape Argus* gives us some information also as to the effect of the eclipse upon the natives. A digger at the diamond-fields told his natives that if they did not find a big stone that day they would see something in the firmament that would frighten them. Just as the darkness was commencing a Kafir brought a 45-carat diamond that had been found a few hours previously. In Natal the Zulus stopped work when the eclipse began, and resumed when it was over, demanding two days' wages, the eclipse, in their opinion, having been a short night. The general effect on the natives at the diamond-fields is thus described in a local paper :—" The natives rushed out of their claims horror-stricken, and said that the sun was dying. The grandest living tableau ever seen was the great gathering of horror-stricken nudes on the Colesberg Kopje, watching, with fearfully rounded and glaring eyes, mouth open and fingers pointed at what they believed to be the dying moments of the Almighty luminary whose majesty is the only God they know. The effect of the eclipse on the imagination of the natives, as depicted in their countenances, is described as terrible. They grouped together upon the heights of the Kopje and on the top of Mount Ararat, silent and awe-stricken. The natives knew nothing of the meaning of the ghastly light that preceded the darkness ; gloom came upon their labours silently as a thief in the night, and it was not until the whole of the mines presented a sulphureous appearance that they left their work. When they did leave it they left it with a rush, crying one to the other, ' The sun is dying.' "

FOOD AND DIETETICS

A Treatise on Food and Dietetics. By F. W. Pavy, M.D., F.R.S. (J. and A. Churchill.)

THE want of a scientific work on Food and Dietetics has been much felt for some time. Experiments in various directions, both physiological and pathological, have been long accumulating, and have much needed arrangement and satisfactory condensation. Dr. Pavy has supplied the deficiency, and in the work before us gives an excellent account of all the most important observations which have any bearing on the subjects he discusses, tempered by the results of his own extended and judicious experience.

Our knowledge of foods in the chemical, zoological, and botanical point of view, that is as far as composition and derivation are concerned, is considerably in advance of our acquaintance with the true physiological bearing of the facts ; and in this section of the subject Dr. Pavy does not attempt to do more than give the well-known analyses and descriptions of previous workers. His object, in the portion of the book devoted to the alimentary principles and the principles of dietetics, is to show how the tendency of modern experiment is to modify and almost subvert the ingenious theories of Liebig as to the functions of the different constituents of our customary diets.

After some introductory remarks on the dynamical relations of food, in which a simple explanation is given of the results obtained by Grove, Mayer, and Joule, as far as they affect the physiology of alimentary principles, the constituent elements of food are discussed both theoretically and practically. Physiologically the separation of the ingesta into " food " and " drink " is shown to be unsuitable. " The two material factors of life are food and air ; and food may be considered as comprising that which contributes to the growth and nutrition of the body, and, by oxidation, to force-production." The great question of the relation of nitrogenised and non-nitrogenised matter to external body-work performed is entered into in considerable detail, and the important experiments of Fick and Wislicinus, Parkes, and Austin Flint, are described in full; to them being added others, performed by Mr. Mahomed in the author's laboratory, on the length of time required for the elimination of the products of metamorphosis of an increased amount of nitrogenised food, from which it may be inferred that urea is produced and eliminated within the three hours following the ingestion of the nitrogenised matter.

It is shown that the original theory of Liebig, in which it is assumed that muscular action involves the destruction of muscular tissue, which till lately has been so generally accepted, "although, in reality, constituting a speculative proposition, unsupported by anything of the nature of proof," is opposed to all the results of recent investigation, and that if it were true "we should have to look upon nitrogenous alimentary matter as forming, through the medium of muscular tissue, the source, and the only source, of muscular power. The renewal of muscular tissue for subsequent oxidation in its turn, and evolution of muscular force, would thus constitute one of the functions of nitrogenous alimentary matter; and on its supply would accordingly depend our capacity for the performance of muscular work." Great stress is laid on the necessity for the combination of nitrogenised with non-nitrogenised food for the sustenance of the body in a vigorous condition; and Mr. Savory's experiments on this point are shown to be quite insufficient to prove the inference which has been frequently drawn from them, namely, that nitrogenous matter, combined only with the appropriate saline principles, suffices for the maintenance of life.

The author reduces the unnecessarily extensive literature on the action of alcohol, which is so very negative in character, into a very moderate space, remarking that "from a review of the evidence as it at present stands, it may reasonably be inferred that there is sufficient before us to justify the conclusion that the main portion of the alcohol ingested becomes destroyed within the system; and if this be the case, it may be fairly assumed that the destruction is attended with oxidation and a corresponding liberation of force, unless, indeed, it should undergo metamorphosis into a principle to be temporarily retained, but nevertheless ultimately applied to force-production. The subject appears to me to be open to physiological as well as chemical investigation, and probably some additional light may be hereafter thrown upon it by an approach through the former channel."

The discussion of the sources of each of the different most important articles of diet is followed by a concise account of its practical value. In the present time of excessive tea-drinking, the following description of the action of tea is of particular interest. "To express in a few words the advantages derivable from the use of tea, it may be said that it forms an agreeable, refreshing, and wholesome beverage, and thereby constitutes a useful medium for the introduction of a portion of the fluid we require into the system. It secures that the water consumed is safe for drinking by the boiling which is necessitated as a preliminary operation in making tea. It cools the body when hot, probably by promoting the action of the skin; and warms it when cold, by virtue, it would seem, of the warm liquid consumed. In a negative way it may prove beneficial to health by taking the place of a less wholesome liquid. Through the milk and sugar usually consumed with it in England, it affords the means of applying a certain amount, and not by any means an insignificant amount, viewed in its entirety, of alimentary matter to the system. Experience shows that it often affords comfort and relief to persons suffering from nervous headache. It also tends to allay the excitement from, and counteract the state induced by, the use of alcoholic stimulants; and further, on account of its anti-soporific properties, like coffee, it is useful as an antidote in poisoning by opium."

Besides the important purely physiological problems that are entered into in the work before us, there are so many which have a strictly practical bearing, and they are treated in so clear and impressive a manner, that the ordinary reader cannot but feel that he has derived great benefit from a careful study of its contents. Much stress is laid in the chapter on Practical Dietetics on the importance of a midday meal:—"A fairly substantial meal should be taken at this time, and it does not signify whether it goes under the name of luncheon or dinner." Carnivorous animals apparently thrive best when fed at long intervals; herbivorous, when they are constantly eating. Man being omnivorous, his food should be taken at intervals of much less duration than the carnivora, and therefore in diminished quantities at each, three fairly substantial meals during the day, at intervals of five or six hours being found the best in the long run. "There are many business or professional men who, after leaving home for their office or chambers in the morning, do not taste food, or, if they do, take only a minute quantity, until they return in the evening. Actively engaged all day, their system becomes exhausted, and they arrive home in a thoroughly jaded or worn-out condition. They expect that their dinner is to revive them. It may do so for a while, but it is only a question of time how long this system can be carried on before evil consequences arise." It is therefore stated as a *sine quâ non* that the interval between breakfast and late dinner should be broken by a repast about half-way between them.

LETTERS TO THE EDITOR

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

Physical Axioms

MR. COLLIER's letter demands from me a reply, which I will endeavour to make as brief as possible.

Mr. Spencer, instead of answering the difficulties which I had shown his *à priori* view of the Second Law of Motion to involve, only noticed my remarks to dismiss them summarily with the lofty sentence that I "proposed to exemplify unconsciously-formed preconceptions," and had committed an absurd blunder in so doing. And now, because it did not appear to me worth while, at the expense of your space and your readers' patience, explicitly to repudiate any such lofty purpose, and so, adopting Mr. Spencer's words, I merely called attention to the fact that the example (of whatever it might be considered to be an exemplification) was of Mr. Spencer's own choosing, I am charged by Mr. Spencer's follower, Mr. Collier, with having "confused issues," which I neither raised nor accepted. If Mr. Collier will do me the favour of reading my original note again, he will find that the object of my remarks was simply to test the truth of a definite assertion by Mr. Spencer that "the Second Law of Motion is an immediate corollary of the preconception of the exact quantitative relation between cause and effect." It was entirely beside my purpose to discuss the general psychological question of the formation of conceptions or preconceptions farther than as it is involved in the truth or otherwise of this particular assertion. Mr. Collier's note is therefore, as far as regards my remarks, entirely irrelevant and needs no other reply than to invite him, as Mr. Spencer declines to do so, to answer the simple and definite questions proposed by me as difficulties which Mr. Spencer is bound to answer, unless he is prepared to admit that he was wrong in the assertion on which I commented.

I have assumed throughout that Mr. Spencer means to assert that the Second Law of Motion is *involved in*, not merely that it *involves*, a particular preconception. And yet this latter is all that Mr. Collier asserts in the summing up of Mr. Spencer's argument, with which he concludes his note. If Mr. Collier truly represents Mr. Spencer, I can only say that, while the assertion may be admitted to be true, it certainly appears to me to be so trite as to be hardly worth formulating. The whole question turns on the distinction between "involving" and "being involved in," which I suppose Mr. Spencer and Mr. Collier would regard as an important one, though it is difficult in some cases to make out distinctly from their language and their line of argument which they mean to imply.

Passing in conclusion beyond the particular issue to which I have hitherto confined myself, I would remark that to my mind all that Mr. Spencer's and Mr. Collier's illustrations prove is that, while unconscious experiences (whether individual or inherited) may give rise to certain general, but (except in the very simplest cases) vague, preconceptions, it is only when these preconceptions are wedded to consciously-made observation or experiment that they cease to be barren generalities and give birth to the fruitful laws of Physical Science. To a mathematician, at any rate, it is almost ridiculous to observe how little either Mr. Spencer or Mr. Collier seem to realise the great gap between the indefinite observation that two things always increase and decrease simultaneously, and the definite conclusion that they are proportional to one another. For example, it is hardly a parody of Mr. Collier's remarks to say :—"A child discovers that the greater the angle between his legs the greater the distance between his feet, an experience which implicates the notion of proportionality between the angle of a triangle and its opposite side ;" a preconception, as it appears to me, with just as good a basis as that whose formation Mr. Collier illustrates, but one which, as I need hardly add, is soon corrected by a conscious study of geometry or by actual measurement.

Harrow, May 25 ROBT. B. HAYWARD

MR. COLLIER'S letter, NATURE, vol. x. p. 43, is even more astonishing than anything that Mr. Spencer has written. A mathematician who reads it feels something like Alice behind the looking-glass ; and perhaps behind the looking-glass it may be "a question pertaining to the psychological basis of inductive logic," with which mathematicians, as such, have nothing to do. But in this world, this side the looking-glass, in which forces are measured and effects are measured, Mr. Collier's letter is very perplexing.

For example, after giving several instances in which a greater force produces a greater effect, Mr. Collier proceeds: "The experiences these propositions record all implicate the same consciousness—the notion of proportionality between force applied and result produced : and it is out of this latent consciousness that the axiom of the perfect quantitative equivalence of the relations between cause and effect is evolved."

Does Mr. Collier know what proportionality means? Does any one of the experiments indicated prove that where effort is doubled the result is *doubled?* The child pulls his boat by a string through the water ; if he pulls twice as hard does he pull it *twice* as fast?

It seems to me that the people on the other side of the looking-glass think perfect quantitative equivalence (however measured) means the same as proportionality ; and are willing to raise first the general result of experience, that greater forces produce greater effects, into an axiom of exact quantitative equivalence (without troubling themselves to consider how quantity is to be estimated), and then to accept Newton's Second Law as an instance of this quantitative equivalence, without showing any connection between quantitative equivalence and direct proportionality in that instance or in any other.

A SENIOR WRANGLER

Ocean Circulation

MR. CROLL will doubtless be of opinion that as my "theories" show such an utter ignorance of "even the elements of physics and mechanics," I can employ my time much better in acquiring some knowledge of those sciences, than in continuing to discuss the subject with him.

I shall be glad to be allowed to state to the readers of NATURE, as I have to those of the *Philosophical Magazine* (May), other grounds on which I must decline to prolong this discussion.

1. Mr. Croll has charged me (Phil. Mag. for March, p. 177, note) with a serious misstatement in regard to the mean annual rate of the Gulf Stream, which he affirms to be *nearly double* what I have represented it. Now *my* statement was avowedly based on the *average of the whole year's observed rates;* whilst Mr. Croll has taken as the basis of *his* the arithmetical *mean* between the maximum and the minimum. It has been said in disparagement of statistics that "anything can be proved by figures ;" and Mr. Croll, who is nothing if not a statistician, seems to me to justify the imputation, for the adoption of his method would make the *average* number of children of a marriage to be at least *ten!*

2. Mr. Croll, in asserting that I have left out of consideration "the fact that the sea is salter in intertropical than in polar regions, and that this circumstance, so far as it goes, must tend to neutralise the difference of temperature," has only exhibited his own ignorance of a very important fact of Ocean Physics—the *low* salinity of equatorial surface-water ; which was ascertained in Kotzebue's voyage fifty years ago, has been confirmed by many later series of observations, has been repeatedly cited in text-books, and has been adduced by myself as an indication that polar water is continually ascending from the bottom to the surface under the equator. But further, not only has this fact been confirmed by the *Challenger* observations, but so remarkable an accordance has been shown by them to exist between the low specific gravity of equatorial *surface*-water and that of equatorial *bottom*-water, as strongly to indicate that, as the latter is certainly polar, the former is so also. It suited Mr. Croll's purpose, however, with these observations before him, completely to ignore them, and to state as fact what is the precise contrary of facts.

3. According to Mr. Croll and his anonymous authority, the Astronomer Royal must be unfamiliar with even "the elements of physics and mechanics ;" for, speaking from the chair of the Royal Society in 1872, he explicitly expressed his acceptance of the doctrine I advocate, as "certain in theory and supported by observation." The eminent meteorologist, Prof. Mohn, of Christiania, also, who expressed to me in writing last year his acceptance of it, must be equally ill-informed ; as, too, must be Dr. Meyer of Kiel, who has been engaged for four or five years past in the investigation of the physics of the Baltic, the North Sea, and their connecting channels, and who has satisfied himself so completely of the power of small differences of specific gravity to put large bodies of water in motion. I have *nowhere said* that no eminent physicist shares Mr. Croll's objections ; though I have not myself met with such a one.

I regret to have been forced, by the personal attacks in which Mr. Croll has latterly thought fit to indulge, thus to retort upon him. Henceforth I shall not consider myself called upon to take any notice of assertions and arguments which I do not find to exert the least influence on the opinions of the eminent scientific men with whom it is my privilege to associate.

WILLIAM B. CARPENTER

Glacial Period

IN answering Mr. Bonney's letter in NATURE, vol. x. p. 44, I shall confine myself to the consideration of his second objection to my theory, as the precise southern limit of the glacial action is not of present importance, and the height of the Scandinavian sea-beaches is irrelevant to the inquiry.

