THURSDAY, JANUARY 14, 1875

THE APPROACHING ECLIPSE OF THE SUN

THE energetic action of the Council of the Royal Society, and the wise liberality of the present Government in matters connected with scientific investigation, have saved us from what would have been little short of a national disgrace.

If all goes well, the approaching eclipse of the Sun —during which, as stated by Mr. Hind, better opportunities for the observation of totality will be afforded than are likely to be again offered before the close of the present century—will be observed by English parties in Siam, and either in Burmah or in some island in the Bay of Bengal.

The work to be done, as determined by the Council of the Royal Society, and the investigations which have led up to it and render it of so great an importance, have been stated in Monday's *Times* in an article which enters so fully into the problem, that we take the following extracts from it :—

"In 1860, Mr. De la Rue, a member of the Astronomer Royal's Expedition, and Father Secchi, a delegate of the Italian Government, were enabled, by the photographs of the eclipsed Sun, which were then taken for the first time, to place beyond all doubt that the strange red prominences seen round the dark body of the Moon at the moment of total eclipse really belonged to the Sun's atmosphere. This was a fine achievement, for it settled a point which had been in debate for a century and a half. Important though it was, however, it was fairly dwarfed by the results of the expeditions sent by the Indian, French, German, and Austrian Governments to observe the eclipse of 1868 in India—dwarfed because in the meantime an instrument had been placed in the hands of the astronomer of a perfectly new kind of power. It was no longer a question of place and shape, but of material. Janssen, Tennant, Pogson, Weiss, and many others observed the eclipse with the spectroscope, and its story was that the prominences which in 1860 had been proved to belong to the Sun really consisted of a glowing gas, or a mixture of such gases. But the spectroscope was not of use only during eclipses. Before 1868 Kirchhoff by its means had stated the approximate composition of the Sun's atmosphere, taken as a whole ; and immediately after the eclipse of that year it was found that by its aid the brightest part of the Sun's atmosphere, to which alone up to this time attention had been directed, could be seen without an eclipse at all. Indeed, we were soon told that outside the bright round disc that we see there was an evelope of glowing hydrogen gas, to which envelope the name of chromosphere was given, and into which are frequently injected from below magnesium and sodium, and, more rarely, iron and the other heavy metals. Here, then, we were enabled roughly to sort out into strata the various substances already detected by Kirchhoff ; that is, it was established that the gases and vapours were not all mixed up together, but that the lightest, such as hydrogen, magnesium, and sodium, were generally at top, and that, as the others were shot up from time to time, and some of them more frequently than others, some of them were, as a rule, located lower down in the solar atmosphere than the others.

"The eclipse of 1869 the Americans had all to themselves, and splendid use they made of it. It has been well said that the line of totality which swept across the United States was one continuous observatory. In this eclipse the halo of light outside the prominence-envelope was the subject of special inquiry, and now this was photographed, as the prominences themselves had been in 1860. At the same time that this was done it was established that there was some other substance lying even outside the hydrogen.

"The eclipse of the next year, 1870, was best seen in different parts of the Mediterranean. The English Government, applied to by the Royal and Astronomical Societies, at once supplied the requisite funds and ships, and sent three parties ; the United States Government sent an equal number ; and the French one party, the Spanish and Italian astronomers observing locally. Further facts were obtained of great value ; but the weather was not good, and the true nature of the corona was not considered to be finally established. Another appeal was therefore made to the Government in 1871 by the Presidents of the British Association, the Royal Society, and the Astronomical Society combined, to observe the eclipse of that year in India. The Government responded with a remarkable promptitude, granting everything that was required. The Indian Government not only had strong parties of their own, but largely aided the observers sent out from England ; and the French Government were again represented by the illustrious Janssen, who had made his exit from beleaguered Paris in a balloon to observe the phenomenon. The Dutch Government had an expedition in Java. The combination of the results of the parties, most of whom had splendid weather, led to the following most important conclusions :—

"First, the corona was now at last photographed, under nearly the same instrumental conditions, from three different places, and the exact similarity of the pictures proved beyond all doubt that part of the corona was a solar appendage. The size of the Sun was enormously increased by this result. Secondly, evidence was obtained rendering it extremely probable that the light of the outer parts of the true solar corona, or *coronal atmosphere*, as Janssen proposed to call it, was stronger in the violet and ultra-violet parts of the spectrum than elsewhere. Thirdly, it was proved that for some distance above the hydrogen envelope, as seen without an eclipse, less bright hydrogen existed. The so-called chromosphere, therefore, was a layer of brighter hydrogen and other vapours. Other results were obtained, but the above are those on which we wish to lay the greatest stress, for reasons we now proceed to state.

"Since the eclipse of 1871 the every-day observations of the Sun and of his lower atmosphere (the chromosphere), which can be rendered visible by the spectroscope, have gone on with great vigour, especially in Italy. A special study of the chromosphere has been made at the expense of the United States Government, at an elevation of some 9,000 feet, on the Rocky Mountains ; and extensive laboratory researches have been undertaken with the view of enabling us to understand better the various phenomena observed. We shall now only refer to the two latter branches of the work. Prof. Young, on the Rocky Mountains, in the clear air at so great a height, saw that the chromosphere was much more complicated than it appears to those who observe in the plains. Among other things, he found that the vapour of the metal calcium, the principal characteristic lines of which require perfect atmospheric conditions to enable us to see them, was very often present along with magnesium, but his observation left it doubtful which vapour extended highest generally. The laboratory experiments proved that, in the case of any one metal present in the Sun, the metal behaves exactly the same in the Sun's atmosphere as it does when driven into vapour by the passage of the electric current between the carbon poles of an electric lamp. At the greatest distance from the poles the spec-

trum of the vapour is the simplest (single-lined), in the core of the arc it is complex (many-lined). Now, in the case of some of the elements present in the Sun, we have a spectrum as complete as that we get in the core of the arc, in others only a line or two, so far as we know at present. In fact, we have hydrogen and the metals of the alkalis and alkaline earths and the metals of the iron class with almost complete spectra on the one hand, and on the other only a few lines indicating the presence of such metals as zinc and lead.

"Nor is this all. A most diligent search has been made for metals of the tungsten, antimony, silver, and gold classes among the metals, and entirely without success. Dealing, however, with the metals the record of which is most obvious in the solar spectrum, hydrogen, magnesium, calcium, sodium, and the metals of the iron group, the order we have given is not only the order in which they would be met by a body entering into the solar atmosphere, but it is the order of the old atomic weights. Further, although it is true that at present we do not know much about the spectra of the stars, we do know that the stars with the simplest spectra are stars which only give clear indications of hydrogen, or hydrogen and magnesium, or hydrogen, magnesium, sodium, and so on. A star as it gets gradually older may apparently give us a spectrum belonging to a gradually increasing depth of the solar atmosphere as it exists at this moment.

"So far we have said nothing about metalloids; that is, those elementary bodies, such as oxygen, carbon, nitrogen, sulphur, and the like, which make up more than half of the parts of our planet most easily got at. Of metalloids in the chromosphere none have been detected, but a year ago a paper was presented to the Royal Society pointing out that their record would appear not to be entirely absent from the solar spectrum; in fact, that we have exactly such a record as we should expect if this large class of bodies existed in a comparatively cool part of the atmosphere at some height above the hotter lower strata. It was also shown that, granting this, we could explain the various classes of stars in the heavens by supposing that as a star got older and colder the metalloids were enabled to exist lower down in the atmosphere, and thus to change the character of the spectra of stars bright and hot into that associated with those which are dim and possibly colder, until at last the metalloidal rain, so to speak, falling on the metals below, gives the material of a future crust. It will be seen, then, that the work since 1871 has been assuming more and more a chemical character, and associated with this are physical questions of the greatest interest, not only bearing on the kinetic theory of gases, but which may eventually help us to follow more intelligently than we can now the matter of a nebula till it forms part of the cooled crust of a planet.

"The present line of inquiry, then, is to determine the chemical nature of a section of the Sun's atmosphere reaching from the photosphere to the extreme limit of the corona, some hundreds of thousands of miles away. This with the old conditions of observation, would have been a hopeless task to accomplish. But, side by side with the results to which we have drawn attention, new methods of investigation have been introduced, and among these the development of spectrum photography deserves first mention. The spectrum of the corona can now be photographed with the same ease as the prominences were photographed in 1860, and if such photographs can be obtained, it is certain that the work of four minutes will in all probability be more valuable than laboratory work extending over as many years. But even spectrum photography would not have been applicable under the best conditions unless side by side with it an instrument had been introduced which is destined to effect a great revolution in astronomical observation. In the Siderostat we have an instrument, suggested by Hooke and perfected by Foucault, which enables us to do away with telescope stands and their equatorial mountings altogether. This is effected by moving a large, perfectly plain mirror in front of the object glass of a telescope, the telescope itself being horizontal and at rest. This arrangement permits of spectroscopes and photographic apparatus being attached to the eye-piece end of the telescope of even greater dimensions than the telescope itself. The special and novel method of attack to which Mr. De la Rue referred as having been suggested to the Council of the Royal Society can now be guessed by our readers; and unless we have missed the mark altogether, it should now be seen that the work of the proposed expedition of this year is the fruit and crown of the work begun in 1860 and carried on by the English and other civilised Governments since that time. . . . ."

We have little to add to the foregoing, except that it appears to us a sad thing, and little to the credit of the leaders of astronomy in England, that such strong arguments should have to be put forward at all in favour of eclipse observations. *Every total eclipse of the Sun ought to be observed as a piece of the national business with as great a regularity as the transit of the Moon over the meridian of Greenwich.* Nay, we may go further, and say with *greater* regularity; for we know something about the motion of the Moon, and we can predict her place with some accuracy, but he would be a bold man who would predict the shape and condition of the Sun's surroundings in the forthcoming eclipse. Practical men might possibly urge the greater utility of one kind of observation, but a man of science who does this is to our mind not a true man of science at all.

Mr. Hind has sent us the following most valuable information regarding the actual conditions of observation, referring at somewhat greater length to Siam, whither English astronomers are invited by the King of Siam.

"Although the course of the central line in this eclipse is mainly a sea-track, yet in its passage from the Nicobar Islands, in the Bay of Bengal, to Siam, better opportunities for the observation of totality will be afforded than are likely to be again offered before the close of the present century.

"Adopting the elements of the *Nautical Almanac*, in which the place and hourly motions of the moon are derived from Hansen's Tables, I find the following points upon the central line:—

Greenwich Mean Time.	Longitude East.	Latitude North.	Sun's Altitude.
H. M. S.	° ′	° ′	° ′
19 8 0	92 36·9	7 34·2	71 8
19 14 0	94 20·2	9 1·6	67 51
19 23 0	97 9·5	11 10·4	62 38
19 26 0	98 9·9	11 52·7	60 51
19 28 30	99 2·5	12 27·3	59 18
19 32 0	100 19·7	13 15·9	57 6

"If we lay down these points on the Admiralty Charts of the Bay of Bengal and Province of Tenasserim (British Burmah), we find the central line passing a little north of Kaikul, in the Island of Camorta, Nicobars, and on making a direct calculation for Kaikul, totality is found to commence at 1h. 21m. 38s. local mean time, and to continue 4m. 27s., the sun being at an altitude of about 70°. I take the position of Kaikul, 6h. 13m. 31s. E. and 8° 11′·8 N. The central eclipse, passing from the Nicobars, traverses Bentinck Island, where the maximum duration of totality is 4m. 17s., and runs between Mergui and Tenasserim, rather nearer to the former place than to the latter. By direct calculations I find—

Totality begins at Mergui at . . . . 2h. om. 6s. local time.

Duration	...	...	4m. 6s.
Sun's altitude	...	...	61°

Totality begins at Tenasserim at 2h. 2m. 7s. local time.

Duration	...	...	3m. 57s.
Sun's altitude	...	...	60°

Nearly midway between the above places, or where a "Conical Peak" is marked on the Admiralty Chart, the total eclipse continues 4m. 14s.

"Bangkok (Siam) will be found to lie rather north of the central line. The circumstances of the eclipse at this point are as follows (long. 6h. 42m. 6s. E. ; lat 13° 42′5″ N.)

"The partial eclipse begins at oh. 51m. 6s. mean time at Bangkok, 134° from the north point towards the west, and 168° from the vertex eastward, for *direct* image ; the sun at an altitude of 76°. The total eclipse begins at 2h. 13m. 7s. and continues 3m. 54s., the sun about 57° high, and the partial phase ends at 3h. 33m.

"The invitation extended to British and other astronomers by the King of Siam, to observe this interesting and important phenomenon within his dominions, may be expected to bring together a number of competent observers in the vicinity of Bangkok ; and in selecting localities for astronomical stations, it must be very desirable to be enabled to form some idea of the extent of error to which the predicted track of the central line may be subject. On this account I have made a further direct calculation for the Siamese capital, taking the moon's position from the American Ephemeris, in which the Tables of Prof. Peirce are employed. With elements thus modified, the partial phase is found to commence at oh. 50m. 42s., or 24 seconds only earlier than by Hansen's Tables ; totality begins at 2h. 13m. 32s., and continues 3m. 59s. Generally I may remark that between the longitudes of the Nicobars and Siam, the track of central line by the American Tables has about five minutes greater latitude than that given by Hansen's Tables.

"(For any point in Siam in the neighbourhood of Bangkok, the *Greenwich* time of commencement of the partial eclipse will be given closely by the following formula :—

$$\text{Cos. } w = -0{\cdot}08471 - [0{\cdot}12053] \text{ sin. } l + [0{\cdot}12430] \text{ cos. } l, \text{ cos } (L - 172^\circ\ 10''{\cdot}1)$$
$$t = 18\text{h. } 55\text{m. } 58\text{s.} - [3{\cdot}71146] \text{ sin. } w + [3{\cdot}83098] \text{ sin. } l$$
$$- [3{\cdot}83692] \text{ cos. } l, \text{ cos. } (L - 4^\circ\ 14''{\cdot}5)$$

The *Greenwich* mean time of beginning and ending of totality may be found from

$$\text{Cos } w = -17{\cdot}5228 - [1{\cdot}74616] \text{ sin. } l + [1{\cdot}68499] \text{ cos. } l, \text{ cos. } (L - 150^\circ\ 25''{\cdot}5)$$
$$t = 18\text{h. } 17\text{m. } 58{\cdot}5\text{s.} \mp [2{\cdot}09477] \text{ sin. } w + [3{\cdot}77348] \text{ sin. } l$$
$$- [3{\cdot}84594] \text{ cos. } l, \text{ cos. } (L + 16^\circ\ 32''{\cdot}8).$$

"In the above formulæ L expresses the east longitude of the point from Greenwich, taken positive ; l is its geocentric latitude, and the quantities within the square brackets are logarithms. Upper sign for beginning of totality, lower sign for ending.)

"It has been stated above that the eclipse of next April may probably be the most favourable for observation that can take place during the present century. In the eclipse of 1878, July 29, the duration of totality is shorter, and the same is the case in the eclipses of 1882, 1887, 1900, &c. In the eclipse of 1886, August 29, the only easily accessible and favourable station appears to be the Island of Grenada, in the West Indies, where the duration of total eclipse is 3m. 15s., commencing at 7h. 10m. A.M. local time, with the sun at an altitude of 20° ; thence the course of the central line is over the North and South Atlantic Oceans, to a point on the African coast north of St. Philip de Benguela. In the eclipse of 1892, April 26, the central line appears to have a sea-track through nearly its whole extent, if indeed it touches land at any point, which requires a more precise computation than I have yet made to determine. The eclipse of 1893, April 16, is the only one that can compare favourably, as regards length of totality and track, with that of the present year : at a point in the vicinity of Ceara, in the Brazils, the duration of total eclipse is 4m. 44s. with the sun at an altitude of 76°."

We may conclude our article by stating that the observations for which the Council of the Royal Society have obtained a promise of a grant in aid amounting to 1,000*l.* will be limited to photographing the spectra of the chromosphere and coronal atmosphere.

For this purpose a siderostat has been placed at the disposal of the Royal Society, and another will be ready in time. These instruments have been made by Messrs. Cooke and Sons, of York, who have in some respects, with their usual skill, improved upon Foucault's model. As an instance of international courtesy which must not be unrecorded, we may state that M. Leverrier would have placed the original instrument devised by Foucault himself, and now at the Paris Observatory, at the disposal of the Royal Society, had it not been constructed solely for the latitude of Paris.

Besides siderostats, it is proposed that equatoreals shall be sent out also, provided with apparatus for spectrum photography, quartz prisms and lenses being generally employed.

The Secretary of State for India (Lord Salisbury), the Viceroy of India, and the Admiralty officials are all hearty in their co-operation. It is hoped that Col. Tennant and a strong staff of assistants will also be on the scene of action.

Although the time is short, then, we may fairly hope that good work will be done. Of this we may be assured, that whether the observers be many or few, whether the weather be good or bad—and General Strachey considers the chances all that can be wished for—the action of the Royal Society and of the Government will redound to the credit of English science, and a bright page may be added to the scientific annals of our time.

EDITOR

COUNT RUMFORD'S COMPLETE WORKS

The Complete Works of Count Rumford. (Published by the American Academy of Arts and Sciences.)

THE American Academy of Arts and Sciences is doing good service and teaching the Old World a sound practical lesson by undertaking the publication of such a work as this. The question of what form should be given to the monument of a great man is often discussed, and fairly admits of much debating ; but when the benefactor of humanity whose memory is to be preserved is one who has done the high service of extending the boundaries of science, we may safely venture to affirm that whatever *other* monuments may be erected, the *first* should be a complete and carefully compiled record of all his researches. The demand for this arises from the manner in which the results of original scientific work are usually communicated to the world, *i.e.* in the form of papers read before learned societies or contributed to magazines, or published as pamphlets, and thus scattered far and wide and liable to be forgotten or even altogether lost. Such a publication should precede all other forms

of memorial on the simple principle that strict justice should precede generosity. The object being to perpetuate and honour the memory of such a man, the first step should be to do *justice* to his memory, and this cannot be done unless his works are collected in an available and presentable form. The most perfect of monumental epitaphs is Sir Christopher Wren's in St. Paul's Cathedral—

"Lector, si monumentum requiris, circumspice."

A handsomely printed record of the life-work of any original investigator might bear a similar inscription. The justice of such an epitaph would be absolutely complete.

That Count Rumford himself took this view of the matter is evident from the fact that on recovering from the illness which in 1793-94 nearly finished his career, he left Bavaria and came to London in September 1795 for the purpose of publishing a collection of these same essays which the American Academy have now reprinted, and that he left London in 1802 when their publication was completed. His narrow escape from death had evidently suggested the necessity of losing no more time in thus doing justice to his own memory.

But it is not every scientific investigator who finds an appreciative monarch, like the Elector of Bavaria, willing to reward so munificently the services of intellect; there are but few who can afford to indulge in the expensive luxury of printing books which the uneducated millions and the ill-educated thousands are equally incapable of appreciating. The professional publisher is prohibited from undertaking such work, from the simple fact that much activity in that direction would land him in the Bankruptcy Court. Here, then, is a clear demand for uncommercial effort, if the memory of great men is to be preserved and the full advantages of their labour are to be reaped by their fellow-creatures.

We should do well here in England by at once commencing a great national effort in this direction. Local patriotism would be appropriately directed by starting the subscription for a republication fund in every town or village which has the honour of having given birth to a worthy worker in science; and our learned societies might carry out the work as the American Academy has done in this case. Birmingham has done well in erecting the noble statue of Priestley that fitly decorates the approach to the Birmingham and Midland Institute; but the student who admires the sculptured presentation of the great philosopher performing his great experiment has considerable difficulty in finding the full original record of this scientific exploit. How very interesting to the general student, either of science or of human nature, would be a complete collection of all the far-scattered and diverse works of Priestley's powerful and wide-grasping intellect! At present they are practically buried. The same may be said of the majority of the inductive philosophers, from Horrocks, Gilbert, and Galileo, down to the name on the latest scientific obituary. Such collections of the works of our great philosophers would be a worthy complement to the Royal Society's invaluable index of scientific papers.

The following list of the subjects treated in the three volumes already published sufficiently indicates the variety of Rumford's work:—

A Method of determining the Velocity of Projectiles; Experiments to determine the Force of fired Gunpowder; Experiments with Cannon, and Improvements in Field Artillery; The Production of Air from Water; The Quantities of Moisture absorbed from the Air by various substances; The Propagation of Heat in Fluids; The Final Cause of the Saltness of the Sea; Chemical Affinity and Solution, and the Mechanical Principle of Animal Life; The Propagation of Heat in various substances; The Source of the Heat which is excited by Friction; An Inquiry into the Weight ascribed to Heat; The Nature of Heat, and the Mode of its Communication; Experimental Investigations concerning Heat; Reflections on Heat; Historical Review of the various Experiments of the Author on the subject of Heat; Experiments and Observations on the Cooling of Liquids in Vessels of Porcelain, gilded and not gilded; Account of a curious Phenomenon observed on the Glaciers of Chamouni; New Experiments on the Temperature of Water at its Maximum Density; The Propagation of Heat in Liquids; Adhesion of the Particles of Water to each other; The slow Progress of the Spontaneous Mixture of Liquids; The Use of Steam as a vehicle for transporting Heat; The Means of increasing the Quantities of Heat obtained in the Combustion of Fuel; Description of a New Boiler; The Use of the Heat of Steam in the making of Soap; Experiments on Wood and Charcoal; Heat developed in the Combustion and in the Condensation of Vapours; The Capacity for Heat of various Liquids; The Structure of Wood, &c.; Chimney Fireplaces; the Management of Fire, and the Economy of Fuel; The Construction of Kitchen Fireplaces and Kitchen Utensils; The various Processes of Cookery, and Proposals for improving that most useful art; The Management of Fires in closed Fireplaces.

One remarkable feature of Count Rumford's papers is their simplicity and clearness. They are all readable, to the least initiated in scientific technicalities. There is no pedantry, no vain display of unnecessary formulæ; but, on the contrary, every page displays the clear and purely scientific intellect of the writer. It matters not whether he is discussing the proper shape of a saucepan lid, the flavouring properties of a red herring, or the deepest mysteries of molecular force; whether he describes his method of eating a plate of hot pudding, or of reorganising and commanding the Bavarian army—the same thoroughness and simplicity of pure inductive and deductive reasoning prevails. He seems to have been incapable of thinking of any subject other than systematically and scientifically; and to this fixed habit of mind his marvellous success in the solution of the most difficult social and military problems is clearly traceable. His last effort, the essay on "The Nature and Effects of Order," upon which he laboured so long during the last years of his fading life, and which the feebleness of his over-tired intellect prevented him from finishing, was apparently intended as a vindication of his peculiarly strict and systematic method of doing everything, which was so miserably misunderstood by his eulogist Cuvier, his intensely French wife, and the Frenchmen by whom he was surrounded and ridiculed during his latter days. To do such work as Rumford achieved, and do it all so coolly without any sentimental flourishes, without drums, or flags,

or processions, or trumpets, or inaugurations, was to them quite incomprehensible, and hence their misrepresentation of his work and character, when they tell us that he looked upon mankind merely as objects of experiment, and not with any philanthropic feeling, and that "il ne s'agissait que de nourrir les ouvriers assez bien pour entretenir cher eux la force musculaire des membres." Those portions of his essays in which he describes the work done at the "House of Industry" in Munich utterly refute these mistaken views of Rumford's character.

I have read nothing more humiliating in reference to the still remaining magnitude of popular ignorance of the merest rudiments of physical science than some of these essays. Take as an example this passage on page 177 of vol. ii. "The waste of fuel in culinary processes, which arises from making fluids boil *unnecessarily*, or when nothing more would be necessary than to keep them *boiling hot*, is enormous. I have no doubt but that much more than half the fuel used in all our kitchens, public and private, in the whole world, is wasted precisely in this manner." Again, he tells all the world that "nothing is so ill-judged as most of those attempts that are so frequently made by ignorant projectors *to force the same fire to perform different services at the same time.* The heat generated in the combustion of fuel *is a given quantity*, and the more *directly* it is applied to the object on which it is employed so much the better, for less of it will escape or be lost on the way; and what is taken away on one side for a particular purpose can produce no effect whatever on the other side where it is not."

These, and quite a multitude of similarly simple and obvious applications of the elementary laws of heat, were not only expounded but practically applied by Rumford eighty or ninety years ago, and we are still blundering on and blindly violating them. Every laundry is still filled with the steam of wastefully boiling coppers, and almost every saucepan in the United Kingdom and elsewhere is wastefully used for the unnecessary distillation of water, not one cook in 500 knowing that water is no hotter when it boils violently than when it "simmers" gently. Nine-tenths of the ranges exhibited at the last Exhibition of South Kensington were constructed in direct violation of the simple and obvious principles above stated, and our ironmongers still persist in making "kitcheners," "ranges," &c., with the fire in the middle, the oven on one side, and a boiler on the other, or even with ovens on both sides; instead of placing the fire on one side, the oven next, and boiler beyond, to utilise residual heat. In most of our best English houses a range capable of cooking for a dinner party of thirty or forty people is kept going to supply water for a tumbler of toddy, although Rumford demonstrated again and again the vast economy and convenience of having several fires in every establishment where the demands for cooking are variable, and his essays give descriptions and drawings of how these fires should be arranged.

It must be remembered that Rumford was no mere theoretical writer or lecturer, but he practically carried out on large and small scale every principle he expounds. He cooked for thousands and tens of thousands in his military kitchens, his House of Industry, in private houses, at the Foundling Hospital in London, at public institutions in Dublin, Edinburgh, &c.; and in these practical demonstrations weighed his fuel, registered its consumption, and published the results.

Thus, at the Foundling Hospital he roasted 112 lbs. of beef with 22 lbs. of coal, the residual heat from the roaster going on to the boiler. In the public kitchen at Munich, where his arrangements were fully carried out, he frequently—as certified by the Colonel and Councillor of War—prepared the ordinary hot dinner for one thousand persons, and "the expense for fuel has not amounted to quite twelve kreutzers" (less than 4½*d.*, or one-fiftieth of a farthing for each person). It must be remembered, in reference to this, that Rumford's soup requires five hours' boiling, or rather heating at the boiling-point.

I have little doubt that the merited failure of all the recent competitors for the Society of Arts' prize was due to the absence of scientific knowledge, and of that systematic inductive method of proceeding by the aid of which Rumford wedded theory to practice, and brought forth such important results. His researches on the "Propagation of Heat in Fluids," upon which our present knowledge of the phenomena of the convection of heat is mainly founded, were suggested by burning his mouth with a spoonful of thick rice soup, and were further elaborated in order to determine the best material for soldiers' clothing. His celebrated demonstration of the immateriality of heat was in like manner a result of cannon-boring. Every essay in these three volumes supply similar illustrations of the action and reaction of theory and practice upon each other, and their mutual development thereby.

One of the most curious and least-known of his speculative efforts is that upon "the mechanical principle of animal life." They bear upon many of the molecular speculations now occupying so much attention, and are sufficiently interesting to demand full quotation of the following essential paragraphs:—

"Suppose an open vessel—as a common glass tumbler, for instance—containing a piece of money, a small pebble, or any other small solid opaque body, to be filled with water and exposed in a window, or elsewhere, to the action of the sun's rays. As a ray of light cannot fail to generate heat when and where it is stopped or absorbed, the rays, which, entering the water and passing through it, impinge against the small solid opaque body at the bottom of the vessel, and are *there absorbed*, must necessarily generate a certain quantity of heat, a part of which will penetrate into the interior parts of the solid, and a part of it will be communicated to those colder particles of the water which repose on its surface.

"Let us suppose the quantity of heat so communicated to one of the integrant particles of the water to be so small that its effect in diminishing the specific gravity of the particle is but just sufficient to cause it to move upwards in the mass of the liquid with the very smallest degree of velocity that would be perceptible to our organs of sight were the particle in motion large enough to be visible. This would be at the rate of about *one hundredth part of an inch* in a second.

"This velocity, though it appears to be slow in the extreme when we compare it with those motions that we perceive among various bodies by which we are surrounded, yet we shall be surprised when we find what a rapid succession of events it is capable of producing.

"If we suppose the diameter of the integrant particles or *molecules* of water to be *one-millionth part of an inch* (and it is highly probable that they are even less), in that case it is most certain that an individual particle, moving

in a quiescent part of that fluid with the velocity in question, would run through a space equal to *ten thousand times the length of its diameter in one second*, and consequently would come into contact with at least *six hundred thousand* different particles of water in that time.

"Hence it appears how inconceivably short the time must be that an individual particle, in motion, of any fluid can remain in contact with any other individual particle, not in motion, against which it strikes in its progress, however slow that progress may appear to us to be through the quiescent mass of the fluid!