Mr. Tiddemann, in an admirable paper On the glaciation of North Lancashire (Quart. Journ. Geol. Soc., vol. xxviii. p. 471), has mapped out the course of the ice as shown by scratched rocks, lines of transported boulders, carriage southwards of local drift, and direction of overturned edges of shaly strata, and proved that it did not flow down the valleys to the westward, but passed across them and the ranges separating them, from the north to the south. On the other side of the Irish Sea the Rev. Mr. Close and others have shown that there also the ice did not move down the valleys, but flowed along the coast southwards. The ice-scratches still preserved on the rocks prove that the configuration of the land was nearly the same then as now, and no explanation has ever been offered of this southerly movement of the ice, excepting that it was prevented from flowing down the natural slope of the land by the whole of the Irish Sea having been at the time filled with ice up to a height of about 2,000 ft. above the present sea-level. The Isle of Man, that lay in the path of this great ice-stream, is glaciated from top to bottom, and it must have been completely buried in ice. It is to the action of this great agent that I ascribe the pushing up of sand and shells over south Lancashire, Cheshire, and North Wales on one side, and Wexford and around Dublin on the other, of the Irish Sea, where the course of the ice southward was obstructed by the narrowing of the channel.

So far from the movement of this great mass of ice being deflected or warded off by local glaciers, we have seen that in north Lancashire it was not affected by them; and long ago Prof. Ramsay proved that the glaciation of Anglesea and the west of Caernarvonshire had not radiated from the high land, but that the ice had come from the north and brought with it numerous boulders from the mountains of Cumberland.

As to the possibility of ice, pushed forward by higher accumulations behind it, thrusting before it loose sand and shells up to higher levels, I may remark that there are many proofs that it possesses this power. In the Isle of Man blocks of granite have been pushed up 600 feet above the level of their source. Mr. Tiddemann has also shown that as the ice moved across the valleys down one side and up the other, it thrust over the edges of the strata. On the other side of the great English watershed, Mr. Dakyns has shown that the ice when ascending the slope of a valley opposed to its course swept before it all the drift lying on the surface, pushing it over to the other side of the range.

Mr. Bonney would be more likely to damage my theory if, instead of protesting against it, he could explain some of the many difficulties that beset that of submergence. Where was the shore of that mythical sea under which England nearly to the Thames is supposed to have been submerged? How is it that not a single undisturbed bed of glacial shells has been found, that nearly all are broken to pieces, that many fragments of Cyprina exhibit glacial scratchings, and that not a single instance has been recorded of the two valves of a lamellibranch having been found together? Was there no friendly cliff or cavern able to preserve a single shell from the ruthless second advance of the ice? Mr. James Geikie finds the fragile bones of water-rats and frogs in his "inter-glacial beds," and uninjured land and fresh-water shells occur in abundance; but not one marine shell has been found in the uplands that does not show proof of having been transported, by being broken, worn, or scratched.

Since my first letter was sent to NATURE, Prof. Ramsay has drawn my attention to Mr. Croll's theory, that the glacial shells of Holderness had been pushed up by ice over the land out of the German Ocean. From other papers of the same geologist, I gather that he does not dispute the submergence of much of England and Scotland during part of the glacial period, and has indeed proposed a theory to account for it. So far as I know I stand alone at present in the opinion that neither during nor since the glacial epoch has there been any submergence of a great part of the British Isles beneath the waters of the ocean, nor can I expect that a theory so contrary to what has been taught for many years by English geologists will obtain a ready acceptance.

THOMAS BELT

Ealing, May 22

Uncompensated Chronometers

WITH reference to the employment of an uncompensated chronometer to indicate the mean temperature of an accompanying compensated chronometer during a long journey, with a view to the application of the proper correction for temperature, Prof. G. Forbes remarks (NATURE, vol. x. p. 50):—

"This method is quite new, and has not been tested by any nations except the Russians."

Permit me to direct attention to the following passage in the "Report on the Coast Survey," which I extract from p. 66 of the Proceedings of the American Association for the Advancement of Science, Springfield meeting, August 1859. The "Cambridge" referred to is Cambridge, Massachusetts.

"The difference of longitude between Cambridge and Liverpool has also been determined by means of large numbers of chronometers carried repeatedly between the two stations on the Cunard steamships. These chronometric expeditions, in the words of Mr. W. C. Bond, director of the Harvard Observatory, 'for the magnitude and completeness of their equipments, have not been equalled by any of the similar undertakings of European Governments. Even the *Expedition chronometrique* of Struve was on a scale much less extensive.' The voyages were continued through a number of successive years. The first great special expedition took place in 1849, and the most recent in 1855. In the latter the effect of temperature on the rate of the chronometers formed a subject of special investigation. For each instrument the effect of temperature on its rate was ascertained by experiment, and the average temperature during each trip was kept account of by means of a thermometric chronometer, constructed like the others, but with individual balance, so that its daily rate was affected by six seconds for a change in temperature of 1° Fahr. Fifty-two chronometers were employed in this expedition, and were transported six times between Cambridge and Liverpool."

The "Greenwich Observations" for many years past (fifteen at least) contain a record of the indications of a "chronometrical thermometer" accompanying the chronometers on trial for purchase by the Admiralty; and on p. 2 of "Rates of Chronometers" in the volume of Observations for 1871 are these words:—

"The chronometrical thermometer differs from an ordinary chronometer only in the construction of the balance, the positions of the metals forming the compensating rims being reversed. By this arrangement the effect of temperature is much magnified."

J. D. EVERETT

Malone Road, Belfast, May 22

Photographic Irradiation

IN NATURE, vol. x. p. 29, the article on the coming Transit of Venus makes mention of photographic irradiation as having "been found by Lord Lindsay and Mr. A. C. Ranyard to be mainly due to the reflection of light from the back of the glass plate. It can be almost entirely avoided," Mr. Forbes goes on to say, "by wetting the back of the plate and placing black paper against it." This subject has been investigated, explained, and the above remedy suggested years ago by practical photographers. In 1867 I used the plates of the Liverpool Dry Plate Company, then sent out with the backs painted red to prevent irradiation.

But even this is not a complete preventive. Colouring the film, as suggested by Mr. Carey Lea of Philadelphia and Henry Cooper, a well-known English amateur, is a much more effectual means, though at a loss of sensitiveness; but the most complete (where the dry emulsion process is available) is to allow the collodion to be acted on by a large excess of nitrate of silver for a considerable time and then to convert this into bromide of silver by addition of ammonium bromide. The result is that the film has a dull opaque character like unglazed porcelain, and not only stops the light more completely than an ordinary collodion film, but remedies another cause of irradiation—the molecular reflection in the film itself.

Two years ago I tested plates prepared in this way on the most difficult subjects (not astronomical) and found the halation much less than by any other means except a deep red tint in the film.

W. J. STILLMAN

Hay Fever

REFERRING to the recent article in (NATURE, vol. x. p. 26) upon hay fever, I can give my own experience as having suffered from the complaint for some years past, mainly in the months of May and June. My most severe attacks have been in the house in early morning. I am, however, near hay-fields, and a tramp, by way of experiment, through one of these has more than once satisfied me of the efficacy of the hay pollen in vastly increasing the troublesome symptoms.

The treatment I have used to myself has consisted of rather strong doses of quinine taken internally, and externally a piece of linen rag dipped in strong camphorated spirit and placed upon the nose and also partly over the nostrils.

Inhaling the vapour of a piece of camphor inclosed in a small silver tube, and carried in the mouth like a cigar, has also, I know, been used with effect. I have judged that the attacks are, to a certain extent, connected with a depressed or relaxed state of the system, partly from the time (early morning) when I have found them at their worst, and partly from the fact that in a pure bracing air like Switzerland I do not get them, even in the haying season. A French lady with whom I once travelled by train tried to satisfy me I had only influenza (*la grippe*), but our passage through a hay-field soon brought on such a succession of sneezings, &c., that I was quickly accorded the honour of a distinct disease.

I tried the homœopathic remedy of extract of hay grasses in spirit, upon the advice of a friend, but I very soon came back again to my allopathic doses of quinine and camphorated spirit, and from these alone have I found any real benefit. I have not yet tried the solution of quinine applied to the nostrils.

Guildford, May 18 J. RAND CAPRON

THE STEAMSHIP "FARADAY" AND HER APPLIANCES FOR CABLE-LAYING*

THE lecturer in his introductory remarks observed that an electric telegraph consisted essentially of three parts, viz., the electro-motor or battery, the conductor, and the receiving instrument. He demonstrated experimentally that the conductor need not necessarily be metallic, but that water or rarefied air might be used as such within moderate limits; at the same time, for long submarine lines, insulated conductors strengthened by an outer sheathing were necessary to insure perfect transmission and immunity from accident. The first attempts at insulation, which consisted in the use of pitch and resinous matters, failed completely, and in the years 1846 and 1847 the two gums india-rubber and gutta-percha were introduced, the former by Prof. Jacobi of St. Petersburg, and the latter by Dr. Werner Siemens of Berlin; this last gum soon became almost indispensable to the cable manufacturer on account of its great plasticity and ductility.

The first outer sheathing used was a tube of lead drawn tightly over the insulated wire, and this again was covered with pieces of wrought-iron tubing connected by ball and socket joints; in this way the Messrs. Siemens successfully crossed various rivers. This method was superseded later on by the spiral-wire sheathing, first proposed by Mr. Bret in 1851 for the Dover and Calais cable; since then, with few modifications and exceptions, this form has been universally adopted.

The lecturer next enumerated the casualties to which submarine cables are liable, and the precautions employed to obviate them. He showed specimens destroyed by rust and the ravages of a species of Teredo. On the Indo-European line a curious case of fracture occurred; a whale, becoming entangled in a portion of cable overhanging a ledge of rock, broke it, and in striving to get free had so wound one end round its flukes that escape became hopeless, and so had fallen an easy prey to sharks, which had half devoured it when the grappling iron brought his remains to the surface. Other enemies to be dreaded are landslips, ships' anchors, and abrading currents.

The new Atlantic cable consists, for the deep-sea portion, of copper conductors, gutta-percha insulators, and a sheathing of steel wires covered with hemp; the shallow-water part consists of similar conductors and insulators sheathed with hemp, which in turn is covered with iron wire.

In paying out, the great point to be observed is that no catenary should be formed, but that the cable should be a straight line from the ship to the sea-bottom; the retaining force should be equal to the weight of a piece of cable hanging vertically downwards to the bottom of the sea. In picking up, a catenary is formed, but a vertical position is the best.

From the peculiar nature of the service for which a telegraph-ship is required, it is evident that she must possess properties somewhat different from those of ordinary ocean-going steamers; thus speed is not so important as great manœuvring powers, which will enable her to turn easily in a small space, or by which she may be maintained in a given position for a considerable time. In the ship about to be described an attempt has been made to meet these requirements.

The *Faraday*, of 5,000 tons register, was built at Newcastle by the eminent firm of Messrs. Mitchell & Co.; she is 360 ft. long, 52 ft. beam, and 36 ft. depth of hold; there are three large water-tight cable tanks having a capacity of 110,000 cubic ft., these are each 27 ft. deep, two are 45 ft. in diameter, and one is 37 ft., they can take in 1,700 miles of cable $1\frac{1}{4}$ in. in diameter. After the cable is coiled in, the tanks are filled up with water to keep it cool, for the lecturer had found, when conducting experiments on the Malta and Alexandria cable with his electrical resistance thermometer, that heat was spontaneously generated in the cable itself, whereby its insulation was seriously endangered.

The *Faraday* has stem and stern alike, and is fitted with a rudder at each end; both are worked by steam-steering apparatus placed amidships, and are capable of being rigidly fixed when required. She is propelled by a pair of cast steel screws 12 ft. in diameter, driven by a pair of compound engines constructed with a view to great economy of fuel. The two screws converge somewhat, and the effect of this arrangement is to enable the vessel to turn in her own length when the engines are worked in opposite directions. On the voyage from Newcastle to London a cask was thrown overboard, and from this as a centre the ship turned in her own length in 8 minutes 20 seconds, touching the cask three times during the operation. This manœuvring power is of great importance in such a case as repairing a fault in the cable, as it enables the engineer to keep her head in position, and, in short, to place her just where necessary in defiance of side-winds or currents.

The testing-room of the electrician in charge is amidships, and so placed as to command the two larger tanks, while the ship's speed can be at all times noted on the index of a Berthou hydrostatic log.

The deck is fitted with machinery to be used in laying operations, which will be best described by tracing the path of the cable from the tanks to the sea. Let us begin with the bow compartment: the cable, which lies coiled round one of Newall's cones, begins to be unwound, passes up through an eye carried on a beam placed across the hatch, next over a large pulley fitted with guides, and by a second pulley is gently made to follow a straight wooden trough fitted with friction rollers, which carries it aft to near the funnels; here it passes through the "jockey," which is a device for regulating the strain, consisting of a wheel riding on the cable, which can be adjusted by a lever, and a drum fitted with a brake, thence it passes on to a "compound paying-out and picking-up machine;" this consists of a large drum provided with a friction brake, and round it the cable passes three times; it is also furnished with a steam-engine, which by means of a clutch can be geared on to the drum when required. Now in paying out, the cable causes the drum to revolve as it runs over it, and the brakes regulate the speed as the vessel moves onward; but should a fault or other accident render it necessary to recover a portion, the drum is stopped and geared on to the engine, the ship's engines are reversed, the stern-rudder fixed; and so what was formerly the bow is now the stern, while the little engine hauls in the

* Abstract of a lecture delivered at the Royal Institution on May 15.—By C. William Siemens, D.C.L., F.R.S.

cable over the same drum which before was used to pay it out; thus it is coiled back into the same tank whence it started. By this means the necessity of passing the cable astern before proceeding to haul it in is avoided. It was during this operation that an accident befell the Atlantic cable in 1865, causing its loss for the time.

The next apparatus is a dynamometer, consisting of three pulleys, one fixed, and the centre one, which rests on the cable, movable in a vertical plane; by this the strain is registered and adjusted. After passing this the cable runs into the sea over a pulley carried on girders and constructed so as to swing freely on an axis parallel to the length of the ship, so that, should the vessel make lee-way, the pulley will follow the direction of the cable, and thus friction and sharp bends are avoided. The bows are also fitted with a similar pulley, compound machine, and dynamometer. We see that by these devices the cable is kept perfectly under control, and should a fault be discovered a simple process of reversal of ship and machinery brings home the faulty portion.

Another great point is to keep the vessel trimmed and steady. For the former requirement nine separate water-tight compartments, including the cone in each tank, which also is hollow, are provided, so that water may be admitted as the tanks are emptied of cable, and thus the ship is kept trimmed. To ensure steadiness and avoid the rolling to which telegraph ships are subject, two bilge keels are set on at an angle of 45°; this was done at the suggestion of Mr. Wm. Froude, whom, said the lecturer, "I have to thank for valuable advice and assistance on several new points connected with the *Faraday*."

A steam-launch is carried on deck, whence she can be lowered into the water with steam up, ready to land shore ends and perform other useful details.

Another class of work for which the vessel is fitted is "grappling" for lost or faulty cable. In shallow seas this is a very simple operation, but in deep water it is rather a delicate matter, and requires the co-operation of two or even three vessels, so as to lift the cable without forming an acute angle, and thus to lessen the chance of fracture or strain. A special rope made of steel wire and hemp, and of great strength, is provided for this kind of work. Some specimens shown could bear strains up to 16 tons.