"Supposing the contact to last as long as the moving particle employs in passing through a space equal to the length of its diameter—which is evidently all that is possible, and more than is probable—then, in the case just stated, the contact could not last longer than $\frac{1}{10000}$ part of a second! This is the time which the cannon bullet, flying with its greatest velocity (that of 1,600 ft. per second), would employ in advancing two inches.

"If the cannon bullet be a *nine-pounder*, its diameter will be four inches, and if it move with a velocity of 1,600 feet in a second, it will pass through a space just equal to 4,800 times the length of its diameter in one second. But we have seen that a particle of water moving 100th of an inch in a second actually passes through a space equal to 10,000 times the length of its diameter in that time. Hence it appears that *the velocity with which the moving body quits the space it occupies* is more than twice as great in the particle of water as in the cannon bullet!"

I am sorry that space does not permit further quotation of this essay, in which the author goes on to show that inequality of fluid temperature is one of the leading phenomena of animal life; that respiration raises the heat in one part, while insensible perspiration cools another; that stimulation of all kinds is accompanied with disturbance of temperature and the consequent motion of particles, which he regards as the life of fluids.

Of course it is not supposed that Rumford, by these ingenious speculations, supplies any mechanical solution of the mystery of *conscious* vitality, but his suggestions have the merit of showing that a vast amount of molecular activity is a demonstrable result of simple well-known facts. He obtains this activity without invoking the aid of those profound assumptions in which the brilliant imaginations of modern mathematicians so luxuriously revel when they reason upon the vibrations, gyrations, &c., of the component particles of interatomic atmospheres.

In spite of all the progress we have made in physical science, these essays, written for the most part during the last century, contain a great deal that is still suggestive and worthy of thoughtful reading both by popular students and experts in physical and social science. This is especially the case in the essay on "The Propagation of Heat in Fluids," reprinted in vol. i. of this work. Many of the conclusions and speculations are now demonstrably erroneous, but some of the suggestions—more particularly those in chap. iii. on the Chemical Action of Light—are worthy of far more attention and investigation than they have yet received. They are avowedly very bold, but the author tells us frankly that their temerity "has not been entirely without design;" that "philosophers may be *enticed* and they may be *provoked* to action," and that he has "endeavoured to use both these methods," even with conscious imprudence, for the purpose of exciting them to further investigation of the subjects for which he has such "passionate fondness."

It will be well if the republication of these essays contribute to the fulfilment of Rumford's enthusiastic wishes.

W. MATTIEU WILLIAMS

THE SILKWORM COCOON

Le Cocon de Soie. Histoire de ses transformations, description des races civilisées et rustiques, production et distribution géographiques, maladies des vers a soie, physiologie du cocon et du fil du soie. Deuxième Edition. (Paris: J. Rothschild, 1875.)

WE have received an advance copy of M. E. Duseigneur-Kléber's monograph, "Le Cocon de Soie," dated for 1875, the get-up of which is calculated at once to arrest attention and excite interest. The 248 quarto pages of clearly printed letterpress containing his information, admirably arranged in methodic form, are accompanied by thirty-seven plates executed in photo-typography, and a map of the world indicating the localities where silkworms are cultivated. Twenty-eight of the plates are devoted to the illustration of the different types of cocoons from different countries, of which as many as 195 are figured from photographs.

Such a work was, he says, quite impossible twenty years ago, and it is only in consequence of diseases that it is possible now. Each district prided itself on the silk it produced, and did not trouble to know what other countries were doing, until the enfeeblement of some and the destruction of other types by disease compelled growers to seek fresh types from a distance, and thus accumulated the information which M. Duseigneur-Kléber has compiled and presented in this attractive form. Many of the types he thinks will probably not be again met with in cultivation, and it is only through noticing and recording facts as they came under his notice during a series of years that his information has been obtained. Looking to the past, he finds that from 1700 the years of disease were 1702, 1720, 1750, 1787, but the chroniclers give no intimation of the character of the disease. In 1810 the "plague" was described by M. Paroletti. The affected worm exhibited small spots all over its body, which were gangrenous, and appeared to be caused by the same disease now known as "Muscardine."

Among the practical points noticed in the first section of the work are the following: That the red or black mulberry produces more vigorous worms than the white; that the old notion of selecting bright-coloured cocoons for breeding has given place to the belief that dull yellow are the best; that the practice of limiting the time of copulation of moths is injurious; that while the worms are making their cocoons, the ventilation of the buildings, too often neglected, is even more important than warmth. The symptoms of the disease known as Pebrine are detailed, but its cause seems to be not known. That its recurrence coincides with unusually wet and cold seasons is established, but whether it results from a parasitic vegetation whose germs are carried in the air is still a subject for experiment. When the external indications are well marked, the silk reservoir is found much diminished in volume. The spots which appear on the skin continue

through successive moultings ; the feet become atrophied : if the worm dies, the body dries up without putrefaction ; if it lives on to metamorphosis the moth shows all the characters of hydropsy.

M. Duseigneur-Kléber has paid much attention to the method of work performed by the worms in the construction of their cocoons. A healthy worm (in disease they act irregularly) selects a suitable spot for its operations, where there is space for its whole body to move about, supporting itself generally by its two last feet only. Having carefully arranged from twig to twig the outline of its work, its movements quicken, and at the end of three hours the first outer layers of its nest are complete, and the sphere of operations is then limited. At the end of five or six hours the exact form of the cocoon is indicated, still remaining diaphanous and rarely coloured yellow. So far it is easy to watch the worm at work, and it is seen that it holds itself in a semicircle or curved like an S. After a little more work the cocoon loses its transparency, and begins to be coloured. The author, however, by methodically cutting into cocoons continued his observations, and found that the worms never stopped to repair the damages thus caused, but going on uninterruptedly, the layers formed within the cut layer rapidly covered the aperture. Remaining attached by its hind legs, a worm forms its layers in the shape of an 8, changing its position from time to time, generally moving but a short distance, though sometimes turning completely round and continuing on the opposite side of the cocoon. He calculates that, varying according to race, there are from thirty to forty different layers in a cocoon, and the time occupied in its construction is from three-and-a-half to four days. Whatever may be the condition of the outer layers, the innermost coat formed is of the finest thread, and the end towards which the head is turned is the tenderest, thus providing a soft and elastic cradle for its metamorphosis.

The book is especially intended for practical purposes, and contains information as to the outward appearance that may guide a dealer in purchasing cocoons, a special chapter being given to each kind of defect. Not only double cocoons, but cocoons in which three or even four worms have worked together, are mentioned.

In the enumeration of silk-rearing districts, besides the well-known localities of France, Italy, the Austrian Empire, China, and Japan, the following less known are among those mentioned :—California, Mexico, Guatemala, Peru, Brazil, Chili, the Argentine Republic, Algeria, and Armenia. In South America especially increased attention is being paid to silk-production, and it gives promise of becoming a very important industry.

OUR BOOK SHELF

The Straits of Malacca, Indo-China, and China ; or, Ten Years' Travels, Adventures, and Residence Abroad. By J. Thomson, F.R.G.S. Illustrated. (London : Sampson Low and Co., 1875.)

MR. THOMSON'S sojourn in the countries with which his book is concerned seems to have extended from 1862 onward, during which time he evidently had plenty of leisure to visit various places on the south-east and east of Asia, extending from Penang to Pekin. We can heartily recommend his modest work to anyone wishing to obtain a fair idea of the social life, scenery, and productions of the districts which he visited, and in which he usually sojourned for some time, including the Malay Peninsula, Siam, Cambodia, Hong Kong, Amoy, Pekin, and other coast-towns of China. He also sailed a considerable distance into the interior of China, up the Yang-tse-Kiang, and made a short walking tour into the interior of Formosa. Mr. Thomson put his eyes, his ears, and his camera (for he is an accomplished photographer) to excellent use, so that we do not know any work of the size that conveys a juster and fuller idea of the manners and customs of the various peoples whom he visited. Mr. Thomson makes no pretension to have travelled in the interests of science, but only to be a photographer and an observer of the ways of men. Nevertheless, throughout the work occasional jottings are introduced that may be of interest to the botanist and geologist. Among the very first pages he hazards some conjectures as to the cause of the love of brilliant colours among tropical men, birds, and flowers, which are evidence of some observation and thought. "Perhaps," he says, "our men of science might be able to tell us whether the heat of the oriental sun develops in flowering plants a craving for the absorption of certain colours of the solar spectrum, and for the reflection of others ; whether, indeed, the electric affinities of plants in this way are affected by temperature. Can we, in the same way, account for the brilliant plumage of tropical birds, in which homogeneous red, yellow, and blue are very conspicuous, and also for the liking which uncultured Eastern races show for the reds, blues, and yellows."

Mr. Thomson gives some very interesting information about the Chinese, whom he found wherever he went, mingling as managers or factors in the life of every place, always bent on making money, and generally succeeding. He seems to have studied their ways intimately, and gives some very curious facts with regard to the powerful associations, or guilds, into which they band themselves everywhere. His visit to Siam, and the account of his intercourse with the King and other dignitaries, will be found entertaining as well as informing.

One of the most valuable chapters in the book, certainly the most interesting to archæologists and ethnologists, is Mr. Thomson's account of his visit, in 1866, to the magnificent ruins in Cambodia, probably the grandest, if not the most interesting ruins in the world. The illustrations to this part of the work will give the reader a fair idea of the nature of these ruins, their colossal and beautiful architecture, and their wonderful sculpture, giving evidence of a vigorous and high civilsation, the lapse or obliteration of which is one of the strangest events in the history of the world. We have much to learn yet about the history of these ruins and of the people of which they are almost the only remains. "A richer field for research," Mr. Thomson rightly says, "has never been laid open to those who take an interest in the great building races of the East, than that revealed by the discovery of the magnificent remains which the ancient Cambodians have left behind them." We may expect the French, who are the dominant European race in this quarter, to add considerably to our knowledge of these remains, and to clear up the mystery which lies around them. Indeed, the late unfortunate Lieut. Garnier, in his "Travels in Indo-China," has both with pen and pencil shed much new light on the subject.

To those who don't know much about Formosa and its strange inhabitants, savage and semi-civilised, Mr. Thomson's account of his tour in the island will be found of considerable interest. Appended is a list of the Diurnal Lepidoptera of Siam, collected by Mr. Thomson, and named by Mr. H. W. Bates, F.L.S. Altogether the book is a thoroughly creditable and, we believe, credible one, full of the most interesting information, and valuable for the considerable insight it gives into the life of

these Eastern Asiatics. The wood engravings, upwards of sixty, taken from the author's photographs and sketches, add much to the value of the volume.

LETTERS TO THE EDITOR

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

Hoffmeyer's Weather Charts

I HAVE the honour to inform you that the issue of Capt. Hoffmeyer's daily charts of the weather from 63° E. to 60° W. longitude, and from 30° to 75° N. latitude, for the three months of last winter, are now complete. (See NATURE of June 25, 1874).

Capt. Hoffmeyer is anxious to know what chance there is of his being able to continue the publication. The number of copies already sold of the existing charts has not been sufficient to cover the expenses of production.

At the same time this Office has found that the rate of subscription (11*s.* per quarter) which it charges has fallen short of the cost, carriage, and postage of the existing charts.

I have therefore to request any gentlemen who are willing to subscribe to a future issue of the charts to send in their names to me as soon as convenient. The rate of subscription will be at least 12*s.* 6*d.* per quarter, and must necessarily be higher if the original cost of the charts at Copenhagen is raised above the price first named, viz., 4 francs per month.

Meteorological Office, Jan. 12 ROBERT H. SCOTT

A New Bird of Paradise from the Island of Waigeou, near New Guinea

I GOT to-day from Ternate the skins (♂ and ♀) of a Bird of Paradise from Waigeou, which came through natives into the hands of Mr. van Mounhenbroek there, who recognised it to be an undescribed species. He proposes to call it *Diphyllodes Guilhelmi* iii., because no Bird of Paradise has yet been named after the King of the Netherlands, under whose sceptre the greater part of the region stands, where Birds of Paradise occur. It is known that two species from Australia are named respectively after the Queen of Great Britain and the Prince Consort, that three are named after naturalists, and that the others have names according to their external features. This new bird is highly interesting, because it stands in a conspicuous way between *Diphyllodes speciosa* and *Cicinnurus regius*, but more allied to the former, and at the same time bearing some characters of *Diphyllodes respublica*; therefore linking these species together in a similar way as it does *Paradisea raggiana* (one of D'Alberti's discoveries) with *P. sanguinea*, *apoda* and *minor*. I shall soon send (in the name of Mr. van M.) the description of the new bird to the Zoological Society of London, and intend to publish a coloured figure as soon as possible. But knowing the lively interest English ornithologists take in new discoveries in the group of the *Paradiseidæ*, I thought it advisable to give a short notice in your journal beforehand. A. B. MEYER

Dresden, Jan. 9

Chappell's "History of Music"

IN a review of my "History of Music," in NATURE, vol. xi. p. 123, your musical critic takes me to task for having cautioned English readers against certain new theories which are to be found in the works of the late F. J. Fétis and in the "Tonempfindungen" of Prof. Helmholtz. I think those cautions very necessary, and perhaps, when your critic has studied the subject, he may think so too; but in the meantime he bows down before such names, and cautions me that if Fétis were alive he "would not be in my shoes for a trifle."

I should rather object to change shoes with the critic, but I may remind him that he seems to have forgotten his obligations to the readers of NATURE. However diffident as to his qualification to controvert me, and therefore hoping for a second Fétis to arise, it was at least his duty to test each of us by the authorities which we quote, and to inform your readers of the result. He must know that two such opposite accounts cannot both be true, and therefore either the one or the other is not trustworthy. Fétis and I differ *toto cœlo*, even to the scales. I had supposed that a few of the extracts which I have adduced from Fétis's own works would have spoken for themselves and have convinced anyone who professes critical knowledge that Fétis was a pretender, and that he was unable to understand the Greek treatises which he had before him. Your reviewer, however, is far too staunch-headed to be convinced, even though Fétis assumes to correct Aristoxenus in Greek, and Josephus in Hebrew.

My own conviction is unchanged by the second, third, and fourth volumes of Fétis's History. I find the same system of charging error upon others when he alone is in fault, and the same inability to understand the books before him. For instance, he had Kosegarten's translation of El Farabi's treatise on Persian, Greek, and Arab music, written at the beginning of the tenth century, but he could not discover from it that the Persians had then no thirds of tones in their scales. Neither did he find out that the Arabs had then emancipated themselves from the Greek minor scales, and had an excellent two-octave major scale, with perfect thirds in it, and a major seventh. It differed from ours, but rather for the better. These two points are most important in history, for in them we trace the comparative civilisation from which those nations have declined.

As to Helmholtz's new musical theories, your reviewer complains that I have described his book as "hasty," when "it is the result of eight years' labour." I think ill-considered conclusions may, in polite terms, be described as "hasty." Secondly, that I have said, "Some very necessary experiments, such as those upon harmonics, were omitted." I am quite of that opinion, for I differ with him as to the existence of "*over*-tones," and I adduce proof that harmonics are *subsequent* to the principal notes, and not simultaneous.

My arguments are before the world, and I have found them supported by others, including two of the very highest authorities. Until they can be rebutted, I have nothing to withdraw, but have much to add to them.

The "Tonempfindungen" is not a book which requires more than ordinary intellect to understand; therefore such deep submission as that of your critic is not necessary. When Helmholtz informs his readers that thirty-three *consonant* vibrations between B and C cause the *dissonance* of that interval, he is literally telling them that white is black; and yet this critic would have us believe him. WM. CHAPPELL

Strafford Lodge, Oatlands Park, Surrey

Origin of Bright Colouring in Animals

THOSE who are moderately well acquainted with Mr. Darwin's writings are not likely to feel that Mr. Murphy's criticisms (vol. xi. p. 148) upon them require any answer; but as many of your readers are probably not so well acquainted with these writings as they ought to be, I shall briefly expound the points raised.

1. Mr. Murphy himself admits that coloration may be as "variable within the limits of the same species" as is "any other part of the organism." In view of this fact, then, why is there any more difficulty in the way of our accepting sexual selection as a *vera causa*, than there is in the way of our accepting natural selection as such? Moreover, we must remember that animals have probably a much keener sense than we have of differences in form and colour among individuals of their own species.

2. Ornamental colouring is, as a rule, confined to the male, because, in Mr. Darwin's words, "the males of almost all animals have stronger passions than the females." I wonder that anyone can have read the "Descent of Man," and afterwards have asked the question to which this is the answer. Compare especially pp. 221, 222 (2nd edition).

3. I do not know on what "evidence" Mr. Murphy relies to "prove that the female is passive," in the sense of not exerting "any choice or power of selection whatever;" but I am quite sure that it must be something very great, if it is to neutralise the vast body of facts which Darwin adduces on the other side; for surely no one can doubt that "the elaborate manner in which the male birds and other animals display their charms before the female," is one of the strongest arguments we could desire to have "in favour of the belief that the females admire, or are excited by, the ornaments and colours displayed before

them." (*Ibid.* p. 541.) Mr. Murphy's assertion that his view of the case is "certainly supported by the very general fact of the males fighting for the possession of the females," makes against his argument if we consider another "very general fact," viz., that there is a sort of inverse proportion between pugnacity and coloration. For an answer to the next paragraph, compare "Descent of Man," pp. 225 and 226.

I do not know that I can quite agree even with your correspondent's closing paragraph. If we can imagine such a state of things as a colony of women left entirely to themselves, I think it is at least open to question whether their "love of dress and ornament" would not begin to decline.

A DISCIPLE OF DARWIN

"Ring Blackbird"

THE bird about which your correspondent C. M. Ingleby inquires is figured in most works on Ornithology as the Ring Ousel—is a local, not uncommon, but generally exceedingly shy bird. Through the late severe weather, however, and for a few days after the thaw, a cock bird has been a daily and very interesting visitor on my lawn. They are generally found on commons and in the neighbourhood of retired copses, and are only driven by stress of weather so near houses.

Bregner, Bournemouth, Jan. 9 HERVEY CECIL

[Another correspondent, F. B. Doveton, writes to the same effect, but states his belief that the Ring Ousel is only a summer visitant with us, its winter habitat being Southern Europe and Africa.—ED.]

THE NEW WESTERN CHINA EXPEDITION

WE are glad to learn that the Western China Expedition which left Rangoon in the middle of last month to reopen the old trade-route between Upper Burmah and Yunan, as we intimated a fortnight ago, has an efficient scientific staff attached to it. Col. Horace Browne is the commander of the expedition, and Mr. Ney Elias, Gold Medallist of the Royal Geographical Society and Assistant Political Resident at the Court of Mandalay, is the topographer. Dr. John Anderson, Director of the Imperial Museum at Calcutta, who was recalled from leave in England for the purpose, has been appointed medical officer and naturalist, and takes with him four collectors—two zoological and two botanical.

The expedition was provided at Calcutta with an efficient guard of fifteen Sikh soldiers, picked men from the fort, and two native doctors. At Rangoon they were to be joined by an Attaché of the British Embassy at Pekin, and a Chinese interpreter. Another of the Pekin Attachés, with an interpreter and guard, is to be despatched from Shanghai into the interior of China to meet them. These Attachés will be of the greatest use in keeping the expedition right as regards their intercourse with the Chinese officials. Dr. Anderson takes with him a fine photographic apparatus, which he will use himself. A considerable sum has been laid out in presents for the chiefs and other personages expected to be met with during the route: for the Viceroy of Yunan, two fine horses and a pair of kangaroo-hounds have been selected, and a large number of other appropriate objects.

The expedition is expected to be able to make its way from the upper waters of the Irawaddy to those of the Yangtse-Kiang in the course of a few months, and will descend the latter river to the sea-coast of China. The Chinese Government has given every facility in the way of passports, so that there is every prospect of a successful result.

THE ACCLIMATISATION OF SALMON IN OTAGO

A RENEWED attempt is now being made to acclimatise the British salmon (*Salmo salar*) in New Zealand. The preliminary stages of the necessary operations have been carried out in Scotland, under the personal direction of Mr. Buckland, one of her Majesty's inspectors of salmon fisheries, and the ship, the *Timaru*, containing the precious freight, has sailed from the River Clyde, and is now, it is to be hoped, a far way on her voyage.

What has been done is as follows:—A quarter of a million of eggs have been taken from large, living salmon captured expressly for the purpose. These ova have been treated on what may be called the "piscicultural plan," that is, the eggs have been forcibly extruded from the fish in a vessel filled with water, by means of gentle pressure applied to the abdomen, from which they fall quite easily; after the ova are washed they are carefully impregnated with the milt of the male fish, and are then ready to be laid down on the hatching boxes. On the present occasion the eggs were brought from Perthshire, where they were obtained, chiefly from tributaries of the rivers Forth and Tay, to Glasgow, in order to undergo the process of packing for their long voyage. It is gratifying to know that only a very small portion of the eggs were spoiled while undergoing the process of being fecundated.

The plan adopted on the present occasion was to pack the ova on trays of perforated zinc, on which had been placed a thin layer of well-washed moss. The trays containing the precious ova were then arranged in a series of boxes, each of them a foot cube; these boxes will be carried to their destination in a cabin expressly built for them, paved with ice to the depth of about two feet, and having walls of ice three feet in thickness. A stratum of the same material is inserted between each box, so that the eggs during the passage of the *Timaru*, which may take a hundred days, will be kept at a very low temperature. Great pains have been taken in the packing of the eggs, and also as regards the disposition of the boxes in the ice-house, which will be hermetically sealed, and not be broken open till the ship is in port. It is an important circumstance in favour of this experiment that the eggs selected were all taken from fish which, judging by their dimensions, would be of considerable weight; not a few of them must have weighed over twenty-five pounds. They were not in the least injured during the process of compulsory deprivation of their eggs and milt, but when restored to the water went off quite lively, and as if they had enjoyed the process of artificial spawning.

The ship is expected to reach her destination, Bluff Harbour, New Zealand, about the end of March, at which date all the salmon eggs which she carries would, in the natural state, have become living fish, and, indeed, be a week or two old. The *Timaru*, as the time approaches for her arrival in New Zealand, will be anxiously watched for, and it is to be hoped that all the future stages of this important experiment will be as carefully gone about and as successfully accomplished as the initiatory operations.

The development of the ova whilst the ship is on her voyage will be largely prevented by the very low temperature which must result from the enormous quantity of ice that is in use. How far the rivers of New Zealand, seeing that upon the arrival of the eggs they will be at an autumnal temperature, may be suited for the ripening of the fish, has yet to be determined. We sincerely hope all the conditions will be favourable to the hatching and growth of the salmon. It will prove a singularly interesting task to trace the history of *Salmo salar*, so to say, from its creation, and to watch its progress from one stage of its life to another. We anticipate in the process the correction of many errors which have crept into the details of its natural history, so far as we know it at present.

The physical conditions of New Zealand have been depicted as being very similar to those of the old country; the resemblance will appear still more striking to emigrants when they see the finest fish of the old country leaping in its rivers.

ON THE EXISTENCE OF THE FALLOW DEER IN ENGLAND DURING PLEISTOCENE TIMES

MR. SCLATER'S translation of Dr. Jeitteles' essay on the geographical distribution of the Fallow Deer in present and in past time (NATURE, vol. xi. p. 71), and the careful criticism which it has called forth on the part of Mr. Boyd Dawkins (*loc. cit.* p. 112), have renewed in my mind a conviction which I formed some years ago, namely, that *Cervus brownii* and *Cervus aama* are identical, and that under the former title the fact of the existence of the Fallow Deer in England during the Pleistocene period lies in some degree obscured.

The interest which, doubtless, Dr. Jeitteles' essay has excited induces me to believe the present to be a fitting occasion to endeavour to demonstrate the probability of this conviction. In his original description of *Cervus brownii* (Quart. Geol. Journ. 1868, p. 514), Mr. Boyd Dawkins thus writes:—

"The antlers of *Cervus brownii* are totally unlike those of any existing species excepting *Cervus dama*, to which they approach so closely that the type-specimen was considered by Dr. Falconer to belong to the latter. The basal half, indeed, so strongly resembles the corresponding portion of that of *Cervus dama* that it would be almost impossible to differentiate fragments from which the coronal portion had been broken away. But the resemblance ends at the second tyne (*c*). If the series of antlers of *Cervus brownii* be compared with those of the Fallow Deer which have been reproduced from Prof. Blasius's valuable work, there is this important difference

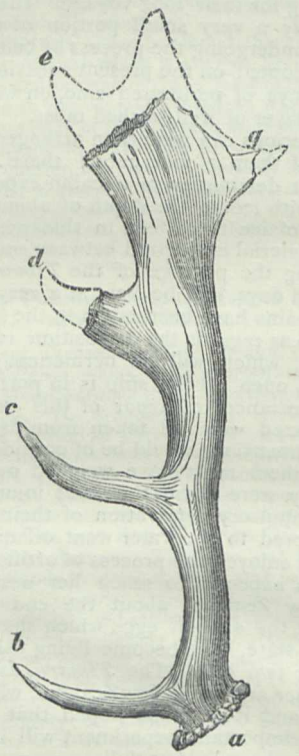

FIG. 1.—Type of *Cervus brownii*.

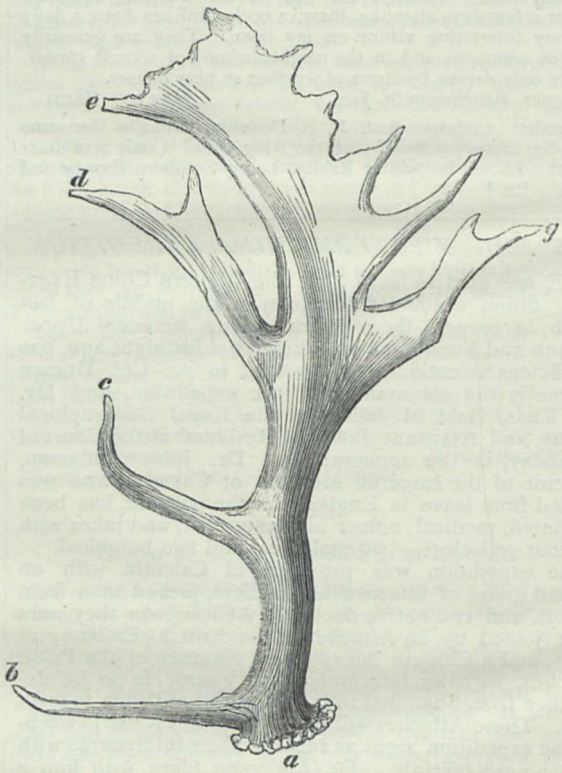

FIG. 2.—Right Horn of Wild Greek Fallow Deer.

visible: in the former the third tyne (*d*) is present on the anterior aspect, while in the latter it is altogether absent. With this exception the antlers of the two species are most closely allied; and Pl. xvii. Fig. 4 corresponds almost exactly with Pl. xviii. Fig 5, the third of the series of antlers selected by Prof. Blasius as typical of *Cervus dama*. To the objection that the development of the third anterior tyne may have been an accident, it may be answered that it is to be found in none of the endless variations of form assumed by the antlers of the Fallow Deer, and that it is presented also by a far more ancient cervine species from the crag of Norwich."

It is therefore clear that in its possession of the third tyne (*d*) is centred, according to Mr. Boyd Dawkins, the Clacton Deer's sole right to be considered specifically distinct from the common Fallow Deer. The accompanying drawings (Figs. 1—4) will, I think, be found to show the insufficiency of this character. Fig. 2 represents a horn of the wild Fallow Deer from Greece; Fig. 3 that of a wild Fallow Deer from Sardinia. In both of these specimens the third tyne (*d*) will be seen to be largely developed. These horns are selected from a considerable series brought to me by my brother, Mr. Basil Brooke, direct from Greece and Sardinia, and in none of the other specimens is this tyne developed, but in all the anterior aspect of the horn resembles ordinary specimens of the horns of *Cervus dama*, such as those reproduced by Mr. Boyd Dawkins from Prof. Blasius's work. Fig. 4 illustrates still further the instability of the foundation upon which is based the specific separation of *Cervus brownii*. The horn here figured belonged to a deer which lived and died in one of my own parks. The third tyne (*d*), so distinctly shown in the figure, was produced but once in the course of the animal's lifetime, neither its companion horn nor those which preceded or succeeded it showing the smallest trace of it.