In conclusion, the lecturer paid a high compliment to the late Prof. Faraday, noticing the great services he had rendered to electrical science, his singleness of purpose, and the invariable kindness with which he had encouraged younger labourers in the same field. The friendly encouragement which he himself had experienced from him would ever remain a most pleasing remembrance. He had seized with delight on the present opportunity to pay a tribute to the honoured name of Faraday, and was happy to be able to do this with the full consent of the revered lady who had stood by the philosopher's side for forty years, while labouring under this very roof for the advancement of knowledge. The name of the vessel and her mission in the service of Science would combine, he thought, to create an interest in her favour in the minds of the members of the Royal Institution, and he hoped that on the morrow she would put to sea accompanied by the earnest wish, "God speed the *Faraday*."

ATMOSPHERIC CURRENTS AS OBSERVED IN THE WEST INDIES, AND PARTICULARLY IN ST. THOMAS

DURING an average period of nine months in the year the regularity of the air-currents over the Virgin group resembles clockwork. The surface, or lowest current, is formed by the trade-wind, which blows briskly from the north-north-east, with a slight variation northward during the night and early morning, and a corresponding deflection southward from noon till near sunset. Varying in strength from a light breeze to a brisk gale, it is hardly ever absent; its greatest strength is usually at or near 3-4 A.M., and about the same hours P.M. It generally bears with it light masses of cumulus, from which there fall occasionally showers, heavy, but very short in duration. This air-current, known as the trade-wind of these regions, does not appear to exceed 2,000 feet in vertical height.

Next above this current comes the south-west wind, rarely absent; it brings with it light cirrus clouds, but seldom cumulus or other indications of rain; its excess of moisture having been probably discharged while crossing the mountains of the South American continent. Very rarely, indeed, does this wind descend low enough to have effect on or even near the surface; when it does so, which generally occurs during the summer and autumn months, it is deflected to the south, and then becomes loaded with moisture, and accompanied by heavy nimbus clouds and electric phenomena.

Highest of all the west wind reigns, manifested by very light cirrus clouds, rapidly formed and as rapidly disappearing; it has at times a slight deflection to the north.

These three winds blow with scarcely any interruption from November to June inclusive; almost the only variation being then afforded by the north or north-north-east wind which sometimes prevails, but near the surface only, for a few days together during three winter months. When —a rare but much-desired event—a southerly current occurs about this time, it brings heavy clouds and abundant rain. While the wind is from the north and north-east, great dryness is indicated by the hygrometer.

But in the months of August, September, and October, and often in the latter half of July, the polar or north-east current loses its strength, and is often neutralised or even conquered by the southerly winds. These during the summer are usually light, and accompanied by a clear and serene sky, only clouded when the north-east, regaining for a time its supremacy, drives the south back, and precipitates heavy showers, amid thunder and lightning, sometimes lasting for three or even four hours; after which the wind veers round again to the south-east and south. The same phenomena, when intensified, concentrate themselves into a hurricane or cyclone—a rare occurrence in this island, not more than four of any great severity having taken place at St. Thomas in the course of the present century. Two indeed, but only of medium violence, occurred within these regions last year; neither of them however visited St. Thomas, the one keeping out to sea eastward, and not touching the coast till it reached lat. 44° in its northerly course; the other, which seems to have originated within the Caribbean Sea, did considerable damage on the coasts of St. Domingo and Cuba, passing ultimately north-east by the Florida Channel. Of both I have given details elsewhere (vol. ix. p. 468). Heavy gales, occasionally amounting to storms, sometimes blow here, particularly during the winter months, from between north and north-east, but from no other quarter of the compass. They are accompanied by cold, the thermometer sinking to 74° F., or even lower, with a dull, cloudy sky, and little rain.

Another phenomenon, peculiar to the winter and spring months, are white squalls; they take place on calm days, generally at noon, and most often at no great distance from shore; their area is very limited, and their duration does not exceed a few minutes; in some respects they resemble a miniature hurricane, and appear to be due to similar causes; but neither have I witnessed in them nor heard recorded any instance of circular motion. They are much dreaded by the small craft of these seas; a slight fall of the barometer is their only premonitory indication.

St. Thomas W. G. PALGRAVE

THE COMING TRANSIT OF VENUS *

VI.

HAVING now discussed all the methods to be employed, and the chief difficulties to be encountered, it is time to examine what has actually been done. What method or methods ought to be chosen? What stations are most suitable, taking into account the chances of good or bad weather and good or bad anchorage? What preparations have been made by the various Governments and by private individuals? And are the arrangements satisfactory?

As to the choice of method, the observation of contacts was the only kind originally contemplated. The employment of photography and heliometers is a comparatively new idea, and will be spoken of later. The observation of contacts is applicable to three methods, for each one of which different stations must be chosen; these are Halley's method, the method of durations, and De l'Isle's method. We will consider these in order.

1. Halley's method fails totally in the transit of 1874, but *may* perhaps be applied in 1882, though not under good conditions. On referring to Fig. 13 in Article III., it will be noticed that Sabrina Land is a station where in 1882 the transit will commence just before sunset, and end just before sunrise. Hence during the transit this station and another placed in America will be moving in opposite directions, thus fulfilling the conditions required by Halley in his communications to the Royal Society. By referring to Fig. 12 it will be seen that no such stations exist in 1874.

2. The method of durations may be successfully applied, so far as mere geometrical position is concerned, in either of the two transits. This method is really combined of two parts, and includes Halley's as a particular case. The lessening of the duration of the transit depends partly upon the diminished motion of one of the stations, or upon the fact that it moves in the opposite direction to the other; and partly on the fact that in one case the planet seems to trace a path on the sun farther from his centre (and therefore shorter) than in the other. The difference in this last case is greatest when the path of Venus is far from the sun's centre. But in transits like the coming ones, where this is the case, the motion of Venus towards the sun's centre at the time of contact is very much slower than when she describes a large chord upon the sun. This has been well pointed out by Mr. Stone,† and from his paper we learn that the method of durations depending upon two such observations at each of the two stations will not be so satisfactory as we might otherwise have expected. But other very serious objections present themselves to a method like this requiring four observations of contact, when we carefully consider the circumstances. In applying this method, one station must be chosen in high southern latitudes. Now diligent inquiries have been made upon this subject, and it appears very improbable that the weather at any suitable station will be such as to give much hope of observing both the ingress and egress in a satisfactory manner. Hence if we depended upon this method there would be a great probability of the expedition proving a failure. The method of De l'Isle requires the observation of only one contact at each of the two stations. For these reasons hardly any expedition will use this method except as secondary to De l'Isle's, the photographic, or the heliometric method.

3. De l'Isle's method. The accuracy with which this method can be applied depends upon the certainty of longitude operations. From what was said in the last article, it will be seen that this is no easy matter; but it is absolutely necessary that it must be done if this method is to be employed. Sir George Airy says that longitudes can be determined with an error of not more than one second by lunar observations; and observers will receive orders to remain at their stations until they have a sufficient number of observations to accomplish this. The lunar observations will be supported, where practicable, by telegraphic determinations of longitude, and also by the transport of chronometers. The Russians, whose stations lie mainly along the whole length of Siberia, will employ a telegraphic line over that region, with branch lines to the subsidiary stations. The English will probably fix the longitude of Alexandria by submarine cable. They will employ chronometers to group together all stations neighbouring each other. The station at Rodriguez will be thus connected with Lord Lindsay's station at Mauritius, and with the French station at Réunion. Lieut. Corbet, R.N., will connect by chronometers the various islands occupied by the Germans, Americans, and French in the neighbourhood of the two English stations on Kerguelen's Island. The three English stations on the Sandwich Islands will likewise be connected by chronometers; and it would be very desirable to connect these islands with San Francisco on the one hand, and Yokohama on the other. The longitudes of both these places will have been compared with Greenwich by telegraph. It would be a matter of the utmost interest to complete the chain round the world by the transport of chronometers across the Pacific. M. Struve says that with the aid of an uncompensated chronometer this might be done with great accuracy. The Germans have also made valuable suggestions for comparing the longitudes of the observing stations of all nations; and the French will also probably help in this matter. Thus it is likely that the longitudes of all the stations of different countries suitable for the application of De l'Isle's method will be very accurately known.

It will be noticed that the accuracy of De l'Isle's method depends upon two longitudes and two observations of contact; while that of durations depends upon four observations of contact. Neglecting all considerations of climate the two methods are, so nearly as the somewhat vague data at our command can tell us, very nearly equal. But the uncertain climate of southern seas renders the chance of many contact observations doubtful and throws the balance in favour of De l'Isle's method. Add to this that before long all the stations except the Kerguelen group will soon have their longitudes determined absolutely by telegraph, and recollecting that the coming observations are to serve astronomers until the next transit of Venus in 2004, by which time even the Kerguelen group may perhaps be chronometrically determined: recollecting all this, there is little doubt that astronomers have been wise in settling upon De l'Isle's method for the main observations of contacts.

It will be well, before going further, to mention the stations which have been chosen by different nations for the observation of the coming transit.

I.—The British, having selected for the reasons above mentioned the method of De l'Isle, originally fixed upon the following stations:—

Alexandria, Sandwich Islands, Rodriguez, Kerguelen's Island, and New Zealand. No alteration has been made in the choice of these stations. Supplementary ones have, however, been added. Thus at Kerguelen's Island there will be two expeditions: one at Christmas Harbour in the north, and the other in the south of the island. In the Sandwich Islands there will be three stations: one at Honolulu, a second on the island of Hawaii, and a third on the island of Kauai, sometimes called by English writers Atooi. The station at Alexandria will be supplemented by a second one at Cairo, and a private one by Col. Campbell, of Blythswood, under the Astronomer Royal's direction at Thebes. The New Zealand station

* Continued from p. 52.
† Monthly Notices of the R.A.S., vol. xxix. p. 250.

will be placed at Christchurch. Since the idea of photography has been introduced, two additional stations have been added by the Indian Government under the superintendence of Col. Tennant, R.E. These are very completely equipped, and will probably be situated the one near Peshawur, the other at Roorkee.

Besides these the observatories at Madras, Cape of Good Hope, Melbourne, and Sydney will be utilised so far as possible. The New South Wales Government have voted 1,000*l*. for other observations in Australia. The English Government have voted 15,000*l*. for all the expeditions, but a much larger sum than this will be actually required. It will be understood that the principal method of observation is De l'Isle's, aided everywhere when possible by all the other methods except the heliometric.

From the account that has been given of the difficulty of determining the longitudes of the different stations it will be seen that no little power of organisation is required for the execution of the foregoing programme. All preparations must be made for the observation of the moon culminators. Alt-azimuths must be made, and also actually invented for the express purpose. Nearly fifty chronometers must be provided, and negotiations must be completed with telegraph companies. The photographic operations have required the invention of a new photoheliograph, and the Janssen method of a new application to it. The observations of contact have required the purchase of a large number of equatoreals; for each station, besides having a 6-inch telescope, has also one or more smaller instruments. One of the larger ones, made by Simms, is shown in Fig. 18. The transit instruments have also been made expressly for this expedition. Besides this all the accessories of these instruments had to be provided. Huts for receiving them had to be made. Forms for entering and reducing the observations had to be prepared and printed. For some of the stations sleeping arrangements, cooking apparatus, washing utensils, and provisions had to be provided. Workmen, masons, and assistant photographers, besides twenty-two observers, had to be collected and trained to the work. When this is considered it will be seen that no ordinary man could fulfil all the duties. Fortunately we have in our Astronomer Royal a man who combines to an exceptional degree theoretical, mechanical, and organising powers; and we may safely say that the present expedition has been completed under a generalship quite unparalleled in the annals of Science. Sir George Airy has accomplished all that was required in a manner that has called forth the applause of those who have been connected with the preparations for this perhaps the most important astronomical event of the century. We must congratulate ourselves upon the fact that he has been most liberally supported on all points by the British Admiralty. If we cannot enter into the same details with regard to other nations, it is only because we have not had the opportunity of learning all their actions. But we cannot conclude this account of the British Government expedition without alluding to the valuable services which have been rendered to it by Capt. G. L. Tupman, R.M.A., who has spent the last three years in training himself and nearly all the other observers in the use of the instruments, seeing the instructions of the Astronomer Royal carried out, ordering the stores, and in the most disinterested manner looking after the expedition; so that (as the Astronomer Royal has lately pointed out) if the observations be successful their success will in a great measure be due to his exertions.

II. Besides the expeditions under the direction of the British Government, another has been prepared which is perhaps the most completely equipped one which has ever been undertaken by a private individual in the interests of astronomy. Lord Lindsay has made preparations to take up his position at Mauritius, provided with means for utilising all the different modes of observation. He will combine his own results mainly with those of the Russians; and it is probable that no station could have been found more suitable for a single observer to occupy when so many different methods are employed. All the instruments are of the most perfect description and made by the best makers. The photographic method which he will employ has been already described. The siderostat has been made expressly for this purpose, and its surface has been tested and found to be truly plane. Lord Lindsay and his assistant Mr. Gill lay considerable stress on the employment of the heliometer, and have discussed its capabilities with great lucidity. They propose to make observations of the external contact by the aid of the spectroscopic method. The expedition will be provided with about 50 chronometers, including one uncompensated. These will be transmitted four times between Aden and Mauritius. It is probable that they will also connect the longitudes of the different stations on that group of islands by chronometers. The German expedition at Mauritius will probably be connected with Lord Lindsay's by a trigonometrical survey. Of these islands two can be connected by direct signals with a heliotrope reflecting the sun's light. From experiments made in Russia, it appears that a signal may thus be seen in a mountainous country with a clear atmosphere at a distance of 200 miles. There is little doubt then that the longitude of each station on this group of islands will be accurately known.

III.—The Germans are sending out five or six expeditions. At Cheefoo the accelerated ingress and retarded egress will be observed; at the Macdonald Islands the retarded ingress and the accelerated egress. The Auckland Islands will be favourable for accelerated egress; Mauritius for retarded ingress, and Ispahan for retarded egress.

They will probably employ all the four methods at most stations, viz. eye-observations of contact, heliometers, photo-heliographs for the distance of centres, and also for position-angles. There will be no photography at Mauritius. Here will be employed four heliometers by Fraunhofer, 3 in. aperture, $3\frac{1}{2}$ ft. focus; four equatorially-mounted telescopes by Fraunhofer $4\frac{1}{3}$ in. aperture, 6 ft. focus; two photo-heliographs by Steinheil, $5\frac{1}{2}$ in. aperture, and two with quadruple object-glasses of 4 in. aperture. Besides these, instruments are required for determining the local time and the longitude; for the Germans lay great stress on De l'Isle's method. For this purpose transit instruments with diagonal telescopes on the Russian method of $2\frac{3}{4}$ in. aperture will be supplied, and alt-azimuths with divided circles 12 in. to 14 in. diameter. The necessity of determining the longitudes accurately has led the German astronomers to consider carfully the best means by which this can be done. Dr. Auwers, to whom the direction of the arrangements has been entrusted, has discussed the matter in a very able manner. It appears from his inquiries that each group of stations will have their longitudes very accurately determined. Thus the stations in east Asia can be connected telegraphically. So also can those about Alexandria; also those about the Caspian Sea and New Zealand. The group of islands near Kerguelen's, the Sandwich Islands group, and the Mauritius group will be determined by chronometers. The only difficulty is to connect these different groups. Many of them will be compared with Greenwich indirectly by telegraph. It is probable that Honolulu will be compared by chronometers with San Francisco and Yokohama, thus completing, as already mentioned, the telegraph and chronometer connection round the world. In any case there is little doubt that before the transit of Venus in 2004 the longitude of Honolulu will be determined by telegraph. Since Lord Lindsay intends to compare the longitude of Mauritius with that of Aden by four chronometer expeditions, aided by an uncompensated chronometer, there is little doubt that the longitude of that group of islands will be accurately known. The group of islands about Kerguelen's will depend very much upon the British observations of the moon; but it will be well if chronometers could be employed to connect it with the Cape. The Germans rely very much upon the heliometric method. It will be a matter of great interest to learn how these observations agree with other methods as a guide to the arrangements for 1882. The expense of this expedition is about 130,000 thalers, besides the expenses connected with chronometric determinations.

The organisation of the German expedition has been entrusted almost wholly to Dr. Auwers, as secretary of the commission. His contributions to the subject are of great value, and the zeal with which he has superintended the expeditions, even in the minutest details, cannot be overvalued.

IV. The Russians are mainly employed in utilising the Siberian stations. The actual places which have been chosen from which to observe the transit are given in the following list, in order from east to west. The numeral 1 appended to a station means that there are good observers, practised with the model, good equatoreals, and a heliometer or photo-heliograph. The numeral 2 signifies the same without heliometers or photo-heliographs. When the numeral 3 is appended, the observer has not practised with the model, and employs a small telescope. The stations are:—

Yeddo 2	Tachkent 1
Port St. Alga 3	Port Peroffski 1
Nakhodka 2	Fort Uralsk 1
Wladivostock 1	Orenburg 3
Port Possiet 1	Aschura-deh 1
Lake Hanka 1	Teheran 2
Chabarovka 2	Nachitzevan 2
Peking 2	Erivan 1
Blagowvschtchenska 2	Tiflis 3
Nertschinsk 1	Taganrok 3
Xhita 1	Kertch 2
Kiachta 1	Ialta 2
Tomsk 3	Thebes 2

Besides these stations the following will be utilised, but the sun will be very low: at Kazan the sun's altitude will be 8° or 10°, at Nicolaif it will be 6°, and at Charkof and Odessa 5°; at Moscow it will be exactly on the horizon.

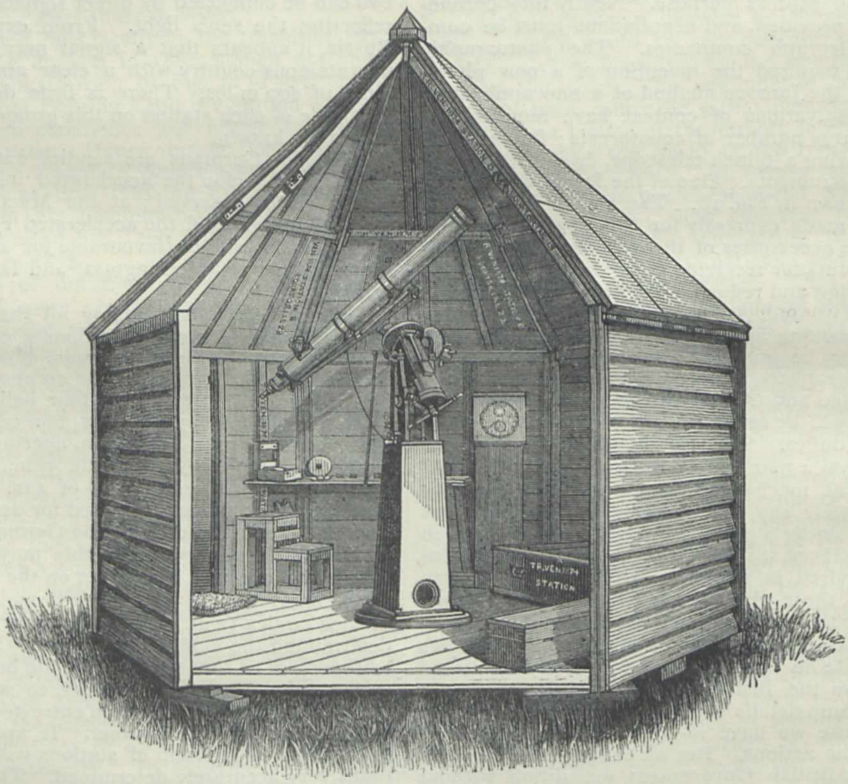

FIG. 18.—6-in. Equatoreal of the British Expedition.

As to instruments, the Russians are employing 6-inch and 4-inch equatoreals. Their heliometers are larger than those of the Germans, having 4 in. apertures. Their photo-heliographs are constructed on the English model by Mr. Dallmeyer. The telegraphic connections between the stations have been already discussed. The expense incurred will be defrayed by the Government. Besides this, the State contributes 45,000 roubles. This will be spent mainly on the transport and maintenance of observers and instruments. The different observatories in Russia have shared the expense of providing the different instruments. The whole expedition has been conducted under the superintendence of M. Otto Struve. Some of the expeditions have already started provided with every means for resisting the cold of a Siberian winter. Great attention has been paid to the chances of good weather. The accelerated ingress and retarded egress will thus be admirably observed; and the comparison which M. Struve has made with observers of other countries in practising with the model will render comparisons possible. Moreover, many of the Russian stations are admirably situated for the employment of the method of durations; and if the two internal contacts be observed at any of the stations in the neighbourhood of Kerguelen's Island excellent results may be obtained.

GEORGE FORBES

(*To be continued.*)

ATOMS AND MOLECULES SPECTROSCOPICALLY CONSIDERED *

LET me commence by congratulating you on the circumstance that this School and the Literary Society connected with it are known over a much more extensive area than Whitechapel. It is some time ago since I first heard of the work which you are attempting to do, and which indeed to a large extent you are doing, in this part of London. All friends of Science must deeply sympathise with your efforts, and I looked upon it as my bounden duty to come here and lecture when asked to do so. I have one more remark to offer: as I knew that my audience would consist if not altogether of old students of Science in this school, still of those largely interested in mental culture and in the acquisition of useful knowledge, I thought it right to ask you to follow me into a region which a few men in lands far apart are now investigating—a region which lies outside the known, and which is being explored by means of the spectroscope. I hope to be able to suggest a few thoughts to some of you, in case you have worked with that instrument, and I hope also to be able to place before those who have not, many facts with which they are already acquainted, in a new point of view.

Now, in the first place, what are Atoms and what are Molecules? A chemist will tell you about the atomic weight of certain elements, and you will hear him talk about molecular volumes, and the like. Here is a definition given by Dr. Frankland in his book on Chemistry ("Lecture Notes," p. 2): "An atom is the smallest proportion by weight in which the element (that is to say the element to which the atom under discussion belongs) enters into or is expelled from a chemical compound." He then points out that when atoms are isolated—that is, when they are separated from other kinds of matter—they do not necessarily exist as atoms in the old sense; they go about in company, generally being associated in pairs. He then defines such a combination of atoms as an elementary molecule. Here, then, is put before us authoritatively a chemist's view of the difference between an atom and a molecule.

Let us now go to the physicist and see if we can gather from him his idea of atoms or molecules. It is remarkable that, in a most admirable book, Prof. Clerk-Maxwell's "Theory of Heat," in which you find nearly all that is known by physicists about molecular theories, the word "atom" is not used at all. We are at once introduced to the word "molecule," which is defined to be "a small mass of matter the parts of which do not part company during the excursions which the molecule makes when the body to which it belongs is hot."

Prof. Clerk-Maxwell goes on to give us ideas about these "molecules," which have resulted from the investigations of himself and others; and if you will allow me, I will read a few extracts from his book (p. 286): "All bodies consist of a number of small parts called molecules. Every molecule consists of a definite quantity of matter, which is exactly the same for all the molecules of the same substance. The mode in which the molecule is bound together is the same for all molecules of the same substance. A molecule may consist of several distinct portions of matter held together by chemical bonds, and may be set in vibration, rotation, or any other kind of relative motion, but so long as the different portions do not part company but travel together in the excursions made by the molecule, our theory calls the whole connected mass a single molecule." Here, then, we have our definition of a molecule enlarged. The next point insisted upon by our author is that *the molecules of all bodies are in a state of continual agitation.*

That this agitation or motion exists in the smallest parts of bodies is partly made clear by the fact that we cannot see the bodies themselves move.

Now in a solid body the molecule never gets beyond a certain distance from its initial position. The path it describes is often within a very small region of space. Prof. Clifford, in a lecture upon atoms, has illustrated this very clearly. He supposes a body in the middle of the room held by elastic bands to the ceiling and the floor, and in the same manner to each side of the room. Now pull the body from its place; it will vibrate, but always about a mean position; it will not travel bodily out of its place. It will always go back again.

We next come to fluids: concerning these we read—"In fluids, on the other hand, there is no such restriction to the excursions of a molecule. It is true that the molecule generally can travel but a very small distance before its path is disturbed by an encounter with some other molecule; but after this encounter there is nothing which determines the molecule rather to return towards the place from whence it came than to push its way into new regions. Hence in fluids the path of a molecule is not confined within a limited region, as in the case of solids, but may penetrate to any part of the space occupied by the fluid."

Now we have the motion of the molecule in the solid and the fluid. How about the movement in a gas? "A gaseous body is supposed to consist of a large number of molecules moving very rapidly." For instance, in this room the molecules of the air are travelling about twenty miles in a minute. "During the greater part of their course these molecules are not acted upon by any sensible force, and therefore move in straight lines with uniform velocity. When two molecules come within a certain distance of each other, a mutual action takes place between them which may be compared to the collision of two billiard balls. Each molecule has its course changed and starts in a new path."

The collision between two molecules is defined as an "Encounter;" the course of a molecule between encounters a "Free path." It is then pointed out that "in ordinary gases the free motion of a molecule takes up much more time than is occupied by an encounter. As the density of the gas increases the free path diminishes, and in liquids no part of the course of a molecule can be spoken of as its free path."

Now the kinetic theory of gases, on which theory these statements are made, has this great advantage about it, that it explains certain facts which had been got at experimentally, facts which had been established over and over again, but which lacked explanation altogether, till this molecular theory, which takes for granted the existence of certain small things which are moving rapidly in gases, less rapidly in fluids, and still less in solids, was launched. The theory in fact explains in a most ample manner, many phenomena so well known, that are termed "laws." It explains Boyle's law, and others, well known to students of this school. This theory, which takes for its basis the existence of molecules and their motions, explains pressure by likening it to the bombardment of the sides of the containing vessel by the molecules in motion; or it tells us that the temperature of a gas depends upon the velocity of the agitation of the molecules, and that this velocity of the molecules in the same gas is the same for the same temperature, whatever be the density. When the density varies, the pressure varies in the same proportion. This is Boyle's law. Further, the densities of two gases at the same temperature and pressure are proportional to the masses of their individual molecules, or, when two gases are at the same pressure and temperature, the number of molecules in unit of volume is the same. This is the law of Gay Lussac.

I have now fairly introduced you to the atom of the chemist and the molecule of the physicist; you will see at once that the methods of study employed by chemical and physical investigators are widely different. The chemist never thinks about encounters, and the physicist is careless as to atomic weight; in his mind's eye he sees a perpetual clashing and rushing of particles of matter, and he deals rather with the quality of the various motions than of the material.

Next let me say a litle more about these "encounters;" and here I must again refer you to Prof. Clerk-Maxwell's book (p. 306). It is assumed that while the molecule is traversing its free path after an encounter, it vibrates according to its own law, the law being determined by the construction of the molecule, or let us say its chemical nature, so that the vibration of one particle of sodium would be like that of another particle of sodium, but unlike that of a particle of another chemical substance, let us say iron. If the interval between encounters is long, the molecule may have used up its vibrations before the second encounter, and may not vibrate at all for a certain time previous to it. The amplitude of the vibration will depend upon the kind of encounter, and will be independent of the number of encounters.

We can imagine a small number of feeble encounters, a large number of feeble encounters, a small number of strong encounters, and a large number of strong encounters.

In the case of feeble encounters, we pass from a small number to a large one by increasing the density.

In the case of strong encounters we pass from low temperature with small density to high temperature with great density.

Increase of density will reduce "free path."

* Revised from short-hand notes of a Lecture delivered to the Whitechapel Foundation School Literary and Scientific Society, March 10, 1874.

Increase of temperature will increase amplitude.

The shorter the free path the more complex the vibrations.

The greater the amplitude the more will the vibration of the molecule be brought out, not merely the *fundamental vibrations*, as we may term them, which we get in the free path, when it is longest, but the *overtones*.

Now why have I risked wearying you with these detailed statements concerning the vibrations of "molecules?" Because we believe that each molecular vibration disturbs the Ether; that spectra are thus begotten; each wave-length of light being set in vibration by a molecular vibration of corresponding wave-length. The vibration is, in fact, the sender; the spectrum is the receiving instrument, in this new telegraphy.

Now there are two questions which I propose to discuss, and they are these:—What light does the spectroscope throw upon molecular questions? and is there any hope that the spectroscope, as researches with it are extended, may aid the study of a subject which lies at the root of chemical and physical investigation?

I have written down several statements, which I propose to discuss one by one. I shall state the experimental basis, when it exists, on which the statements rest and the methods by which the results have been obtained

I shall for a time use the word "particle" to represent a small mass of matter, because it does not tie me to the "atom," or the "molecule" of the chemist, or to the "molecule" of the physicist. "Particle" is a neutral term, which I hope none of you will quarrel with.

1. My first proposition is this:—*When particles are aggregated together, so as to form a solid or liquid, they give out rays of light of certain refrangibilities; and the spectrum is continuous as far as it goes.* This was Kirchoff's first generalisation.

It surely is an important fact from the point of view of the molecular theory that all solids and liquids, with their particles moving as already stated, do give you a perfectly distinct spectrum from that which you get when you deal with any rare gas or vapour whatever. A poker put into the fire becomes of a dull red heat, after a time a white heat is arrived at. As far as the vibrations exist they are continuous, there are no breaks in the series of wave-lengths. You may also get a platinum wire, and drive it to incandescence in the same way by means of electricity. Analyse the light by means of the spectroscope, the spectrum is the same as that of the poker Further, we can go to the sun, and divest it in imagination of the atmosphere which absorbs much of its light, and we know that, with a small exception, we shall get a perfectly continuous spectrum similar to that in the case of the poker or platinum wire. Connected with spectroscopic investigation there is this wonderful fact, that as it deals with matter in the most general way, it is perfectly easy to carry on a line of argument, not by referring to different chemical elements, but to matter, now on the earth, now in the sun, or again in some of the stars. It is a great leveller. In this continuous spectrum we have a spectroscopic fact connected with that kind of molecular motion which physicists attribute to particles so long as they are closely packed together in the solid state, and so long as they have but a small free path as in the fluid state.