It may be remarked that the tyne *d* in the type of *Cervus brownii* (Fig. 1) stands at a lower level in relation

to the greatest palmation of the horns, than is the case in the other three specimens. The explanation of this discrepancy is very simple. The former represents (as its own characters and a comparison of it with the remainder of the fragments with the species found at Clacton readily prove) a young animal, probably a buck of four years of age, whilst the other figures represent the horns of adult animals. In the immature Clacton Deer the force expended in producing the abnormal tyne *d* well-nigh exhausted the supply at the command of a system fully occupied with the production of things more needful, namely, materials for the vigorous increase and consolidation of flesh and bone. Hence the long, attenuated palm, which probably ended very much in the manner in which Mr. Boyd Dawkins has restored it. Analogous instances of excess of growth in one direction,

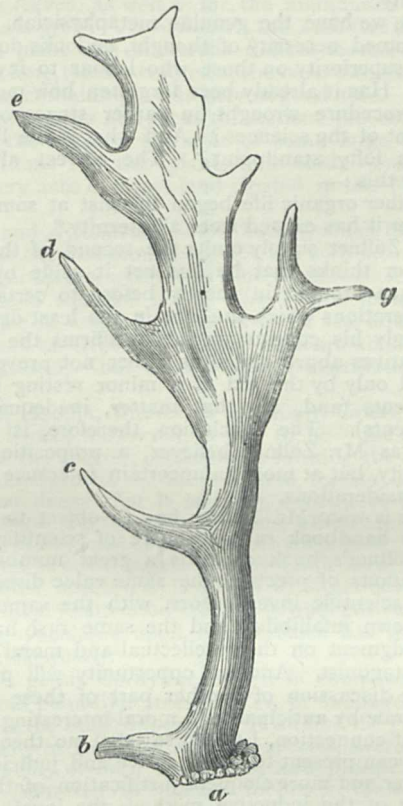

FIG. 3.—Right Horn of Wild Sardinian Fallow Deer.

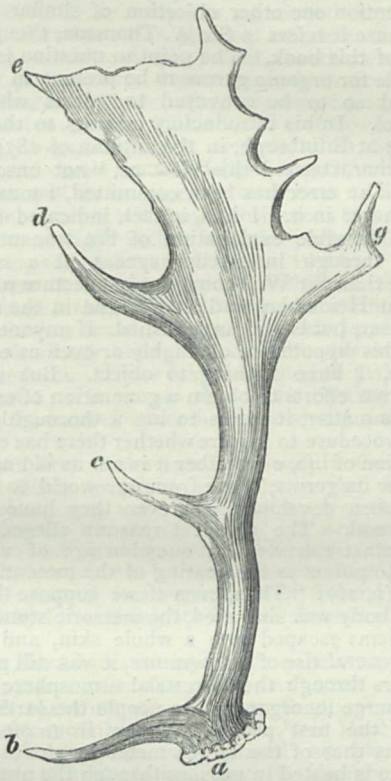

FIG. 4.—Right Horn of Park Fallow Deer.

causing a corresponding defect in another, may be seen in all large collections of deers' horns; indeed, in my own collection I find the horn of a young fallow buck, in which the characters specially alluded to in the type of *Cervus brownii* are shown in a still more marked degree.

These facts appear to me fully to justify the rejection of *Cervus brownii* as a species distinct from *Cervus dama*, and therefore to warrant the belief in the existence of this species in England during Pleistocene times. Whether the Fallow Deer became extinct in Northern Europe before the advent of Prehistoric man, or whether it continued to exist in these islands even at the commencement of the Roman occupation, are questions which strike me as altogether beside that of the truth of the "ancient belief" to which Mr. Boyd Dawkins shows such firm allegiance. In either case, the species may have been reintroduced by the Romans, a people whose magnificently lavish expenditure upon luxury and pleasure despised bounds.

VICTOR BROOKE.

HELMHOLTZ ON THE USE AND ABUSE OF THE DEDUCTIVE METHOD IN PHYSICAL SCIENCE *

WE have still to speak of his attack on the authors of this book with regard to the emission theory of light. They say that such a theory is not to be justified unless a light-corpuscle has been actually seen and investigated. In this demand Mr. Zöllner detects "an impossibility which is not simply physical, but even logical, and which it is easy to expose. In fact, if the sensation of light is produced only when the corpuscles come in contact with our nerves, it is obviously *impossible* to have any ocular perception of such a corpuscle *before* it has touched or affected our nerves of sight." And then this remark is followed by declamation about gross blunders in logic, absolute nonsense, and so on. And, in fact, there is absolute nonsense here; only the nonsense does not lie in what the English writers have said, but in the interpretation which their opponent has put upon their words. Does a man who believes himself so superior to his antagonists in the firmness of his grasp of the principles of the theory of knowledge, still need to have it explained to him that to *see an object* means, according to the emission theory, to receive in the eye, and so to feel, the corpuscles of light that rebound from the object in question? But, this being so, there is no logical impossibility, and nothing inconsistent with the premises of the theory, in the supposition that a light-corpuscle at rest—and the corpuscles are at rest as soon as they are absorbed by dark bodies—may throw off other corpuscles that impinge on it, and so may become for these a centre of radiation, which will be visible as the radiant point. Whether such

* Concluded from p. 151.

a process can be brought under observation, and how this is to be effected, are, of course, questions which, on the argument of the English authors, fall to be answered by those who undertake the direct proof of the existence of the corpuscles. And whatever opinion one may form of the stringency and fitness of this demand, it involves no logical contradiction, which is the very point on which the argument must turn if Mr. Zöllner is to make good his case.

I will mention one other objection of similar scientific value, because it refers to Sir W. Thomson, though not to a passage of this book. The point in question is whether it is possible for organic germs to be present in meteoric stones, and so to be conveyed to worlds which have become cool. In his introductory address to the British Association at Edinburgh, in the autumn of 1871, Sir W. Thomson characterised this view as "not unscientific." Here, too, if an error has been committed, I must profess myself a sharer in it. I had, in fact, indicated the same view as a possible explanation of the transmission of organisms through interstellar spaces at a somewhat earlier date than Sir W. Thomson—in a lecture which was delivered at Heidelberg and at Cologne in the spring of the same year, but is still unpublished. If anyone chooses to regard this hypothesis as highly or even as extremely improbable, I have nothing to object. But if failure attends all our efforts to obtain a generation of organisms from lifeless matter, it seems to me a thoroughly correct scientific procedure to inquire whether there has ever been an origination of life, or whether it is not as old as matter, and whether its germs, borne from one world to another, have not been developed wherever they have found a favourable soil. The physical reasons alleged by Mr. Zöllner against the view in question are of very little weight. He points to the heating of the meteoric stones, and adds (p. 26): "Thus, even if we suppose that when the parent body was shattered, the meteoric stone covered with organisms escaped with a whole skin, and did not share the general rise of temperature, it was still necessary for it to pass through the terrestrial atmosphere before it could discharge its organisms to people the earth."

Now, in the first place, we know from oft-repeated observations that of the larger meteoric stones only the very surface is heated in passing through the atmosphere, the inner portions remaining cold, or even very cold. All germs, therefore, that happened to be in cracks of the stone would be protected from combustion in our atmosphere. But even germs lying on the surface would doubtless, when they entered the very highest and most attenuated strata of the earth's atmosphere, be blown away by the powerful current of the air long before the stone reached the denser parts of the gaseous mass, where the compression becomes great enough to generate considerable warmth. And on the other hand, with regard to the collision of two worlds as assumed by Thomson, the first consequences of such an event would be violent mechanical motions, while heat would be generated only in proportion as these motions were destroyed by friction. We do not know if this would last for hours, or days, or weeks. The fragments, therefore, projected in the first instant with planetary velocity might escape without any development of heat. I do not even think it impossible that a stone, or swarm of stones, flying through lofty strata of the atmosphere of a world might catch up and sweep along a quantity of air containing unburnt germs.

I have already said that I should not yet be willing to put forth all these possibilities as probabilities. They are only questions the existence and range of which must be kept in view, so that if opportunity offers they may be solved by actual observation or by inferences from such.

Mr. Zöllner then ascends to the two following propositions:—

"That scientific investigators in the present day attach such extraordinary importance to *inductive proof* of *generatio æquivoca*, is the clearest mark of their lack of familiarity with the first principles of the theory of knowing."

And again:—

"In like manner the hypothesis of *generatio æquivoca* expresses . . . nothing else than the condition for the conceivableness of nature in accordance with the law of causality."

Here we have the genuine metaphysician. In view of a presumed necessity of thought, he looks down with an air of superiority on those who labour to investigate the facts. Has it already been forgotten how much mischief this procedure wrought in earlier stages of the development of the sciences? And what is the logical basis of this lofty standpoint? The correct alternative is clearly this:—

"Either organic life began to exist at some particular time, or it has existed from all eternity."

Mr. Zöllner simply omits the second of these alternatives, or thinks that he has set it aside by a passing reference brought in shortly before to certain physical considerations which are not in the least decisive. Accordingly his conclusion, which affirms the first of the alternatives above stated, is either not proved at all, or proved only by the aid of a minor resting on physical arguments (and, for that matter, inadequate physical arguments). The conclusion, therefore, is not in any sense, as Mr. Zöllner believes, a proposition of logical necessity, but at most an uncertain inference from physical considerations.

This is what Mr. Zöllner has to object to the authors of this handbook in the sphere of scientific questions.* Mr. Zöllner's book contains a great number of other accusations of precisely the same value directed against other scientific investigators, with the same confidence in his own infallibility and the same rash haste in passing judgment on the intellectual and moral qualities of his antagonist. Another opportunity will present itself for the discussion of another part of these cases. If I may draw by anticipation a moral interesting to us in the present connection, I would say that no theoretical arguments can present to the attentive and judicious reader a stronger and more eloquent justification of the strict discipline of the inductive method, the loyal adhesion to facts which has made science great, than is supplied by the practical example of the consequences of the opposite, would-be deductive, or speculative method given in Zöllner's book; and this all the more that Mr. Zöllner is beyond question a man of talent and knowledge, who did most promising work before he fell into metaphysics, and even now shows acuteness and the faculty of invention whenever he is limited to the field of the actual, *e.g.* in the construction of optical instruments and the devising of optical methods.

NEW ZEALAND PLANTS SUITABLE FOR PAPER-MAKING

THE utilisation of waste materials for paper-making is a subject upon which a great deal has been said and still remains to be said and done. In every country waste vegetable matter which contains fibre in anything like suitable proportions is sure to attract much attention. The subject has been handled in various works, directly or indirectly, in this country as well as on the Continent; and with regard to Australian plants suitable for paper-making, Baron Mueller, of Melbourne, issued a lengthy treatise in connection with a series of specimens of paper actually made from the plants enumerated and exhibited in the Paris Exhibition of 1867. We have now before us a paper by Mr. T. Kirk, F.L.S., of Wellington, on

* In the region of personal questions, and with reference to the claim of priority as to the principles of spectral analysis made by Sir W. Thomson for Mr. Stokes against Mr. Kirchhoff, I must side with the latter, fully agreeing with the reasons which he has himself brought forward.

some indigenous materials of New Zealand suitable for the manufacture of paper. The plants enumerated occur in great abundance in different parts of the colony, and, it is said, are being yearly destroyed to an enormous extent by the progress of settlement. Most of the plants alluded to in this paper belong to the endogenous group, Liliaceæ and Cyperaceæ being the chief natural orders. In the genus Astelia a group of small tufted sedge-like plants belonging to the first-named order, five species of which are described as occurring in New Zealand, four are recommended, both on account of the quantity of fibre contained in their leaves, as well as for the abundance with which the plants grow. *A. Solandri*, the Tree-flax of the colonists, is a plant with numerous radical leaves, from one to two feet long, thickly clothed at the base with shaggy silky hairs, and containing a quantity of good fibre. It is abundant on lofty trees and rocks throughout the colony, resembling in the distance the nest of some large bird. "Hundreds of tons" of this plant, it is said, "are destroyed on every acre of forest-land cleared in the North Island."

A. Banksii and *A. Cunninghamii*, both of which have a similar habit to the first-named species, but with narrower and much longer leaves, sometimes from three to six feet in length, produce a superior fibre. The first is found in great abundance in wooded places near the sea, and the latter is common on trees and rocks. Both are abundant in the North Island, "but their southern distribution is uncertain."

A species of Astelia, known as the Kauri Grass, and called by Mr. Kirk *A. trinervia*, is said to be "the most abundant of all the species, occasionally forming the chief part of the undergrowth in the northern forests up to 3,000 ft., and so dense that it is often difficult to force one's way amongst the interlaced leaves, which are from three to eight feet long, and of a paler green tinge than either of the preceding. It could be procured by hundreds of tons, and as, like other species, it is found in situations not adapted for ordinary cultivated crops, a permanent supply might be fairly calculated upon. Experience has shown that it may be cut yearly."

In the allied genus Cordyline, which is composed of shrubby or small palm-like trees, the Ti, or cabbage-tree (*C. australis*), is the most important. It attains the greatest height of any of the New Zealand species, averaging from ten to twenty or even thirty feet, and producing a trunk usually from ten to eighteen inches in diameter, but sometimes even three feet across. The plant is very abundant in many districts, and the leaves contain a very large quantity of fibre. *C. Banksii*, a smaller growing species, with a trunk from five to ten feet high, produces a fibre of superior quality, but less abundant; the plant, however, is very plentiful on the margins of forests, gullies, &c., all over the North Island, and in the northern parts of the South Island.

That the leaves of the Cordylines are suitable for paper-making there can be no doubt. In appearance, when dry, they very much resemble the so-called palmetto leaves which have recently been brought into this country from America for the purpose of competing with esparto. These palmetto leaves are those of one or more species of Chamærops, perhaps *C. serrulata*, which is known in some parts of the Southern States as the Saw Palmetto. The leaves of *Cordyline australis* are not altogether unknown in Europe as a paper material, for it appears that some years since a quantity was sent to England from New Zealand specially for trial, and were made into paper at a mill in Yorkshire: at that time the leaves were highly recommended for the manufacture of a superior kind of paper. A leaf somewhat similar, but generally of softer texture, is that of the genus Freycinetia. *F. Banksii*, known as the New Zealand Screw Pine, is abundant in most woods, and it is said that the leaves might be procured by thousands of tons. *Gahnia setifolia*, which is abundant in both islands and capable of being procured in almost unlimited quantity, is recommended for the manufacture of coarse paper. The Gahnias are a group of tall-growing, coarse, rigid cyperaceous plants, with long, harsh, cutting leaves, from which fact the plants are known in some parts of the colony as "cutting grasses." The genus is distributed through New Zealand, Australia, Tasmania, the Malayan and Pacific Islands.