2. I now come to my second proposition:—*When particles are in a state of gas or vapour, and are rendered incandescent by high tension electricity, line-spectra are produced in the case of all the chemical elements.*

I have several photographs which I will throw on the screen, showing such spectra as these now in question. We have thus the spectra of the light given off by the vapour of cobalt and of nickel rendered incandescent by means of high-tension electricity. I will next show you the spectra of other chemical elements, such as aluminium and iron compared with nickel and cobalt, pure and impure iron compared with a meteorite. These line-spectra are only to be obtained from gases and vapours, and as a rule only when we employ high-tension electricity.

We get a perfectly distinct spectroscopic result from the one we had before, precisely in the case where according to the physicists we have an enormous motion and agitation of molecules.

3. I now proceed to the next proposition:—*In some cases particles in a state of gas or vapour can be set swinging by heat waves.* I have here some salts of sodium and strontium, these I place in the heat of a Bunsen burner, they are at once dissociated and the particles of the metals are set swinging by the heat waves and we get their longest lines. Now that is not only true for strontium and sodium, but for many other elements. But if I put salts of iron, or of the other heavy metals in the flame, I shall not get bright lines. Or again, in some other vapours, such as sulphur, we only get a spectrum, not of lines, but continuous over a limited part of the spectrum. In fact I may say that with the exception of those elements which easily reverse themselves, this heat is absolutely incompetent to give me anything like a bright line.

4. *Particles, the amplitudes of vibrations of which may either be so slight that no visible light proceeds from them, or so great that they give out light of their own, absorb light of the same wave-length and of greater amplitude passing through them*

Consider how beautiful this statement is when you look at it in the light of its teaching with regard to particles. We throw sodium into a flame and get a yellow light; we place it on the poles of our electric lamp and render it incandescent, and its light is rich yellow.

We have similarly incandescent sodium outside the sun, through which the rays of sunlight pass outwards towards the earth, and we may have similar non-luminous sodium vapour in a test-tube; and the vibration which gives the yellow light, in the case of the sun, and which is invisible in the vapour of the tube, instead of giving a bright line gives a dark one. Let me show you some photographs of the solar spectrum, so that as you have seen the bright lines due to radiation, you may see the dark lines in the solar spectrum which are due to absorption.

Our knowledge of the elements existing in the sun and stars depends entirely upon the principle first suggested by Stokes, that particles are set swinging when light waves pass through them with the particular rate of vibration which they effect.

The elements to which a large number of the Fraunhofer lines are due have been determined by means of the vibrations of particles on the earth. Whether a particle vibrates on the earth or on the sun it does not matter to the spectroscope, the vibration is the same, but as the particle is set vibrating at the sun by a greater amplitude of the light passing through it we get a dark line instead of a bright one. To show that in the stars, representing to us other suns, the spectra are very various I will exhibit spectra of the three classes of stars into which most may be grouped. In the middle we have a simple line spectrum, in the centre a more complex one, and at the bottom a channelled spectrum.

5. Next I have to point out to you that *line spectra become more complicated as the particles are brought nearer together, provided the state of gas or vapour be retained.* See the importance of this observed fact in connection with the molecular theory. If in the solid the particles can only oscillate round their mean position, if in the gas they can go through with enormous rapidity a tremendous number of various movements of rotation and vibration, and along their free path; and if spectroscopically we can follow these movements by differences in the phenomenon observed, is it too much to hope that in the coming time we shall have an enormous help in our inquiries? We get a solid or liquid condition, and a continuous spectrum; we get the most tenuous gaseous condition and then the phenomenon is changed, and the spectrum consists of a single line. So far indeed as the visible spectrum goes, it is possible by working with the gas at low pressure, and not too high temperature, to get a spectrum from any gas or vapour of only a single line, and as you increase the density, and thus force the particles closer together, and make the conditions of the gas approximate in the way of aggregation more to those of a solid, so does the spectrum get more and more like that of a solid, till we see at last a bright continuous spectrum. Take, for instance, hydrogen, and use, not an ordinary air-pump, but a sprengel mercury pump; use this for three or four hours, and observe the spectrum of the gas. It is a single line. Fill the tube again with gas, at ordinary atmospheric pressure, double the pressure, or multiply it ten or more times, and what becomes of the line? Not only does that green line which first appeared get more and more obvious and thick, but more lines appear, and they get thicker, till at last there is such a background of continuous spectrum that these are all invisible as lines. At twenty atmospheres the spectrum is as continuous as that of a solid.

6. Here is my sixth proposition:—In the case of metals *there are two different ways in which the continuous spectrum is approached.* Mind I do not say reached, for there may be much more to learn on this point. To render this clear I must show you some more photographs and explain the method by which they have been obtained. Here I have a coil and a jar, and here the poles. We drive the metal of which these poles are composed into vapour, the vapour is rendered incandescent; the spectrum we should get would therefore be one of bright lines. Now,

instead of bringing the spectroscope close to the poles, in which case, in every part of the spectrum, we should get light from every part of the spark, I prefer to use a lens, by means of which I throw an image of the spark on the slit; then in each strip of the total visible spectrum is the spectrum of some particular part of the vapour. Think the matter over a little for yourselves. These poles are perpetually giving off vapour, which is constantly going away; some of it is being oxidised, some of it is travelling away along the currents of air set up. What follows? There must be more vapour close to the pole than in the interval between the poles; that will be still more true if I make the interval between the two poles longer. In the part between the two poles, if they consist of two different elements, we have three distinct spectra. In the upper part, a region rich in the upper vapour; in the lower, one rich in the lower vapour; between them one which is rich in neither. We have then at least three distinct layers, so to speak, in the spectrum, the spectrum of the vapour of the upper pole the spectrum of the vapour of the lower one, and also of the central region. The number of particles of each vapour will decrease from each pole. You will see in a moment that much the same condition of affairs will be brought about, if, instead of using a spark, I use an electric arc, in which the pure vapour of the substance which is being rendered incandescent

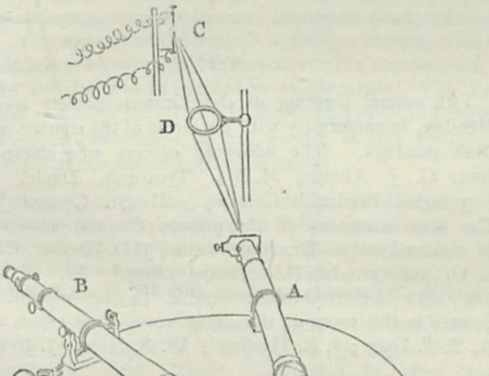

Fig. 1.—C, spark; D, lens; A, collimator; B, observing telescope.

fills the whole interval between the poles, the number of particles being smaller at the *sides* of the arc. Now I can throw an image of such a *horizontal* arc on a vertical slit; the slit will give then the spectrum of a section of the arc at right angles to its length. You have a photograph of such a spectrum of iron now before you. I wish to draw your attention to the long and the short lines. The vapour which exists furthest from the core of the arc has a much more simple spectrum than that of the core of the arc itself. The spectrum of the centre consists of a large number of lines; that furthest from the centre consists of one line. If you picture to yourselves the particles getting nearer to each other, as you get nearer the source of supply, you see that the nearer the particles are together the more they hang about and the more lines we get in the spectrum. It is important to notice that vibration once begun always goes on; it never gives *place* to others, although it may give *rise* to others; so that you get the largest number of lines in the centre, where the particles are closest together. Now I have specially to refer to the fact that the way in which the continuous spectrum is built up varies in different substances. Here I have a photograph giving the spectrum of aluminium and calcium compared with that of the Lenarto meteorite. The spectra of calcium and aluminium differ generically from that of the meteorite. I want to draw attention to the thick or winged lines you get in the case of aluminium and calcium. These spectra are good specimens of those which give a continuous spectrum by thickening the lines, while the elements in the meteorite are as good specimens as I could put before you of those which produce a continuous spectrum by increasing the number of their lines.

There is another remarkable fact connected with this.

Fig. 2.—Long and short lines of zinc and cadmium.

You see a thin dark line in the centre of the thick bright lines; this is due to the absorption by the rarer cooler vapour lying outside this vapour. This is almost invariably observed in the substances giving us the lines thickening as the continuous spectrum is approached, while iron does not give us any such reversal. It is well to see if one can group facts together. That is the first business of a man of Science. It is extraordinary that in all the substances I have yet examined the question of specific gravity decides whether the substance should have its spectrum complicated by thickening or increasing

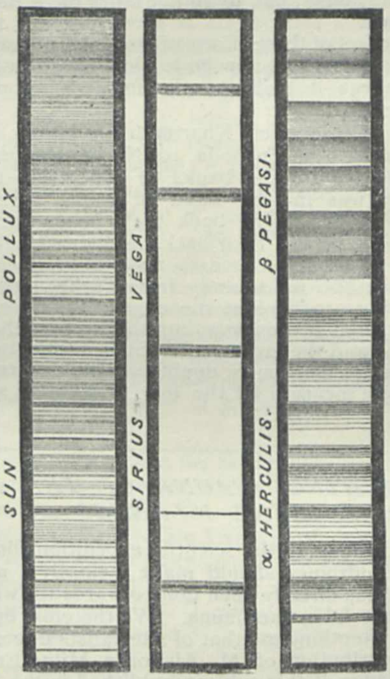

Fig. 3.—Long and short lines of iron.

its lines. You know the specific gravity of iron is high. In the case of aluminium, magnesium, sodium, and others where this is low you have the widening of the lines and the easy reversal.

So much for the continuity of the spectroscopic record of the continually increasing distance of particles from particles. We began with a solid and a continuous spectrum, we end with a tenuous gas and a spectrum of a single line, and we partly bridge over the gap between these states in two different ways.

J. Norman Lockyer

(*To be continued.*)

COL. GORDON'S JOURNEY TO GONDOKORO

WE have been favoured with the following remarks concerning Colonel Gordon's journey to Gondokoro.

Colonel Gordon, "His Excellency, the Governor-general of the equator!" arrived at Khartoun on March 13, and had with him a *Pall Mall Gazette* of Feb. 13; he writes on the 17th from Khartoum as follows:—

"At this season of the year the air is so dry that animal matter does not decay or smell, it simply dries up hard; for instance a dead camel becomes in a short time a drum.

"The Nile, flowing from the Albert Nyanza below Gondokoro, spreads out into two lakes; on the edge of these lakes aquatic plants, with roots extending 5 ft. into the water, flourish; the natives burn the tops when dry, and thus form soil for grass to grow on; this is again burnt, and it becomes a compact mass. The Nile rises and floats out portions, which, being checked in a curve of the channel, are joined by other masses, and eventually the river is completely bridged over for several miles, and all navigation is stopped.

"Last year the governor of Khartoum went up with three companies and two steamers, and cut away large blocks of the vegetation; at last one night the water burst the remaining part, and swept down on the vessels, dragging them down some four miles, amidst (according to the Governor's account) hippopotami, crocodiles, and large fish, some alive and confounded, others dead or dying, the fish being crushed by the floating masses. One hippo was carried against the bows of the steamer and killed, and crocodiles 35 ft. long were killed: the Governor, who was on the marsh, had to go five miles on a raft to get to the steamer.

"The effect of these efforts of the Governor of Khartoum is that a steamer can now go to Gondokoro in twenty-one days, whereas it took months formerly to perform the same journey."

Colonel Gordon left Khartoum on March 21, and in his last letter from Fashoda, 10° N., he touches on some of the scenes on the banks of the river—the storks, which he was in the habit of seeing arrive on the Danube in April, laying back their heads between their wings and clapping their backs in joy at their return to their old nests on the houses, now wild and amongst the crocodiles 2,000 miles away from Turkey; the monkeys coming down to drink at the edge of the river, with their long tails, like swords, standing stiff up over their backs; the hippos and the crocodiles. Such scenes to a lover of nature, as Col. Gordon is, doubtless would serve to make up in some measure for the loss of civilised society and comforts.

THE EXTINCT FAUNA OF THE MASCARENE ISLANDS*

THE members of the scientific expedition about to start for Rodriguez should make themselves acquainted with what has already been done towards the working out of its wonderful extinct fauna. We therefore beg leave to call their attention, and that of naturalists in general, to a recent contribution of M. Alphonse Milne-Edwards to our knowledge of this subject, published in the "Annales des Sciences naturelles."

In this excellent memoir M. Milne-Edwards describes the objects disinterred during some researches made in the caverns of Rodriguez under the direction of Mr. Edward Newton, the Colonial Secretary of Mauritius, as also the contents of a small collection from Mauritius itself, made in the same recent formation whence the complete skeletons of the Dodo were latley obtained.

* "Recherches sur la Faune ancienne des iles Mascareignes." Par M. Alph. Milne-Edwards. Ann. Sc. Nat., sér. 5 Zool., t. xix.

The remains described and figured are entirely those of Birds, to the extinct forms of which class the author of this memoir has lately devoted so much of his attention. The most remarkable form thus restored to us is certainly the rail-like bird, apparently allied to the *Ocydromus* of New Zealand, which is proposed to be called *Erythromachus leguati*. This bird is of greater interest, as there can be little question that it is the *Gelinote* of which the old voyager Leguat speaks, as abundant in the island 200 years ago, and as being "grasse pendant toute l'année et d'un goût délicat," although we cannot quite understand how the pectoral muscle can have been sufficiently large to provide much sustenance to the hungry mariners of those days! Besides the *Erythromachus*, M. Milne-Edwards resuscitates species of owls, pigeons, parrots, and herons, and concludes his useful memoir with some pregnant remarks upon the general character of the ancient fauna of the Mascarene Islands.

We trust that the new expedition, soon about to start for Rodriguez, will not fail to succeed in obtaining a much more intimate acquaintance with both the ancient and modern fauna of this remote island.

NOTES

THE annual meeting of the Linnean Society was held on Monday, in conformity with the terms of the charter, when Prof. Busk presided. The following officers were elected:—President, G. J. Allman, M.D.; Treasurer, Daniel Hanbury; Secretaries, Frederick Currey; and St. George J. Mivart. The five members of the present Council recommended to be removed were—Dr. Braithwaite; J. D. Hooker, C.B., M.D.; J. G. Jeffreys, LL.D.; Daniel Oliver; W. W. Saunders. The five Fellows recommended to be elected into the Council in the room of the above were—Major-Gen. Strachey; W. T. T. Dyer; J. E. Harting; W. P. Hiern; J. J. Weir.

THE Annual Report, dated Jan. 31, 1874, of Mr. Gould, Government Astronomer to the Argentine Republic, has come to hand, containing an account of the work done at Cordoba Observatory during the past year. Judging from this and the previous report, and from the amount of encouragement given to Mr. Gould by the Argentine Government, it seems likely that Cordoba Observatory will produce as valuable results as any other observatory in the southern hemisphere. The observations of the stars between 23° and 80° of S.D. have been diligently continued, the heavens for this purpose being divided into a number of zones of convenient size. More than 70,000 observations of stars have in this way been made, and Mr. Gould confidently hopes that by the middle of this year the zone-observations will be completed, by which time he calculates that about 65,000 different stars will have been observed. Besides this a large number of observations for instrumental corrections have been made, besides repeated and careful observations of five or six stars in each zone for the purpose of detecting any errors of observation in the other stars of the zone. A considerable amount of photographic work has also been done, though Mr. Gould has been sadly hampered in this department. A variety of other useful astronomical work has been done at the observatory, which, under Mr. Gould's superintendence and by the liberality of the Argentine Government, is being gradually brought to a condition of great efficiency.

Mr. Gould is also provisional director of the Argentine Meteorological Office, which has been established for only about two years; here also he has set to work in a thorough manner with results that promise well for the future, notwithstanding the difficulties that have met him in the getting together of good instruments. He has endeavoured to collect all the meteorological observations on record, made at any time in any portion of the national territory or its immediate vicinity; and very excellent progress has been made in this direction. He has also enlisted coadjutors to make systematic observations in various parts of the country, and soon he hopes to have the country well dotted with such observers. A considerable amount of work has been accomplished in tabulating and computing the results thus far collected. By the end of another year it is expected that sufficient observations will be available to permit the publication of a volume devoted exclusively to the meteorological statistics of the Argentine Republic.

DR. BURMEISTER, well-known for his thorough knowledge of the natural history of the region of La Plata, where he has resided for many years, has been, we learn from the *Academy*, nominated to the post of Director of the Natural History and Physical Faculty of the University of Cordova, where seven chairs are already held by German professors.

THE delegates of the Oxford University Museum have appointed Mr. H. J. Stephens Smith, M.A., Balliol College, Fellow of Corpus Christi College, to the keepership of the University Museum, vacant by the lamented death of Prof. Phillips. The stipend of the keeper is 80*l*. per annum, with an official residence adjacent to the museum. The appointment of Mr. Smith will have to be ratified by convocation. The Professorship of Geology, vacant also by the demise of Prof. Phillips, and worth 300*l*. per annum, is still vacant, though no official announcement of the vacancy has been made.

THE first party of the English expedition for observing the transit of Venus took its departure on Saturday afternoon in the Government transport *Elizabeth Martin*, from Woolwich. The stores include cases of astronomical and photographic apparatus to the extent of nearly 150 tons measurement, besides provisions and other necessaries, as some of the party will be for several weeks located in inhospitable regions. Of the gentlemen who left on Saturday, Lieut. Neate, R.N., will be chief astronomer at Rodriguez, in the Indian Ocean, and Lieut. Hoggan, R.N., one of his assistants; Lieut. Goodridge, R.N., one of the astronomers at Christmas Harbour, Kerguelen, which lies between the Cape and Australia; Mr. J. B. Smith, astronomer and photographer at the same station; and Lieut. Cyril Corbett, C.B., is to be chief astronomer at a second station in the same island. There are to follow—Mr. Burton, astronomer and photographer at Rodriguez; the Rev. F. S. Perry, F.R.S., chief astronomer at Christmas Harbour; the Rev. W. Sidgreaves, astronomer at the same station; and Lieut. Coke, R.N., who will act as astronomer with Lieut. Corbett at the second station, Kerguelen.

WE greatly regret to hear that the Rev. R. T. Lowe, the well-known author of a "Flora of Madeira," was among the passengers who lost their lives in the recent wreck of the *Liberia*.

THE French Academy has elected M. de Tchebycheff, the eminent geometer of St. Petersburg, foreign associate, in place of the late M. De la Rive, and M. Ollier of Lyon, a corresponding member in place of the late Dr. Guyon.

SCIENCE is beginning to make headway in the re-constituted University of Strasburg. A new observatory (under the direction of Prof. Winnecke) is to be commenced at once, and an 18-inch refractor has been ordered. The Physical Cabinet (under the direction of Prof. Kundt) already possesses a very fine collection of the newest apparatus, and the professor has a class of fifty men.

IN a small pamphlet, reprinted from the *Wiener Abendpost*, Karl von Littrow takes advantage of the foundation of the new observatory of the Vienna University to give a history of the old observatory, which has been in existence for more than a century, and of some of the work which has been done in it. The new observatory has apparently been carefully planned, and will be well provided with the most approved instruments.

WE would draw attention to the valuable Notes concerning the work of the *Challenger* between Simon's Bay and Melbourne, in the *Times* of Monday and Tuesday. Very important observations have evidently been made on the currents, temperature, and life of the southern seas. Some interesting observations are made regarding icebergs, and the remarkable similarity of the fauna of the southern seas to that of the northern is noticed. "We scarcely expected," the writer says, "to find the water so deep, but it agrees with our former observations, which lead us now always to expect to find the deepest water near the land. To account for this we can only reason that no large part of the surface of the earth can be raised higher than another by means of a volcano or otherwise, unless at the same time a corresponding hollow or depression is excavated in the neighbourhood. To form a hill, the earth must be removed from somewhere else."

PROFS. DONDERS and Th. W. Engelmann have published, in Dutch, the results of their inquiries made during 1873 on the passage of blood-cells through the vessel. Working with a unilocular microscope, they have not been able to find any aperture by which the white corpuscle can pass through the vessel.

THE last number of the *Journal of Botany* contains a sketch by Mr. B. D. Jackson of the life of William Sherrard (1658-1728). Mr. Jackson's object is thus stated:—"The whole life of William Sherrard was so intimately connected with that of the leading men of Science in his day, that a comprehensive account of his career would be an epitome of his times. The exigencies of space, however, forbid more than a sketch of his life, designed to correct certain errors which appear in all the accounts that have come under my notice, copied apparently from one book into another." Mr. Jackson says of him:—"Whilst we cannot admit him as the equal of his contemporaries, Ray and Tournefort, who originated systems, yet the services he rendered to botany at a period termed by Linnæus 'the golden age,' must make his name as lasting as the science. His intercourse with the leading men in the science both at home and abroad was intimate and frequent; he was generous even to excess in distributing seeds and dried plants, an unfailing patron of deserving naturalists, and crowned his useful life by the bequest of his library and herbarium (the most authentic and one of the largest at the time) to the University of Oxford, with the endowment of 3,000*l*. for the professor of botany."

WE are glad to learn that the anticipations expressed in one of our recent numbers as to the management of the future office for Maritime Meteorology in Germany, have been fulfilled by the appointment of Herr W. von Freeden to the post of director. Herr von Freeden was for many years at the head of the Navigation School at Elsfleth, near Bremen, and since 1867 has superintended the Seewarte at Hamburg. The best results may be hoped for from his long experience and his known zeal for Science.

IT is requested that those members of the University of Cambridge who desire to avail themselves of the facilities for study at the zoological station at Naples, for which a grant has been made from the Worts Travelling Bachelors' Fund, will send their names to Mr. Foster, Fellow of Trinity College, on or before October 1. The nominations will be made by the Board of Natural Science Studies early in October.

AN expedition is being fitted out for an exploration of the Arctic Seas. Capt. Wigans, Sunderland, has engaged Mr.

Lamond's splendid steam yacht *Diana*, and will proceed *viâ* Nova Zembla, sailing from Dundee on June 1. Capt. Brown, Peterhead, will command the *Diana*.

ON the 20th inst. a large representative meeting of various corporate towns was held at the Society of Arts, Adelphi, under the presidency of Lord Hampton, in reference to the national museums. The following resolutions were passed unanimously :—1. "That all museums and galleries supported or subsidised by Parliament should be made conducive to the advancement of education and technical instruction to the fullest possible extent, and that special Parliamentary funds should be granted to assist local and provincial museums in the acquisition and loan of objects, and with building grants, and thus extend their usefulness." 2. "That in the opinion of this meeting all national museums and galleries should be placed under the authority of a Minister of the Crown, with direct responsibility to Parliament, thereby rendering unnecessary for the purposes of executive administration unpaid and irresponsible trustees except those who are trustees under bequests or deeds, who might continue to have the full powers of their trust, but should not be charged with the expenditure of money voted by Parliament." The chairman was requested to submit to the Prime Minister the foregoing resolutions, and press their importance on his attention.

WE cannot regret that Lord Hampton's motion for the appointment of a Minister of Education in the House of Lords last Friday was lost. Lord Hampton does not seem to understand what is really required, and the Duke of Richmond's reply under the circumstances was perfectly appropriate and conclusive.

IT is known that several years ago the German Astronomical Society undertook the systematic revision of star catalogues for the boreal hemisphere up to the 9th magnitude. That heavy task has been undertaken by fourteen observatories—Cambridge (England), Christiania (Norway), Palermo (Italy), Neufchâtel (Switzerland), Leyden (Netherlands), Harvard College and Chicago (U.S.), Pulkowa, Dorpat, Helsingfors, Kazan (Russia), Berlin, Leipsig, Bonn (Germany). The boreal hemisphere has been divided into zones, each of which has been allotted to two different observatories. Pulkowa was entrusted with the care of observing fundamental stars numbering 539. The work is just half done, and will be finished by the end of 1875, when every star marked by Lalande in his "Histoire celeste," and Argelander in his star catalogue, will have been revised.

A CHOLERA conference is to meet in Vienna in the course of the autumn, to discuss the best methods of preventing the propagation of the disease. Prof. Pettenkofer, who has carefully watched the progress of cholera in Munich since its outbreak nearly a year ago, will be present, and will no doubt have valuable information to contribute. The number of deaths, which last winter amounted to 55 a-day in Munich (as a maximum), had sunk last month to 2 per diem.

THE German Society of Anthropology is industriously collecting material for the Prehistoric map, which it was resolved, at the meeting of April 1870, to prepare for publication. Among other points to be indicated on this map will be the position of the most notable Prehistoric settlements, fortifications, lake-dwellings, cave-dwellings, burial-mounds, and other places of sepulture. By a judicious use of colours, the various periods—Stone, Bronze, and Iron—will be indicated, and altogether the map will be one of great value to the student of archæology and ethnology.

WE have already referred to the treatment by the French Government of M. Alglave, Professor in the Law Faculty of Douai, and editor of *La Revue scientifique*. M. Alglave had been delegated temporarily to the faculty of Grenoble, but as he had undertaken to deliver a course of lectures at Lille, and had moreover been designated secretary to the approaching session of the French Association at that town, he petitioned the minister to permit him to remain at Douai ; the reply was absolute dismissal from his post without delay. Such is a specimen of how French ministers use their "little brief authority."

LAST Thursday a handsome new aquarium, well stocked with marine and fresh-water fish, was opened at Manchester. The sea-water is brought by train in barrels from Blackpool, a distance of about 40 miles, and a constant supply is maintained.

MR. J. W. DOUGLAS, the well-known entomologist, has become one of the editors of the *Entomologist's Monthly Magazine*.

THE first part of the third issue of Sowerby's "British Wild Flowers" (Van Voorst) is now out; the descriptions with an Introduction and a Key to the Natural Orders, being by C. Pierpoint Johnson, Botanical Lecturer at Guy's Hospital.

THE additions to the Zoological Society's Gardens during the last week include a Wild Boar (*Sus scrofa*) from Algeria, presented by Mr. W. F. Tempest ; an Ourang-outang (*Simia satyrus*) from Borneo, deposited ; a Racoon-like Dog (*Nyctereutes viverrinus*) from Amoorland, new to the collection ; a Great Bustard (*Otis tarda*), European ; five Red-legged Falcons (*Erythropus vespertinus*), European, purchased ; three Temminck's Tragopans (*Ceriornis temmincki*) and three Peacock Pheasants (*Polyplectron chinquis*), hatched in the Gardens ; and two Hairy Armadillos (*Dasypus villosus*), born in the Gardens.

THE FLORENCE INTERNATIONAL BOTANICAL CONGRESS

THE International Botanical Congress commenced its sittings at Florence on May 15, under the presidency of Dr. Hooker, Prof. Parlatore being disabled by illness from filling that post. The vice-presidents elected were Mr. Bentham and Dr. Moore for Great Britain, M. de Candolle for Switzerland, M. Fenzl for Austria, MM. Planchon, Weddell, and Baillon for France, MM. Reichenbach, Hofmeister, Wendland, and Karl Koch for Germany, and MM. Regel, Bunge, Gelernoff, and Wolkenstein for Russia. At the Congress England was represented by Professors Bentham, Allman, and Masters, Drs. Hooker and Ball, Messrs. Smee, Hiern, and Maw ; David Moore represented Ireland, and Charles Moore Australia.

On the first day a paper was read by Dr. Planchon on *Phylloxera vastatrix* and the vine disease ; on vegetable palæontology by M. Carnel ; on the development of *Cynomorium coccineum*, by Dr. Planchon ; M. Famintzin on the spores of *Aethalium*.

At the second meeting, May 18, Prof. de Candolle, presided, and among the papers read was one by Mr. W. P. Hiern, of Cambridge, on the determinations of the fossils that have been referred to *Diospyros* or allied genera. At the third meeting, May 20, Dr. Bunge, a Russian botanist, presided, and the papers included one by De Candolle on Alpine plants. On the 16th took place the inauguration of the bust of Philip Barker Webb, an English botanist, who left his valuable herbarium to Florence. An oration was made by Dr. Bolt, of Berlin.

The International Horticultural Exhibition, which took place concurrently with the Congress, was opened by the King on the 15th, and the following day 1,800 people were present.

The show was held in a new iron building in the middle of the town, which is to be used as a market. The *Italian News*, published in Rome May 19, says : "The Floral Exhibition has proved a decided success, in spite of the bad weather which accompanied its inauguration. There has been a large daily attendance. The show was remarkably complete, and the prizes have been awarded with such justice that no jealousies have been allowed to mar the pleasure of the recipients."

It is proposed that the conference for next year shall be held in London.

SCIENTIFIC SERIALS

THE *Geographical Magazine*, May.—The principal article in his number is a translation by Col. Yule, C.B., of some of the notes appended to the Russian edition of his "Essay on the Oxus," by the late Alexis Fedchenko; they are extremely interesting.—Mr. E. D. Morgan contributes a paper on the new Russian province of Amu Daria, which is accompanied by a map.—Mr. E. G. Ravenstein's paper On the Viti or Fiji Islands, with the excellent map which accompanies it, will be very acceptable to many at the present time.—The number contains a very curious and interesting paper purporting to be the autobiography of a slave, under the title of My parentage and early career as a slave.

THE *Geological Magazine* for May, contains the following original articles:—The shell-bearing gravels near Dublin, by the Rev. Maxwell Close, F.G.S.; On some new Devonian fossils, by Prof. H. Alleyne Nicholson, F.R.S.E.; On the substitution of zinc for magnesium, by E. T. Hardman, F.R.G.S.I.; The volcanic history of Ireland—address to the Royal Geological Society of Ireland, by Prof. Hull, F.R.S., president; On a raised beach at Tramore, by E. T. Hardman.

THE *American Journal of Science and Arts*, April 1874.—We have here the continuation of Prof. Leconte's interesting paper On the great lava flood of the North West, and the structure and age of the Cascade mountains. There has been much speculation as to the origin of the "prairie mounds," which consist of a drift soil of earth, gravel, and small pebbles. Prof. Leconte considers they are entirely the result of surface erosion acting under peculiar conditions, viz. a treeless country and a drift soil consisting of two layers, a finer and more movable one above, and a coarser and less movable one below.—Mr. Chase gives an account of the auriferous gravel deposit of Gold Bluff.—Mr. Meek continues his notes on some of the fossils figured in the recently issued fifth volume of the Illinois State geological report; and Mr. Verril gives results of recent dredging expeditions on the coast of New England.—In a paper On the lignites and plant-beds of western America, Mr. Newberry calls in question some of Mr. Lesquereux's conclusions, and seeks to show that several of the beds are Cretaceous and not Eocene.—Among the remaining matter we find notes on a mass of meteoric iron found at Howard co. Ind. (with remarks on the molecular structure of meteoric iron); on the parallelism of coal seams; and on recent earthquakes. We may also notice, in the Scientific Intelligence, a lengthy abstract of a paper by Josiah Cooke, jun., On the vermiculites, their crystallographic and chemical relations to the micas, with a discussion of the cause of variation of the optical angle in these minerals.