The large order Compositæ, containing as it does such a variety of plants, from trees down to shrubs and herbs, might be expected to include many whose woolly foliage would prove useful for paper-making. The genus Celmisia, however, is the only one mentioned in the paper under consideration; the species are perennial bulbs, with radical, rosulate, simple leaves, mostly covered with a white or buff-coloured tomentum, which gives them a leathery texture, and hence the plants are called Leather-plants, or Cotton-grass. The commonest species in the islands is *C. longifolia*, which ascends to an elevation of 5,500 feet, and varies much in height, length, and breadth of leaves, as well as in general robustness. *C. verbascifolia* is a fine species, with broad coriaceous leaves averaging from four to eight inches long, but, according to Mr. Kirk, growing sometimes to a length of two feet. *C. coriacea* is likewise an abundant species, with thick leaves from ten to eighteen inches long, and from half an inch to two-and-a-half inches broad, covered on their upper surface with matted silvery hairs, and on the other with thick silvery tomentum. These leaves are said to make a good paper material; it is certain that when dry they are very tough, and the natives make them into strong and durable cloaks.

The plants here enumerated are only a few of those considered likely to prove valuable in the colony for paper material; they are selected because of their being little or perhaps not at all known for economic uses. Such well-known plants as the New Zealand Flax (*Phormium tenax*) are passed by with a simple mention of the fact that a company has recently been formed in Auckland, specially for utilising its fibre in the manufacture of paper.

While on the subject it may not be quite out of place to mention, in reference to the notice on the use of *Zizania aquatica*, in NATURE, vol. xi. p. 33, that several of the North American daily papers, as the *New York Tribune*, *Montreal Gazette*, &c., are printed on paper made entirely from this plant, and that the promoters of its use in England propose to bring it to this country in the form of half-stuff, to save expense of freight.

JOHN R. JACKSON

A FRENCH OFFICIAL ACCOUNT OF THE ORIGIN OF THE ROYAL SOCIETY

WE find in the first volume of the "Memoirs of the French Academy" a few curious details relating to this subject which may be of some interest to our readers. We translate the text *verbatim*, with the addition of a few explanatory remarks. These details were originally published in Latin, by the first perpetual secretary of the Academy, and may therefore be considered as official.

"Full fifty years had elapsed (in 1666) since the learned men who lived in Paris began to meet at the abode of Father Mersenne, who was the friend of the most learned men in Europe, and was pleased to be the centre of their mutual visits.* MM. Gassendi, Descartes, Hobbes, Roberval, Pascal (father and son), Blondel, and some others met at this place (close to the Place Royale, in a convent). The assemblies were more regularly held at M. de Montmort's, Master of Request in Parliament (and

* Father Mersenne was the intimate friend of Descartes, and his philosophical propagandist. It was not deemed prudent by the writer to mention Descartes' name, except as coupled with others.

editor of Gassendi's works*), and afterwards at M. Thevenot's.† A few foreign visitors to Paris were present at these meetings. . . . It is possible that these Paris assemblies have given birth to several Academies in the rest of Europe. However, it is certain that the English gentlemen who created the Royal Society had travelled in France, and had visited at Montmort's and Thevenot's.

"When they were again in England they held meetings at Oxford, and kept on practising the exercises to which they had been accustomed in France. The rule of Cromwell was beneficial to these meetings. These English gentlemen, secretly attached to their legitimate lord, and unwilling to take any part in public affairs, were very glad to find an occupation which would give them an opportunity of living far from London without being suspected by the Protector. The Society remained in this state up to the time when Charles II., having resumed the kingly office, brought it to London, confirmed it by his regal power, and gave it privileges. So Charles II. rewarded the sciences which had lent an easy pretext for keeping the faith towards him."

The narrative explains that the creation of the Royal Society was an example given to Louis XIV. for establishing his Academy of Sciences.

THE TRANSIT OF VENUS

SINCE our last notice of the Transit observations, a letter, dated Mauritius, Dec. 10, has been received by the Astronomer Royal from Lord Lindsay, containing a detailed account of the results he obtained. Besides, a brief statement of the observations of Mr. Meldrum, the Director of the Government Observatory, Mauritius, has appeared in the *Times*, with news from other observers, which, with its comments upon them, we reproduce in a condensed form.

Mr. Meldrum, with a perfect telescope of six inches aperture, by Cooke, of York, has been fortunate enough to obtain an observation of the ingress, although both Lord Lindsay and the German party were prevented from doing this by the cloudy state of the sky. But, although Mr. Meldrum obtained the two interior contacts, clouds and haze were at intervals passing over the sun, which, in fact, was obscured during the greater part of the transit. At times, beautiful definitions of the planet were noted, especially soon after the first interior contact. Then there was a long period of obscuration, after which, most fortunately, the sun shone out for the second interior contact. Only the first exterior contact was lost, the sun not appearing at all until 6h. 16m. A few minutes before the last exterior contact the sun was again obscured, and when the clouds passed away the transit was over.

Lord Lindsay states that his expedition has been in a great measure successful. The morning of the 9th was cloudy before sunrise, and for a short time afterwards. The first external and first internal contacts were missed from this cause; the sun was not seen until 1h. 2m. after the first external contact, when it came out for a few minutes, when photographs and measures were obtained. It was not till 8 A.M. (local mean time) that it became fairly fine, and remained so with small periods of cloud obscuration until the end of the transit. Lord Lindsay took 271 plates, out of which number, perhaps, 110 will be of value. One of his photographs shows the second internal contact beautifully.

With the heliometer, Mr. Gill obtained five complete determinations of greatest and least distance of the centres of the sun and Venus, besides nine measures of cusps and two separate determinations of the diameter of Venus near the end of the transit. Dr. Copeland obtained, with the six-inch equatorial and Airy double-image micrometer, fifteen measures of least distance of Venus from the sun's limb, and ten measures of cusps. Dr. Copeland also observed the last internal and external contacts with this instrument. The last internal contact was observed with the four-inch equatorial and the polarising eye-piece by Mr. Gill. He also observed the last external contact with the heliometer. Both Dr. Copeland and Mr. Gill agree that the contacts of Venus and the sun are remarkably similar to those seen in the model. They also agree that any phenomena which could be classed under the head "black drop" took place and disappeared within a period of five seconds. All the photographic exposures are automatically registered on the chronograph by a method which gives the actual duration of the exposure. The heliometer observations were also registered there. Dr. Copeland observed by eye and ear; all other observations (photographic and heliometric) also observed by eye and ear as a check on the chronograph. The German expedition under Dr. Low got the third and fourth contacts, with three complete sets of heliometric measures.

With regard to the operations of the party sent out by the Government of Holland to Réunion, the further information shows that there, as at Mauritius, the ingress was missed altogether, in consequence of the bad weather. The second interior contact at egress was observed both by Dr. Oudemans and Dr. Soeters, not the least trace of the black drop being observed. Only nineteen plates could be exposed, and of these only two or three are considered of value. The observations with the heliometer were more successful. The party, instead of measuring the distance of the planet from the sun's edge along a radius, had calculated beforehand, for each ten minutes, the direction of the most favourable chord for determining the relative parallax of Venus; two sets of eight measures of this kind were recorded.

Some observations made at Colombo by Mr. George Wall, and communicated to the *Ceylon Times*, are of great interest, as here is again recorded an exact reproduction of the appearance observed by Chappe d'Auteroche in 1769. On this the *Times* remarks that it is clear that science will lose much from an incomplete discussion of all the observations made in 1761 and 1769. On this subject we also draw attention to the following letter which we have received from Mr. E. W. Pringle, dated Manantoddi, Wynaad, Dec. 13:—

"I make no apology for sending you a short account of the late transit as seen by me in Wynaad, especially as I feel some surprise at the difference between the expected and actual phenomena.

"Owing to non-receipt of instruments from England, I had to fall back on a small 2½" refractor by Cooke, of York, the definition of which is superb, even with a power of 53—that used on the occasion.

"My station was on a hill nine miles from Manantoddi, about 800′ above that place and 3,600′ above sea-level.

"The morning of the 9th was simply perfect; not a breath of air, and not a cloud, with the exception of a wisp or two of cirrus that the sun soon shook off.

"The plateau beneath was wrapped in the fleecy mantle that proved so disastrous to the eclipse observers of 1871, but this I could afford to despise from my more lofty station.

"I missed first external contact, and watched anxiously for the internal contact. When the planet was about half immersed, the entire disc became visible, for the portion external to the solar surface was surrounded by a fine silvery ring like a minute corona. This observation was verified by my brother, and the phenomenon was again visible at emersion.

"As first internal contact approached I looked carefully for the 'black drop,' but, to my astonishment, the horns of the sun grew nearer and nearer, and at last seemed to fade into the last portion of the before-mentioned silvery ring, without my seeing the smallest vestige of the far-famed 'drop,' or any apparent

* Montmort for years entertained Gassendi in his house. He was a very alented *bibliophile*, and all the books from his library now realise an immense value. He was a member of the Académie Française.

† Thevenot had travelled much, and was in constant correspondence with many travellers. He had been appointed librarian to the King, and lived the house where the library was kept, in what is now the Rue Vivienne, within a little distance of its present site.

elongation of the limb of the planet. Had it existed to the extent of one hundredth of the diameter of Venus, I am confident I should have seen it.

"At last external contact I fancied that the limb of the sun at point of contact was broken more rapidly than it should be, but if there was a 'bead' it was a very minute one.

"At first internal contact, in spite of the low altitude of the sun, the definition of the perimeters of both it and the planet was excellent; but at last internal contact, owing to the great heat and a strong land breeze, there was some amount of atmospheric interference.

"The time of the transit was taken with an ordinary watch, a good goer, and I hope to be able to fix the position of the station before long, although such observations here must of course be of very secondary consideration.

"During the transit I tried to obtain absorption bands from the atmosphere of the planet, but failed, owing to insufficient power and the difficulty of keeping the slit of the stellar spectroscope used, on the planet, with altazimuth motion.

"I may mention that on the evening of the 9th there was a fair display of parhelia, just at sunset. The sky was then covered with delicate bands of cirrocumulus."

ON THE AGE OF AMERICAN STONE IMPLEMENTS, OR "INDIAN RELICS"

THE interest connected with the various forms of ordinary stone implements, of which arrow-heads are by far the most abundant form, is greatly lessened by the fact that nothing connected with their discovery bears upon the question of the date of their origin. We know about the date of the introduction of iron, by European visitors to our country, and therefore about the time of the abandonment of stone implements and weapons by the Red men; but concerning the time of the commencement of the use of stone here in the States we are almost wholly in the dark.

Having, during the past three years, had unusually favourable opportunities for collecting the various types of relics from a locality extraordinarily rich in them, we have endeavoured to learn something concerning the date of their origin by studying them *en masse* and *in situ*, as in this manner they at least suggest probabilities, which isolated specimens, gathered from numerous and distant localities, would never do. During the past three years we have gathered and carefully examined, as they were taken from the soil, over nine thousand stone implements, embracing fully nineteen twentieths of the forms described by Mr. John Evans in his "Ancient Stone Implements of Great Britain," and some twenty forms of weapons and household implements not mentioned in his work.

The result of the examination of this enormous collection of specimens on the spot where they were found, has been to convince us that the ruder forms, usually of slaty rock and other minerals softer than flint, are older, as a rule, than the beautiful jasper specimens found immediately above them. No such conclusions could be arrived at from merely examining these same specimens in a cabinet, and if these ruder and more elaborate forms were intimately associated in the soil, it would be difficult to dissociate them; but taking the history of the discovery of each specimen separately, we find that just in proportion as these relics are rude in manufacture and primitive in type, *they are more deeply embedded in the soil*. We have *never* met with a jasper (flint) arrow-head in or below an undisturbed stratum of sand or gravel, and we have but seldom met with a rude implement of the general character of European drift implements on the surface of the ground; and when such specimens did occur, there were generally some indications of unusually deep disturbance of the surface of the ground. Indeed, it is in fact just what it should be in theory, *i.e.*, the older forms are found alone, and at considerable depths below the surface; the newer and latest types found only at the surface, except when in graves, and associated with these a few specimens of the more archaic forms; just as we now in our own time see, in some isolated localities, household implements still in use, that, as a rule, have been discarded for better forms for more than a century. We repeat, that the conclusions arrived at by us we claim to be warranted by the fact of their applying to the collection of over nine thousand specimens gathered by us from a limited locality, and examined at the time of their discovery with special reference to the relationship the rude and elaborate forms bore to each other.

The belief here expressed with reference to the relationship of rude and elaborate relics is in accord with the division of the Stone Age into a Paleolithic and a Neolithic era; inasmuch as no indication of a *polish* has been found on any of the rude relics gathered by us; and polished celts and grooved axes with well-ground blades, or edges, occur only on the surface or in graves. It may be well to state here that by the phrase "on the surface" we mean on or in the soil that is now in cultivation. Relics that are upturned by the plough are considered as being "on the surface,"—beneath the surface being the stratum underlying the cultivated soil, and so beyond the reach of the ploughshare.

When and how the Atlantic coast of North America became peopled by the Red men cannot be determined by these same relics; but that that event should have been comparatively recent, and that such rude relics as we now find deeply embedded in the earth, and the magnificently wrought agate and jasper spears, and polished porphyry and hematic celts, should have been in use at the same time and by the same people, is simply incredible. We cannot now go into the full details of all the points of interest connected with our discoveries, but offer with confidence to students of American archæology this fact, that the paleolithic relics are immensely older than the elaborately worked surface-found forms. This fact, we believe, is a powerful support to the theory (if, indeed, it needs further demonstration) of the gradual development of man from the condition we call savagery.

CHARLES C. ABBOTT

Prospect Hill, Trenton, N. J., U. S. A.

NOTES

THE invitation addressed by the King of Siam to the Royal and the Astronomical Societies ought to be gratifying to scientific men in more ways than one; it is one more evidence of the spread of a respect for science, and of an idea, however vague, of its high value. The letters amount, indeed, as the *Times* remarks, to the offer of a large subsidy on the part of the King, and are no empty compliment. They indicate in the clearest manner the effect which the steady prosecution of inquiries by the most civilised is having in the less civilised countries; an effect of an important kind, which it would be difficult to arrive at in any other peaceful way. The following is the text of the King's letter to the Astronomical Society:—"The Royal Palace, Bangkok, Oct. 9, 1874.—My dear sir, I have much pleasure in informing you that I have received the commands of his Majesty to request you to inform the Royal Astronomical Society that if it will appoint men of science to observe the total eclipse of April next, his Majesty will be happy to consider them as his private guests during their visit, and will take on himself their entertainment and provide them with transport for themselves and their instruments from Bangkok to the station selected by them and back again, and will erect such temporary buildings as are required for them and their assistants. A communication to this effect will be made by his Excellency the Minister for Foreign Affairs to the Acting British Consul-General here; but as this will be slow in reaching the gentleman interested, his Majesty has commanded me to address this note to you to communicate it to the Society as soon as possible. I shall be most happy to

receive any communication from the Secretary of the Society named ; and if any gentlemen propose to avail themselves of his Majesty's invitation, I should wish to receive particulars of the probable number of the party or parties, of the station or stations proposed, and the foundations required for instruments—a plan, in fact, for each intended observatory, that I may submit them for his Majesty's orders. You may state that our topographer, Capt. Loftus, and other officers who, as surveyors, are accustomed to precise observations, will be happy to assist if desired, and his Majesty will willingly release them from their other duties for this purpose. With the assurance of my high esteem, believe me, my dear sir, your most faithful friend, BHASHAKARAWONGSE, H.S.M. Private Secretary."