Poggendorff's Annalen der Physik und Chemie, Jubelband.—The hearty co-operation with which the proposal was met, to commemorate the jubilee of the scientific veteran who has for years edited the *Annalen*, is here represented in a collection of more than sixty papers of original research, many of them by well-known investigators. We can do little more than briefly glance at some of the subjects that are treated, of which there is great variety. Electricity and magnetism meet with a considerable share of attention; and we may first of all note some interesting studies, by M. Wüllner, on discharges of the induction current in spaces filled with rarefied gases. This research betokens considerable minute care. Variations were made, in the form of the tubes used, degrees of rarefaction, direction of spark, velocity of rotating mirror in which the light was reflected, &c.; the influence of magnets was also observed, and some striking peculiarities of striation in the image of the discharge are brought to light, and shown in drawings.—M. Hittorff examines from a different point of view the conduction of electricity by gases.—Prof. Blaserna, of Rome, studies extra currents; and he points out that at the moment of closure the current begins to flow, first slowly, then more quickly, till it reaches a maximum, from which it descends, by a series of oscillations, between maxima and minima, to zero.—M. Reiss, in reference to what he terms the electric induction of a non-conductor in itself, enunciates the proposition that at the under surface of a free non-conducting plate, whose upper surface is electrified, there is an electric layer of the same sign with the electricity of this surface, while immediately above there is an electric layer of the opposite sign.—The heat-action of electric disjunction currents forms the subject of a communication from M. Edlund; and M. Kohlrausch describes the action of polarisation on alternating currents; also a sinus-inductor. The electromotive force of liquid batteries, the thermo-electric properties of topaz, spar, and arragonite, the action of magnets on discharges in rarefied gas, the conductivity of glass for electricity and heat, and some peculiarities of galvanic polarisation, are also treated; and of the more theoretical papers, we may specify one by Prof. Feilitzsch, On the poles of equal normal intensity in the magnetic field of a galvanic battery current, and one On a general theorem for calculating the action of magnetising spirals, by Dr. von Waltenhofen.—Perhaps no scientific serial presents such a rich collection of material in the department of mineral chemistry as *Poggendorff's Annalen* during these fifty years. The influence of Berzelius has made itself powerfully felt; both his spirit and his method being evidently reflected in the researches by his students, among whom Prof. Heinrich Rose occupies the first rank. Those who are interested in this branch will find in the *Jubelband* a valuable *résumé*, by Prof. Rammelsberg, of the work of the *Annalen* in reference to it; and a list is given of forty young chemists who have laboured on various mineral forms, under Rose's direction.—In a paper On the struggle for existence among molecules, by M. Pfaundler, an ingenious parallel is drawn between the phenomena of production of certain chemical compounds through partial dissociation and reciprocal reaction, on the one hand, and production of species through natural selection (according to Darwin's theory) on the other; and this article is followed by one On the equivalent of *vis viva*, by M. Wilhelm Weber.—The phenomena of light and heat are studied in various aspects. In a note On the spectrum of aurora, Prof. Angström considers that the yellow light (characteristic of all auroras) arises from fluorescence or phosphorescence. An electric discharge is supposable, which, though in itself faintly luminous, is rich in ultra-violet light, and is thus capable of producing strong fluorescence. It is also known that oxygen, and several compounds of it, are phosphorescent. Prof. Angström thinks it unnecessary to have recourse to "variability of gas-spectra under varying conditions of pressure and temperature."—M. Zöllner has a paper of photometric researches on the physical character of the planet Mercury, in which he comes to the conclusion that Mercury has a surface closely resembling that of our moon; it is without an atmosphere.—Mr. Bolzmann studies the connection between the turning of the plane of polarisation and the wave-length of various colours; M. Ketteler, the specific law of so-called anomalous dispersion; M. Knoblauch, the reflection of heat and light rays from inclined diathemanous and transparent plates; and M. Dufour the reflection of solar heat from the Lake of Geneva.—A curious phenomenon is discussed by Prof. Lommel, viz. the appearance of a luminous halo round the shadow of one's head in wet grass, especially when the sun is low. He supposes it to arise from light being refracted through the drops, received by the surface below, and sent back through the drops to the luminous source; the light thus suffering a fourfold refraction, and also a diffuse reflection. It is a like cause to that which explains the shining of cats' eyes in the dark.—In experimenting on the specific heat of water at various temperatures, M. Bosscha arrives at results somewhat different from those of Regnault.—M. Hagenbach continues his experiments on fluorescence.—There are several papers referring to new and improved instruments. The practical physiologist will be interested in some new arrangements, by Dr. du Bois Regmond, for studying the physics of nerve and muscle, including a mercury key, a double commutator, a "frog pistol," and a spring myographion.—M. Barentin describes an improvement on Poggendorff's machine for demonstrating acceleration; M. Gorst a spectroscope with fluorescent eye-piece; M. Melde a wave-apparatus for showing Chladni's sound-figures; M. Rudorff an improved Bunsen photometer; while M. Jolly makes a new determination of the expansion coefficients of some six gases, and investigates the action of air thermometers.—The theoretical limits of capability of the microscope forms the topic of an able memoir by M. Helmholtz.—Some hydraulic researches by M. Meyer prove that pressure is propagated in water with the velocity of sound; and that the Poisseuille law holds good for outflow of water not only through capillary tubes, but also through wider tubes, provided these are sufficiently long (thus it was found to hold for 250 to 3,000 m. length in a tube 7 mm. diameter).—M. Karsten communicates an instructive account of recent scientific researches on the temperatures, saltness, &c., of the Baltic and North Seas.—In mechanics we have a number of bending-experiments from M. Buff, in reference to elasticity of various substances—iron, glass, wood, &c.; and among the few chemical subjects treated (not to prolong our enumeration) are the constitution of chlorhydric acid and its salts (Thomsen), new sulphur salts (Schneider), and the volume constitution of some oxides (Schröder).—The only paper from an English source appears to be that of Prof. Tyndall's, On propagation of sound through the atmosphere.—A well-executed portrait of Prof. Poggendorff is prefixed to this interesting volume.

Astronomische Nachrichten, Nos. 1,984, 1,985, and 1,987.—These numbers contain a long paper by Prof. E. Kayser on some new applications of the level to astronomical instruments, especially to the alt-azimuth.—A table of the eclipses of Jupiter's satellites, observed at Toulouse from Jan. 4 to April 1, appears in No. 1,985.—Observations of planets 135 and 136, are given by H. G. von der Sande Bakhuyzen, J. Paliser, and E Stephan.—No. 1,987 contains a paper by C. Hornstein, On the daily variation of the horizontal magnetic force of the earth. The author points out the correspondence between the sun-spot period and the variation above mentioned, the maximum and minimum of each, according to the table, appears to occur at the same time.—R. Luther gives a number of observations on the positions of the minor planets and variable stars. The elements of Winnecke's comet are given by W. Schur as follows:—

$$
\begin{aligned}
T &= \text{March } 14{\cdot}0356 \text{ Berlin mean time} \\
\Omega &= 274^\circ\ 7'\ 5'' \\
\Pi &= 302^\circ\ 15'\ 41'' \\
i &= 31^\circ\ 32'\ 26'' \\
\log. q &= 9{\cdot}947502.
\end{aligned}
$$

Prof. Winnecke communicates the discovery of the above comet.—Prof. Weiss gives an ephemeris of Winnecke's comet I. Position for May 18, R.A. 15h. 22m. 15s., D. + 43° 8′, decreasing in R.A. about 15′ a day, and increasing in D. a few minutes.—C. Bruhns gives positions of Winnecke's and Coggia's comets.—Dr. J. Holetschek gives an ephemeris for Coggia's comets as follows:—

12h. Berlin time.

	R.A. h.	m.	s.	D. °	′
May 23,	6	13	38	+ 67	21·0
June 4,	5	51	14	+ 63	9·5
,, 16,	5	12	0	+ 47	5·0
,, 28,	4	49	50	+ 11	6·1

Prof. Peters, A. de Jasparis, and G. Bümher also give observations on the two above-mentioned comets,

Journal de Physique, April.—This number begins with a note in which M. Desains describes an improved method of studying Newton's coloured rings; the plane is made movable to and from the lens by means of a fine micrometric screw, so that the pressure can thus be varied; and the rings are observed with monochromatic light, either direct from a flame, or isolated from the spectrum.—In a paper On transformation of optical achromatism of object-glass into chemical achromatism, M. Cornu finds that, given an achromatic astronomical telescope, the object-glass of which is formed of a convergent lens of crown glass and of a divergent lens of flint glass, this object-glass may be transformed into one capable of giving satisfactorily distinct photographic images, by separating the two lenses to an extent dependent on the nature of the two glasses. With the glasses used in optics, a separation of 1½ per cent. of the focal distance of the object-glass is sufficient, and the chemical focus is very near the optic focus. The aberrations produced by this separation may, the author thinks, be entirely neglected. Using an excellent telescope 100 mm. aperture and 1·40 m. focal distance, and separating the two glasses 15 mm. he succeeded in photographing a scale, divided into millimetres, placed at 40 metres distance; the lines were quite distinct; the relation of the empty spaces to those filled in was quite recognisable, and with a microscope and micrometer it was possible to measure the thirtieth part of the intervals.—This paper is followed by the first part of one in mathematical physics, in which M. Blavier studies the electric resistance of the space inclosed between two cylinders.—A new rheostat is described by M. Crova, in which two platinum wires pass down to the bottom of a long graduated tube containing mercury, the height of which can be varied through elevation or depression of a spherical vessel communicating with the bottom of the glass tube, through a tube of caoutchouc.—There are, further, notices of M. Seebeck's recent researches on motion of sound in bend and bifurcating tubes, M. Dufour's on reflection of solar light at the surface of Lake Leman, &c.

Bulletin Mensuel de la Société d'Acclimatation de Paris.—The February number of this *Bulletin* commences with a paper by M. Decroix, on the consumption of horse-flesh in France, as meat, from which it appears that hippophagy is largely on the increase.—The question of silkworm culture again occupies a prominent position in the report, and a statement of the services rendered by acclimatisation in Egypt is very interesting. The *Eucalyptus globulus*, the cocoa tree, the silkworm, the *Cytisus cajan* of Madagascar, or Ambrevade, are among the recent acquisitions of that country.—The cultivation of tea in Java is the subject of a valuable paper by M. E. Prillieux; in 1826 the first seeds of the tea-plant were sown in that island; and in 1867 the annual production was 1,600,000 lb. The very best qualities often thrive in that country.—The introduction of the African ostrich into France is proposed. The plumage of a male ostrich is valued at from 300f. to 500f. (12*l*. to 20*l*.); that of a female at about half that, while the plumage of the American ostrich is sold at 15f. to 20f. the kilogramme (12*s*. to 16*s*. per 2 lb.)—The system of oyster-culture, till recently so successfully adopted in France, is threatening to collapse; and some valuable hints thrown out by M. D. de Mayréna may be of service in assisting to arrest the decay.—In the Jardin d'Acclimatation 335 mammalia and 2,647 birds were received during January and February, amongst which were a new monkey, *Lemur catta*, two St. Hubert bloodhounds, some Viellot's pheasants of Java, two emus, a very fine ostrich, and an Indian duck (*Anas pœcilorhynca*), a curious-looking bird, with a beak orange at the root, black in the middle, and pure white at the tip; the plumage is a grey colour.

Bulletin de l'Academie Royale de Belgique, No 3, 1874.—This number opens with a tribute to the memory of M. Adolphe Quetelet, in the form of six discourses delivered at the funeral of that eminent *savant* on Feb. 20 last, by MM. Keyser, Ed. Mailly, &c., representing various learned Societies.—In the department of Science we find an account of M. Louis Henry's continued researches on diallylic derivatives. In a previous paper he had shown that allylic compounds combine directly with hypochlorous acid to produce glyceric compounds; and he here extends the observation to diallylic compounds, diallyl having been found to combine directly with hypochlorous acid and form a diallylic dichlorhydrine.—In a second note of researches on camphor, M. Dubois describes an advantageous mode of preparing brominated camphor. It rests on the previous formation of an additional brominated product, $C_{10}H_{16}OBr_2$; which is then decomposed into brominated camphor and bromhydric acid, $C_{10}H_{15}BrO + BrH$. Among the numerous products obtained from action of iron, heated red, on camphor-vapour, M. Dubois finds a terpene $C_{10}H_{16}$, which he regards as important with reference to the composition of camphor.

Archives des Sciences Physiques et Naturelles, April 15.—This number commences with a chemical paper, by M. Eugene Demole, On distillable oxygenated bases derived from glycol and aromatic amines. It appears that when a primary amine is in presence of oxide of ethylene it is not a molecular combination that is produced, but a true product of substitution of glycol. The secondary base which thus forms possesses still a hydrogen replaceable by alcoholic radicals, and the product of this substitution is a tertiary base; which, again, is susceptible of the addition of alcoholic iodides to form quaternary iodides indecomposable by alkalis.—In the next paper, M. Dufour studies the phenomenon which occurs when two masses of air, differing in hygrometric state, are separated by a partition of porous earth; a diffusion takes place, in which the more abundant current passes from the drier to the more humid air. The activity of diffusion depends on temperature only indirectly, in so far as this occasions difference of vapour-tension on the two sides of the partition. It depends little, if at all, on fraction of saturation. The difference between the quantities or tensions of water-vapour on the two sides is the important element; the diffusion is nearly proportional to this difference.—A spectroscope with fluorescent ocular is described by M. Soret. The method consists in placing a plate of a transparent and fluorescent substance (uranium glass, or a fluorescent liquid between two thin plates of glass) in the eye-glass of a spectroscope, at the focus of the object glass, and observing the spectrum with an ocular inclined to the axis of the eye-glass. It is specially applicable to solar light, and renders distinctly visible the spectrum from H to N, without the necessity of working in a dark chamber. It is less delicate than the photographic method, but much quicker.—M. Achard investigates the action of differential manometers with two liquids.

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, May 19.—Dr. E. Hamilton, vice-president, in the chair.—Mr. Sclater exhibited a skin of the new Japanese Stork (*Ciconia boyciana*), and read an extract from a letter recived from M. Taczanowski, relating to its occurrence in the Amoor territory.—Letters were read from Dr. W. Peters relating to the locality of *Poriodogaster grayi*, and from Dr. Hector containing a correction to his article on *Cnemiornis*, published in the Society's "Proceedings."—Prof. Newton exhibited and made remarks on two original letters, the property of Dr. J. B. Wilmot, written from Mauritius in 1628, and referring to the Dodo.—A communication was read from Mr. G. E. Dobson, containing an account of some experiments made on the respiration of certain species of Indian fresh-water fishes.—A communication was read from Mr. W. H. Hudson, containing an account of the habits of the Burrowing Owl (*Pholeoptynx cunicularia*) of the pampas of Buenos Ayres.—Two communications were read from Mr. W. C. McIntosh. The first of these was entitled "Contributions to our Knowledge of the British Annelida;" and the second contained the first portion of an account of the Annelida collected during the *Porcupine* expeditions of 1869 and 1870.—A communication was read from Dr. J. E. Gray, F.R.S., containing a list of the species of feline animals (*Felidæ*).—A second communication from Dr. Gray contained the description of a new species of Cat from Sarawak, proposed to be called *Felis badia*.—A communication was read from M. L. Taczanowski, entitled "Description d'une nouvelle espèce de *Mustela* du Pérou Central."

Geological Society, May 13.—John Evans, F.R.S., president, in the chair.—The following communications were read:—Note on some of the generic modifications of the Pleiosaurian pectoral girdle, by Harry G. Seeley, F.L.S. The restorations and interpretations of the Pleiosaurian pectoral girdle given by Conybeare, Hawkins, Owen, Huxley, Cope, and Phillips, were discussed and reasons given for dissenting from their views. The old genus *Pleiosaurus* was divided into two families, the Pleiosauridæ, containing the genus *Pleiosaurus*, and the Elasmosauridæ, with *Eretmosaurus*, *Colymbosaurus*, and *Murænosaurus*. A new type was taken for the genus *Pleiosaurus*, which showed distinct clavicles. *Eretmosaurus* has neither clavicle nor interclavicle, and the scapulæ, concave in front, are blended in the median line, and blended laterally with the coracoids. Its type is *Pleiosaurus rugosus* of the Lias. *Colymbosaurus* has for its type *Pleiosaurus megadeirus* of the Kimmeridge clay. It has no inter-clavicle, the scapulæ are prolonged forward in a wedge and backward, so as to meet the coracoids in the median line, and inclose two coraco-scapular foramina. *Murænosaurus* is founded on a new type from the Oxford clay. It has no interclavicle, but the scapulæ are prolonged forward to meet in the median line; they are not prolonged backward to meet the coracoids, hence but one coraco-scapular foramen is formed. A similar condition marks the pelvic girdle.—*Murænosaurus leedsii* Seeley, a Pleiosaurian from the Oxford clay (Part I.), by Harry G. Seeley, F.L.S. All parts of the animal, except teeth, ribs, and hind limbs, were described. The pre-maxillary bones extend bird-like between the nares to the frontals. The foramen parietale is between the parietal and frontal, and directed backward. The cerebral lobes of the brain have a chelonian form, are prolonged in olfactory nerves, like those of *Teleosaurus*, and have the optic lobes moderately developed. The exoccipital bones do not enter into the occipital condyle. The basisphenoid is perforated by the carotids, as in *Ichthyosaurus*. The hypoglossal nerve does not perforate the exoccipital bone. There are 44 cervical, 3 pectoral, 20 dorsal, 4 sacral, and the first 8 caudal vertebræ preserved.—On the remains of *Labyrinthodonta* from the Keuper Sandstone of Warwick, preserved in the Warwick Museum, by L. C. Miall. The author considered that *Labyrinthodon ventricosus* Owen is not a distinct species, and that *L. scutulatus* Owen has not been proved to be a Labyrinthodont. The species as identified by the author are as follows:—*Mastodonsaurus jægeri* Von Meyer, *M. pachygnathus* Owen, *Labyrinthodon leptognathus* Owen, *Diadetognathus* (g.n.) *varvicensis*, sp.n.

Chemical Society, April 16.—Prof. Odling, F.R.S., president, in the chair.—Dr. Corfield delivered his lecture On the sewage question from a chemical point of view. The lecturer, after remarking that he was going to consider the question of the value of chemical evidence on the sanitary view of the subject, compared the various systems for treating sewage, all of which might be reduced to two classes; the first, that of conservancy, where more or less of the solid matter was retained in the neighbourhood of habitations, and the other where the whole of the excretal matter was removed along with the foul water by means of sewers. He emphatically condemned the former as poisoning the wells in the neighbourhood and liable to give rise to disease, for it was a fact that the smallness of the death-rate at any large town was proportional to the efficiency of the means used for the removal of the sewage. He subsequently discussed the various methods of rendering sewage innocuous, showing that the only one of any value for this purpose was that of intermittent surface irrigation.

Royal Horticultural Society, May 13.—Scientific Committee. A. Grote, F.L.S., in the chair.—The Rev. M. J. Berkeley exhibited *Claviceps microcephala*, produced by the ergot of *Anthoxanthum*, which generally gave rise to *Claviceps purpurea*. The former species was rufous when fresh but purple when dry, and possibly the two species were not distinct.—Prof. Thiselton Dyer read the following extract from a letter from Dr. Thwaites to Dr. Hooker under date March 31:—"The leaf disease in our coffee is just now in abeyance in the estates I passed by on my way to Newera Eliya, but it is such a treacherous disease in the way of its appearance, and disappearance, and reappearance, that one cannot predict with any certainty what it is going or not going to do. There cannot be the least doubt that the disease at Tellicherry is the same as what our coffee estates are suffering from (*Hemileia vastatrix*)."—Col. Beddome had heard in India that the leaf disease existed in the Wynaad district (which included Tellicherry), and that it was the same as that of Ceylon.—The Rev. M. J. Berkeley reported that he had carefully examined the leaves of the diseased plants of *Daphne indica* exhibited by Mr. Smee, and that he failed to detect the presence of any organism, vegetable or animal, which could account for the diseased state of the tissues.—Prof. Thiselton Dyer read the following letter from Baron von Mueller:—"From Melbourne will be sent to you by this month's post a dried branch of *Correa lawrenciana*, with flowers as brilliantly red as any of the showiest varieties of *C. speciosa*. . . . In my recent journey to Mount Kosciusco from the west, I saw only plants of *C. lawrenciana* with red flowers, whereas on the southern brooks I saw always only the variety with the greenish flowers. Possibly the plant may prove hardy in Britain, as it ascends here to 4,000 feet." Prof. Thiselton Dyer also read the following communication from Mr. Jackson, Curator of the Kew Museum:—"The insects accompanying this were taken from a piece of a trunk of a copal tree (*Trachylobium hornemannianum* Heyne), recently received at the Kew Museum from Zanzibar through the Foreign Office. The wood was for the most part riddled through and through with insect borings, evidently the work of white ants. Mr. Frederick Smith, of the British Museum, to whom I sent some of the living insects, replied:—"The insect you have found in the copal wood is a species of white ant (*Termes*). It appears to belong to the modern genus *Eutermes*, and to be *E. lateralis* Walker. It is extremely interesting to see a living *Termes*, and it is the first time I have done so. There is a European species found in the warmer parts of France and Italy."

General Meeting.—J. A. Hardcastle in the chair.—The Rev. M. J. Berkeley commented on the effects of the late inclement weather. The crop of peas in the neighbourhood of London was practically destroyed. Messrs. Standish sent cuttings of various Japanese plants grown by them at Ascot which had escaped hitherto without injury, while many of the more commonly cultivated shrubs had suffered severely.

PHILADELPHIA

Academy of Natural Sciences, Dec. 16, 1873.—Dr. Carson, vice-president, in the chair.—Remarks on Fossil Elephant Teeth. Prof. Leidy observed that the fossil elephant teeth, presented this evening by Mr. Richard Peters, were obtained by him in Mexico. In appearance the fossils resemble some others, obtained in New Mexico and Chihuahua, referred to in his recent work, "Contributions to the Extinct Vertebrate Fauna of the Western Territories." All appear to have pertained to the coarse-plated variety of molars referred to a species by Dr. Falconer with the name of *Elephas columbi*. Some of the specimens had been found in association with remains of the mastodon, the extinct and near relative of the elephant. The two genera were contemporaneous, and were represented by many species during the middle and later Tertiary periods, but no remains of either have yet been discovered in the early Tertiary deposits. It is probable that both are successors from a common stock which existed at a period intermediate to that in which were formed the known Eocene and Miocene deposits. The molar teeth in the two genera differ in a striking manner, and so widely, that early observers thought those of the mastodon were adapted to a carnivorous habit. That the course of evolution was from the more simple to the more complicated type would appear to be confirmed in the fact that the temporary molars have proportionately shorter crowns and longer roots than in those of the permanent series.

BOSTON, U.S.

Society of Natural History, Dec. 3, 1873.—Prof. John McCrady read a paper on the food and reproductive organs of the oyster, with an account of a new parasite. This parasite apparently destroys, for the time at least, the fertility of the oyster, and to its abundance may perhaps be due the seasons of short spawn, often noticed by those engaged in the oyster culture. The parasite seems to be a new species belonging to the genus *Bucephalus* and may be called *Bucephalus cuculus*.—Prof. Alpheus Hyatt gave a description of his investigation for the past fourteen years upon the Ammonites of the Jurassic period, showing the connection of the forms in the family Arietidæ, and tracing them all to one species, *Amm. psilonotus* of Quenstedt.—Dr. H. A. Hagen read a paper on the origin of the so-called "Tailed Man," often described and pictured by the older authors. In an attempt to copy from a number of old works the figures of this fabulous creature, it gradually became evident that these figures were copies one from another, with slight changes, by the accumulation of which a "tailed man" was gradually constructed. The origin of all these figures is a poor representation of the "Wanderoo" (*Simia silenus* Linn.), given by the old knight, Bernhard von Breydenbach, in his "Voyage to Palestine" in 1486.

VIENNA

Imperial Academy of Sciences, Feb. 5.—Prof. Linnemann made some further contributions towards a knowledge of allyl compounds and acrylic acid. He finds that this acid is completely changed, by sulphuric acid and zinc, at moderate temperature, into propionic acid; also (contrary to present views), that allyl-alcohol, especially in acid solution, takes up hydrogen, and passes into propyl-alcohol.—Prof. Puschl, in a note on specific heat of carbon, offered an explanation of this being different (in the diamond) at different temperatures. He supposes, that for its internal radiation, at ordinary temperature (from the surfaces of the atoms), the diamond is much less opaque than a metal, and that it is more opaque the higher the temperature. Hence the diamond is radiated through by obscure heat, more abundantly the lower the temperature of the source of this; in other words, its opacity for obscure heat increases with the temperature of the source. The same will hold for other kinds of carbon, with this difference, that the opacity of the transparent diamond for a particular kind of direct heat must have a maximum which is not to be looked for in untransparent carbon. He desires that physicists, who have the opportunity, would test the diamond in reference to this point.—M. Puluj gave an account of experiments to determine the constant of friction of air as function of the temperature. According to the theory of gases (with the hypothesis of molecular shocks) the constant referred to must be proportional to the absolute temperature. The author finds it proportional to the $\frac{2}{3}$ power of the absolute temperature, or $\eta = \eta_0(1 + \alpha\theta)^{\frac{2}{3}}$; which comes nearer to the law than the older determinations by Maxwell and Meyer, and argues the correctness of the hypothesis named.

Feb. 12.—Prof. Dvôrák communicated a memoir on the conduction of sound in gases. He shows how the peculiar acoustical behaviour of hydrogen does not contradict theory, but may be simply explained through resonance. The *vis viva* which the same sounding body, with equal excursions in equal times, gives in different gases, is proportional to the root of the product of the density and expansive force of the gas.—Prof. Leitgeb presented a paper on the growth of *Fissidens*; it conforms to the laws of growth of other mosses.—M. Stefan communicated a memoir on the theory of magnetic forces. The first part treats on calculation of the magnetic force of electric currents; the second, the action of a magnet on an internal point; and the third, the theory of magnetic induction. It is shown, from a series of experiments, that all kinds of iron and steel permit the same maximum of magnetisation, that the resistance of iron and nickel to magnetisation is at first very great, then decreases to a minimum, which is reached when the induced magnetic moment is a third of its maximum, and thereafter the resistance increases to an indefinite extent. From these data a formula is constructed for the magnetic molecular force.

PARIS

Academy of Sciences, May 18.—M. Bertrand in the chair. M. Chasles read a paper entitled "Questions relating to series of similar triangles subjected to three common conditions."—M. Serret presented a note accompanying the presentation of vol. vi. of Lagrange's works. The volume contained eleven memoirs on various astronomical subjects. On the magnetic bundles formed by separate laminæ, by M. Jamin.—M. Faye communicated a letter with a reply by M. E. Gautier, who maintains the old views of Galileo concerning the nature of sun-spots.—New apparatus for the transfusion of blood, proposed by M. Mathieu; a note by M. Bouley.—M. A. Ledieu presented the continuation of his thermodynamical researches entitled "General ideas on the mechanical interpretation of the physical and chemical properties of bodies."—Note on some thermometric observations during winter in the Alps, by Dr. Frankland.—On the influence of ferments on surgical maladies (second note), by M. A. Guérin.—On the combinations of arsenic with molybdic acid, by M. H. Debray.—Note on the employment of iron shot for replacing leaden shot in rinsing bottles, by M. Fordos.—On soluble starch, by M. Masculus. Starch is dissolved in acidulated boiling water, the acid neutralised, and the solution filtered and evaporated to a syruppy consistence. An abundant granular deposit is obtained, which is washed with cold water, and then with alcohol. This soluble starch gives all the reactions of natural starch, and is decomposed by diastase in the same manner, but with greater ease.—On the transmission of the irritation from one point to another in the leaves of *Drosera*, and on the part which the tracheæ appear to play in these plants, by M. M. Ziegler. The author concluded, that the tracheæ, or the fibres surrounding them, transmit the irritation from one hair to another, and that the movements of the hairs of the circumference of the leaves are not reflex movements induced by an irritation proceeding from a centre situated elsewhere than in the leaf.—On the concussion of bodies, by M. G. Darboux.—On the temperature of the sun, a note by M. J. Violle.—Studies on electric chronographs, and researches on the induction spark and on electro magnets, by M. M. Deprez.—On the motion of the air in pipes, by M. C. Bontemps.—M. F. A. Abel communicated his fourth memoir on the properties of explosive bodies.—Note on the decomposition of tungstate and of molybdate of sodium by sal-ammoniac, by M. F. Jean; these substances when boiled with solution of sal-ammoniac disengage ammonia, the liquid remaining acid.—On the constitution of clays, by M. T. Schlœsing.—On the identity of bromoxaform and of pentabrominated acetone, by M. E. Grimaux. The author's experiments show that methylic alcohol and methylic acetate are not attacked in the cold by bromine, but at 150°—170° the latter body is transformed into methylic bromide and bromacetic acids. The substance formed by the action of bromine upon the alkaline citrates is pentabrominated acetone, and the chlorinated bodies obtained by the action of chlorine on citric acid and citrates are chlorinated derivatives of acetone and not of methyl-acetic ether.—Experimental study on the influence of the injection of bile on the organism, by MM. V. Feltz and E. Ritter.—On the hind foot of the *Hyænodon parisiensis*, by M. G. Vasseur.

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Charles Darwin.

From a Photograph by O. G. Rejlander.

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