THE great solar eclipse of 1868 was visible in Siam, as the 1875 eclipse will be. The then reigning Siamese king had not invited any European astronomer ; but the French Government sent an expedition, who located themselves in Malacca for the purpose of taking spectroscopic observations. The King of Siam, who professed to be an astronomer, came with a royal train and a large army to observe the sun and perhaps the sun-observers. The observations were very successful indeed ; but the French astronomers had located themselves on marshy land and were almost all attacked by fever, of which they were cured only on their return to France. Such was not the case, however, with their royal guest, who was also attacked, and died a few months afterwards.

A TELEGRAM, dated Hong Kong, January 9, states that the *Challenger* has left that place in continuation of her cruise.

WE are informed that a subscription list has been opened in Stockholm for the purpose of erecting a monument to Scheele, whose discoveries gave such a powerful impulse to the advancement of chemical science in the eighteenth century.

IT is also reported that there is a probability of a monument being erected in Brussels in honour of the late M. Adolphe Quetelet, the well-known Secretary of the Belgian Academy.

A NEW section of the Glasgow Philosophical Society—Section C, Physics (including Mechanics and Engineering)—has been formed, with Jas. R. Napier, F.R.S., as president, Prof. Sir Wm. Thomson, LL.D., F.R.S., and Prof. R. Grant, LL.D. F.R.S., as vice-presidents, and Thos. Muir, M.A., F.R.S.E., as secretary, and has already begun to do good work in the cause of original research. The success of this section, along with that of the recently organised Science Lectures Association, affords good evidence that in Glasgow, as elsewhere, there is a significant stirring among the dry bones from which we may hope for valuable results in the not distant future.

THE January number of Petermann's *Mittheilungen* contains a letter from Dr. Nachtigal, who has done for the eastern countries of the Sahara and Soudan what Barth did for the central, telling of his return to Cairo after an absence of about six years. He was received by the Viceroy and the German inhabitants of Cairo with the greatest honour. As his health has been considerably impaired by the hardships he has had to undergo, he intended to stay some time in the genial climate of Egypt to recruit, not caring to plunge suddenly into the rigours of a northern climate. Dr. Petermann gives a brief *résumé* of the course of Dr. Nachtigal's journeys.

THE scheme which was proposed about a year ago for the erection of an aquarium, to be built on the beach at Hastings, has been revived, and we are informed that a limited liability company, composed of local capitalists, has been started for the purpose of carrying out the project. The building will be erected a little to the east of the present pier, and one of the two designs to which premiums were awarded last year will probably be adopted.

FROM a previously undisturbed deposit on Funk Island, a guano-covered rock to the east of Newfoundland, several bones of the Great Auk (*Alca impennis*) have been recently brought to this country. They are not in a first-rate state of preservation, being considerably injured by exposure.

THE Marquis of Bute has recently purchased eight Canadian Beavers, seven of which have arrived safely in the Island of Bute, and have been placed in the enclosure constructed for the four which died some time ago on Drumreoch Moor. To increase the chance of their acclimatisation, the animals will be supplied with a certain amount of food for some time to come.

FROM a report of a journey into the interior of Formosa made in the latter part of the year 1873, we learn that the flat portion of the country is almost everywhere cultivated with the greatest care : the principal crops are rice, sugar-cane, and sweet potatoes ; and the minor crops, pea-nuts (*Arachis hypogæa*), indigo, and *Areca palius*. The mountain region, though very steep and rugged, was covered with thick tropical forest. Tree-ferns, as well as other ferns, grew luxuriantly ; and in places where there was a bit of level ground, Chinese had formed settlements around which they were growing rice, and were clearing patches of the hill-sides for the cultivation of tea. Formosa is the island from whence we obtain our supplies of the camphor of commerce, but in the interior the trees which abound in the forests are said to be left untouched, as the natives do not know how to make camphor.

THE cultivation of cocoa (*Theobroma cacao*) is being largely extended in Guayaquil. New plantations have been found, and new trees planted on the old estates, so that the average yield will be greatly increased. The crop of 1873 was the largest yield known for many years. Another of the chief products of Guayaquil is indiarubber, or caoutchouc, the yield of which has very much decreased of late, owing to the custom of destroying the trees to collect the gum, so that it has become necessary to go further into the forests in search of the trees, which, together with the increased difficulty of transport, has added much to its first cost.

ONE of the large Blue Gum Trees (*Eucalyptus globulus*) in the Temperate house at Kew is now showing bunches of fruit. These fruits are from three-quarters to an inch in diameter, and are peculiar on account of their hard woody nature, being nearly enclosed by the ligneous calyx, and opening at the apex by valves corresponding in number with the cells.

AMONGST economic plants of interest at present flowering at Kew, the Tea-plant and the Star Anise claim notice. A fine bunch of the Black Tea (*Thea chinensis*), var. *Bohea*, cannot fail to attract attention in the Temperate house at this season, where flowers in general are scarce. Though the genus *Thea* is so closely allied to that of *Camellia*, its flowers are comparatively inconspicuous when compared with those of the well-known *C. japonica*. The large yellow anthers, however, redeem it from insignificance. The Star Anise (*Illicium anisatum*), which find a home in the Economic house, is a native of South-west China, growing to a height of about fifteen feet. The common name of Star Anise is derived from the stellate form of the fruit when ripe, and its odour somewhat resembling that of aniseed. Large quantities of these fruits, with the seeds in them, are exported from China to Europe and India. On the Continent they are largely used to flavour spirits, but with us their chief use is for expressing an essential oil, which is frequently sold for real oil of aniseed.

THE differences between the organisation of the French Academy of Sciences and the Royal Society are striking. Anyone wishing to become a French Academician is obliged to visit each of the electors and to ask personally for their suffrages.

The number of French Academicians is strictly limited, and no new member is appointed except to fill a vacancy. There is a special section open to members who may have no sufficient scientific qualifications; they are called *Académiciens libres*, and belong to no special section, but cannot vote in the election of members, and are not paid.

EXPERIMENTS have been tried on some French railways for warming passenger cars by a stove, which is placed outside. It is said a single stove is sufficient for a whole car, and the expense is very small indeed, twenty-six pounds of coal keeping up the fire for about 200 miles. The warmed air circulates inside the car.

ATTENTION has been drawn in France by the news of the burning of the *Cospatrick* to the proper means for extinguishing fire on board ships. M. de Parville advocates in the *Débats* the obligatory use of signal-thermometers in the hold; each elevation of temperature being notified by the ringing of an electric bell. Others advocate the use of extinguishers. These are large bottles full of compressed carbonic acid, which may be of immense use in limited spaces, perhaps more valuable than water.

WE notice to-day the sailing of the *Timaru*, from Glasgow, with a consignment of salmon eggs for Otago, New Zealand. The ship *Tintern Abbey* has also recently sailed for New Zealand, having on board no less than 1,130 living birds, viz., blackbirds (*Turdus merula*), thrushes (*Turdus musicus*), starlings (*Sturnus vulgaris*), redpoles (*Linota rufescens*), of each 100; hedge-sparrows (*Accentor modularis*), 150; linnets (*Linota cannabina*), 140; goldfinches (*Fringilla carduelis*), 160; yellow-hammers (*Emberiza citrinella*), 170; and, lastly, partridges (*Perdix cinerea*), 110. When the birds arrive in New Zealand they will be let fly under proper authority. There is, we understand, a heavy penalty enforced against shooting at or injuring these birds in New Zealand, and it is hoped that they will do well at the Antipodes. The New Zealand farmers cannot get on without them, for they keep down the insects that ravage the crops. The Acclimatisation Society of Canterbury, New Zealand, we understand, have begun and are now persevering in this good public work.

THE weather has been extraordinarily warm and genial in Paris, as in London, and in the whole of France, for some days, but almost all the rivers have been swollen to a dangerous height owing to the rapid melting of immense quantities of snow. Disasters have been experienced along the banks of many streams, principally the Rhone. At Lyons the disasters were increased by a stockade or *barrage* erected suddenly across the stream. All the ice collected and produced an immense iceberg at a point called Ile Barbe. It was feared for a while that this stupendous mass of ice would force its way above the stockade and destroy everything below, and great efforts were made unsuccessfully to get rid of it. But the continuance of the genial temperature has gradually destroyed the obstruction. Never was the theory of regelation, as propounded by Tyndall, submitted to the test of a larger experiment.

MESSRS. H. S. KING and Co. have in the press, and nearly ready for publication, the following works relating to science:—"Mankind: a Scientific Study of the Races and Distribution of Man," considered in their bodily variations, languages, occupations, and religions, by Dr. Peschel.—Translations of two new works by Prof. Ernst. Hæckel: viz., "The History of Creation," edited by E. Ray Lankester, M.A. This book will be illustrated by coloured plates and genealogical trees of the various groups of both plants and animals.—"The History of the Evolution of Man," translated by E. A. Van Rhyn and L. Elsberg, M.D., with various notes and other additions sanctioned by Dr. Hæckel. Also the following new volumes of their International Scientific Series:—"Fungi;" their nature, influences, uses, &c., by M. Cook, M.A., LL.D., edited by the Rev. M. J. Berkeley, M.A., F.L.S. "The Chemical Effects of Light and Photography in their application to Art, Science, and Industry," by Dr. Hermann Vogel, of Berlin; and a treatise on "Optics," by Prof. Lommel, of the University of Erlangen. These three books will be profusely illustrated.

MESSRS. SMITH, ELDER, and Co. will publish, in a few days, a work called "The Cremation of the Dead," by Mr. William Eassie, C.E., who is well known for his work in sanitary matters.

THE cultivation of oysters has been attempted by the United States Commission of Fisheries in the Great Salt Lake of Utah, where numbers of these bivalves from California have been placed with the view of testing the possibility of their thriving there. Some beds were choked by mud brought down some small streams, but in other parts the oysters promise to succeed. Shad have also been placed in the lake and have been seen in good health, and a lot of salmon fry from the Sacramento, artificially hatched out, have been placed in the Jordan and other rivers running into the Great Salt Lake. So far, in the fresh waters, they have done well, and at ten months old were from four to six inches long. It remains to be seen whether they will thrive as well in the salt waters of the lake as in the sea itself. The experiment is a most interesting one, and opens up some curious questions in the natural history of the salmon and the other fish under experiment.

THE Council of the Society of Arts have passed a resolution to the effect that it is desirable that the Cantor Lectures programme be from time to time, as far as may be found practicable, arranged to further the scheme of the Society's Technological Examinations, and that steps be taken for getting such lectures published in a special form as guide-books.

THE third number has been sent us of the *Journal* of the Society for the Promotion of Scientific Industry, whose headquarters is at Manchester. The *Journal*, which is of considerable size, contains reports of the meetings of the Society, at which a number of good practical papers have been read. One of the most scientifically important of these is on "The Chemistry of Calico Printing and Dyeing," by Mr. Charles Dreyfus.

WE have received from the author, M. E. Mailly, a very interesting "Essai sur la Vie et les Ouvrages de M. L. A. J. Quetelet," poet, *littérateur*, geometer, physicist, astronomer, and statistician, doubtless one of the most remarkable men Belgium has produced. As we gave some account of M. Quetelet's life and work shortly after his death, we need not further notice M. Mailly's book, which we recommend to all who desire to know further about this notable man. The publisher is Hayez, of Brussels.

WE are glad to see that Mr. J. E. Taylor's lectures in Ipswich on "Plants, their Structure, and their Uses," have been so successful that it has been found necessary to engage a larger hall than that in which the course was begun.

THE *Bulletin* of the Minnesota Academy of Natural Sciences for 1874 contains a report on the birds and a list of the mammals of Minnesota. There are also geological notes from early explorers in the Minnesota Valley, arranged by Mr. N. H. Winchell.

"THE Safe Use of Steam, containing Rules for the Guidance of unprofessional Steam Users," by an Engineer, seems a book likely to be of practical use to many persons. It is published by Lockwood and Co.

MR. L. SCHWENDLER sends us two papers by him: "On Earth Currents," reprinted from the *Proceedings* of the Asiatic Society of Bengal; and "On the General Theory of Duplex Telegraphy," from the *Journal* of the same Society.

"NOTES on a Till or Boulder Clay with Broken Shells, in the lower valley of the River Endrick, near Loch Lomond, and its relation to certain other Glacial Deposits," is the title of a paper by Mr. R. L. Jack, F.G.S., reprinted from the *Transactions* of the Geological Society of Glasgow.

UNDER the title of "Report of the Government Botanist for the year ending June 30, 1874," Baron von Mueller, of Melbourne, has given a *résumé* of the scientific work of the year, carried on by him or under his immediate supervision. In the first place, Baron Mueller refers to the issue during the year of the sixth volume of the "Flora Australiensis," in the production of which he is associated with Mr. Bentham; towards the composition of the seventh volume he mentions that it will include the Grasses, numbering about 250 species, the Rushes, Sedges, Restiaceæ numbering alone about 70 species, the Naiadeæ, Palmaceæ, &c. With regard to the number of species, however, these may be considerably modified before publication. In reference to a botanical appendix which Baron Mueller made to the works of Mr. F. A. Campbell, of Geelong, on the New Hebrides and the Loyalty Islands, which appendix was drawn up from collections made by the author during a visit to these islands, he says: "By such means we have obtained the first connected records of the insular vegetation of those spots of the globe after the lapse of more than a century since their discovery. Such opportunities for research should also be seized on by other travellers, and especially by educated settlers residing on these islands, as thereby will be gained not merely an advancement for phytographic science, but also a closer acquaintance with the natural productions of any of the Pacific insular lands, to the advantage also of Australian industries and commerce." With regard to the Palæontology of Victoria, Baron Mueller describes the vegetation of the Pliocene period as remarkable for its densely umbrageous trees of almost tropical types, which, as very recently ascertained, spread over very extensive areas, where in the present nothing of the past physiognomic grandeur of the vegetation is left. The elucidation of new economic plants and the tests as to their value in the world of commerce has long been one of Baron Mueller's special points. his pen has produced many pamphlets on these and kindred subjects, and from his laboratory have issued many actual results of his researches in this direction. The large collection of chemical products from the various species of Eucalyptus, Melaleuca, Acacia, &c., together with other vegetable products of Victoria, will be remembered by many as forming one of the principal features of the Australian Court of the London International Exhibition of 1873. This collection, which included oils, tars, acetic acids, and alcohol from species of Eucalyptus, Melaleuca, Casuarina, &c., as well as fibres, papers, and starches, were, at the close of the Exhibition, presented to the Kew Museum, where they are now exhibited. In regard to what Baron Mueller terms "field service," he says he was engaged for seven days in December 1873 in investigating the plants in the forest regions of the Upper Yarra and the southern branches of the Goulburn River. Measurements were also taken at this time of the heights of some lofty trees of *Eucalyptus amygdalina*, the highest of which gave 400 ft. To some trees which appeared to be higher access could not be obtained in the short time allowed and the means at command, as the dense jungle would have to be cleared for a base line. A magnificent species of Festuca (*F. dives*), discovered in West Gippsland by Baron Mueller in 1860, "was now," he says, "ascertained to have a wide range through the forests towards the Yarra and Goulburn sources, where among grasses it forms a most stately object, the height of 12 ft. being not unusual, while occasionally this superb grass, in the fern-tree gullies or rivulets, attains, in rich soil, to 17 ft. The result of this journey," Baron Mueller says, "was the discovery of many plants new to Victoria and a few new to science. So far as the country itself is concerned, the Alps are easily accessible for horses from the eastern side, as the slopes are more gradual. The summits can be traversed for many miles with little or no impediment: being at an elevation of from 6,000 to 7,000 ft., they are above the region of trees and shrubs, and are consequently open in all directions."

WE have received the indexes to vol. vii. of "Patents and Patentees," 1872, for the colony of Victoria. The volume contains three separate indexes: "Subject Matter," "Alphabetical Index of Names," "Chronological and Descriptive," and seventeen sheets of illustrations. The work gives in a compact form a good idea of the activity of inventors in the colony.

THE additions to the Zoological Society's Gardens during the past week include a Black-handed Spider Monkey (*Ateles melanochir*) from Central America, presented by Mr. H. Campbell; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. C. Lucas; a Ring-necked Parrakeet (*Palæornis torquata*), from India, presented by Miss Attwood; a Yellow-bellied Parrakeet (*Platycercus flaviventris*) from Tasmania; and a Little Grebe (*Podiceps minor*), British, purchased.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science* for this month contains several articles and notices of interest, the most important of which are: "Observations on the Anatomy of *Tænia mediocanellata*," by Mr. F. H. Welch, in which the author describes the detailed structure of that species, which, as he remarks, is considerably more common than the better known *T. solium*. Two plates accompany the description; very instructive sections through the segments in different directions occupying one of them.—Mr. C. H. Golding Bird describes the method to be employed in imbedding in elder-pith for cutting sections, a method more simple and frequently as advantageous as imbedding in wax, the moistened pith adapting itself to the inequalities and supporting the substance to be cut, in a most convenient manner, without the necessity for a tripod, spirit-lamp, &c., required when wax is used.—Mr. W. Archer has a paper "On Apothecia occurring in some Scytonematous and Sirosiphonaceous Algæ, in addition to those previously known," in which the transfer by Bornet of *Ephebe pubescens* to the lichens suggested observations as to whether other species, *Stigonema* and allied genera, would not require similar relegation on account of the discovery of apothecia and spermogonia in them. The question as to the nature of these Gonidia-forming Algæ types is discussed.—Mr. Ray Lankester makes "Observations on the Development of the Cephalopoda," in which he continues his elaborate investigations on the development of the Mollusca. The points on which most stress is laid in the present paper are the formation of the blastoderm and the nature of the "autoplasts;" the development of the pen-sac, and of the alimentary canal, and especially of the eye, whose radical similarity in the di- and tetra-branchiate Cephalopoda is proved, at the same time that its great difference from the vertebrate organ is rendered equally apparent.—Mr. H. C. Sorby has a paper "On the Chromatological Relations of *Spongilla fluviatilis*," which is shown to contain much the same colouring matter, soluble in carbon-disulphide, as the highest plants, though in different proportions.—The last paper, reprinted from this journal, is Prof. Huxley's "Classification of the Animal Kingdom," read before the Linnean Society in December last.—A review is given of Stricker's "Manual of Histology," as well as an excellent short life, by Dr. Payne, of Dr. Lankester, one of the founders of the journal.

Astronomische Nachrichten, No. 2,016.—In this number is a list of some thirty stars, of types iii. and iv., discovered by D'Arrest. Notes on colour and bands in the spectrum of each

are added.—Oppolzer gives the elements of Winnecke's comet (Comet III. 1819), and an ephemerls for every day, from Jan. 1 to March 1, 1875. The eclipse of the sun of October last was observed by H. Bruns and others at Dorpat; four telescopes were used, of 162, 97, 53, and 77 millimetres aperture respectively. It appears that the first contact was observed to take place earlier with the larger instruments than with the smaller; there is a difference of 44 seconds in time in the case of the 162 and 53 millimetre glasses. H. Bruns also contributes some remarks on the finding of the altitude of falling stars.—Dr. J. Holetschek gives elements and an ephemeris for the planet Peitho (118) for the month of Dec.; and Ormond Stone adds a remark on certain equations in the determination of a comet's distance from the earth.—No. 2,017.—Dr. O. Lohse writes to the editor an account of the method of photographing the sun. He apparently uses collodion, containing chloride of silver, or paper, instead of the ordinary sensitive plate. He remarks that the process has the advantage of requiring no chemical preparation for each photograph, and he says the spots are sharply defined.—Prof. Bredichin sends his positions and observations of 22 of the minor planets, the comets of Winnecke, Borrelly, and Coggia; and Fearnley gives a list of 58 stars with their ascertained positions for comparison with Coggia's comet.—Leopold Schulhof gives elements and an ephemeris for the month of Dec. of Planet (139).—Victor Fuss gives the times of contact of four observers of the solar eclipse of October last.

THE *Bulletin de la Société d'Acclimatation de Paris* for September opens with a curious instance, related by M. Duwarnet, of a cross between the red and common grey partridge; the practical use of which, however, is not apparent, though it is a curious example of a cross between two species of birds hitherto regarded as irreconcilable.—M. La Perre de Roo contributes an article on Military Pigeons, which details the uses to which pigeons may be put for military purposes. Russia, Italy, Austria, and Germany have already created establishments for the breeding and training of pigeons with this object.—M. J. Bech pleads the cause of the small birds in France, most of which, as soon as the legal shooting season commences, are killed in large numbers by sportsmen who cannot find better game. He recommends the absolute prohibition of the slaughter of insectivorous birds.—The acclimatisation of sponges is the latest idea of one of the members of the society, who suggests that the celebrated Syrian sponges might be cultivated in the South of France.—The Notes from America include observations on the Mexican Agave, the introduction of mahogany into India, and the teaproductions of that country.

Der Zoologische Garten.—In the November number Dr. von Olfers discusses the food of the Stork (*Ciconia alba*), and its consequent value to the farmer. He finds the principal items of its bill of fare to consist of frogs, moles, grasshoppers, and the larger carabine beetles.—Dr. Dorner reviews the twelve species of Deer now represented in the Hamburg Zoological Gardens; a Stag (*Cervus elaphus*), aged only two years, has already antlers with twelve points.—H. Thienemann remarks on the habits of the Little Bustard (*Otis tetrix*), which has recently established itself as a breeding species in Thuringia, as has also the Fieldfare (*Turdus pilaris*).—Among the remaining articles are notes on *Plotus levaillantii*, by H. Marno; and on *Tropidonotus tessellatus*, by H. Geisenheyner.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, Dec. 16.—Mr. John Evans, F.R.S., president, in the chair.—The following communications were read:—(1) Descriptions of the Graptolites of the Arenig and Llandeilo Rocks of St. David's, by Messrs. John Hopkinson and Charles Lapworth. Commencing with a brief historical account of the discovery of graptolites in the neighbourhood of St. David's, from their first discovery in the Llandeilo series in 1841 by Sir Henry De la Beche and Prof. Ramsay, the authors proceeded to explain their views on the classification of the graptolites (*Graptolithina*, Bronn), which they place under the order *Hydroida*, dividing them into two groups: *Rhabdophora* (Allman), comprising the true siculate or virgulate graptolites, which they consider to have been free organisms; and *Cladophora* (Hopkinson), comprising the dendroid graptolites and their allies, which were almost certainly fixed, and are most nearly allied to the recent *Thecaphora*. The distribution of the genera and species in the Arenig and Llandeilo rocks of St. David's was then treated of, and the different assemblages of species in each of their subdivisions were compared with those of other areas. The Arenig rocks are seen to contain a number of species which ally them more closely to the Quebec group of Canada than to any other series of rocks, all their sub-divisions containing Quebec species, while the Skiddaw slates, which before the discovery of graptolites in the Lower Arenig rocks of Ramsey Island in 1872 were considered to be our oldest graptolite-bearing rocks, can only be correlated with the Middle and Upper Arenigs of St. David's. The graptolites of the Arenig rocks of Shropshire and of more distant localities were also compared with those of St. David's. In the Llandeilo series of this district the *Cladophora* have now for the first time been found, a few species, with several species of *Rhabdophora*, occurring at Abereiddy Bay in the Lower Llandeilo, which alone has been carefully worked, there being much more to be done in the Middle and Upper Llandeilo, from which very few species of graptolites have as yet been obtained. Some of the recently introduced terms, and altered or more definite terminology, employed in the descriptions of the species were then explained; and the paper concluded with descriptions of all the species of graptolites collected in the Arenig and Llandeilo rocks of St. David's within the last few years of which sufficiently perfect specimens have been obtained, doubtful species being referred to in an appendix. Forty-two species were described, belonging to the following genera:—*Didymograptus*, *Tetragraptus*, *Clemagraptus* (gen. nov.), *Dicellograptus*, *Climacograptus*, *Diplograptus*, *Phyllograptus*, *Glossograptus*, and *Trigonograptus* (Rhabdophora); *Ptilograptus*, *Dendograptus*, *Callograptus*, and *Dictyograptus* (Cladophora). (2) On the age and correlations of the plant-bearing series of India, and the former existence of an Indo-oceanic continent, by Mr. H. F. Blanford. In this paper the author showed that the plant-bearing series of India ranges from early Permian to the latest Jurassic times, indicating that, with few and local exceptions, land and freshwater conditions had prevailed uninterruptedly over its area during this long lapse of time, and perhaps even from an earlier period. In the early Permian there is evidence in the shape of boulder-beds and breccias underlying the lowest beds of the Talchir group of a prevalence of cold climate down to low latitudes in India, and, as the observations of geologists in South Africa and Australia would seem to show, in both hemispheres simultaneously. With the decrease of cold the author believed the flora and reptilian fauna of Permian times were diffused to Africa, India, and perhaps Australia; or the flora may have existed somewhat earlier in Australia, and have been diffused thence. The evidence, he thought, showed that during the Permian epoch, India, South Africa, and Australia were connected by an Indo-oceanic continent, and that the first two remained so connected, with at the utmost some short intervals, up to the end of the Miocene period. During the latter part of the time this continent was also connected with Mayalana. The position of the connecting land was said to be indicated by the range of coral reefs and banks that now exists between the Arabian Sea and West Africa. Up to the end of the Nummulitic epoch, except perhaps for short periods, no direct connection existed between India and Western Asia.

Zoological Society, Jan. 5.—Dr. E. Hamilton, vice-president, in the chair.—A letter was read from Dr. George Bennett, of Sydney, giving an account of an Indian beetle (*Chrysochroa ocellata*), which had been captured alive in the Bay of Bengal, 273 miles from the nearest land, by Capt. Payne, of the barque *William Mansoon*.—A letter was read from Mr. Anderson, of Futteyghur, East Indies, giving an account of the eggs and young of the Gavial (*Gavialis gangeticus*).—The Secretary read a letter addressed to him by the Marquis of Normanby, Governor of Queensland, announcing that he had forwarded by the ship *Ramsay*, under the care of Capt. Carter, a fine specimen of the Australian Cassowary (*Casuarius australis*), as a present for the Society's collection.—A communication was read from Mr. A. G. Butler, giving descriptions of thirty-three new species of *Sphingidæ* in the collection of the British Museum.—A communication was read from Mr. Andrew Anderson, of Futteyghur, giving corrections of and additions to a previous paper by him on the Raptorial Birds of North-western India (P.Z.S., 1872, page 619).—A communication was read from Mr. E. L. Layard, H.B.M. Consul for Fiji and Tonga, containing ornithological notes made in the Fijis, together with descriptions of some supposed new species of birds.

Royal Microscopical Society, Jan. 6.—Chas. Brooke, F.R.S., president, in the chair.—Dr. Ord read a paper on the natural history of the common urates, in which he described the results of a number of experiments with urates of soda and ammonia, carried on with a view to ascertain what was the meaning of the different forms in which they appeared in the animal system. The various forms assumed by these salts in colloid media, and under the action of acids or chlorides, were described at some length, and the subject was further illustrated by drawings and preparations exhibited in the room.—A paper by Dr. Pigott, on the invisibility of minute refractory bodies in consequence of excessive aperture, was read by the Secretary.—Some beautiful sections of a foraminifer (*Alveolina*), both transverse and longitudinal, mounted by Möller, were exhibited by the Assistant Secretary.

Royal Geographical Society, Jan. 12.—Sir Rutherford Alcock, vice-president, in the chair.—A letter was read from Lieutenant-Colonel C. C. Long, a staff officer in the Egyptian service, giving the Society an account of his recent journey to King Mtesa, on the shores of Lake Victoria Nyanza. According to Col. Long's account, he left Gondokoro on the 24th of April last, charged by Col. Gordon with a friendly mission to the powerful King of Uganda (King Mtesa), and accompanied by two Egyptian soldiers and two servants. The journey occupied fifty-eight days, at the end of which the party was rewarded by the sight of the richly-cultivated central district of Uganda, appearing like a great forest of bananas. King Mtesa received the envoy with great friendliness, and ordered thirty of his subjects to be decapitated in honour of the visit. Permission was given Col. Long to descend "Murchison Creek" and view Lake Victoria. The journey from Mtesa's residence occupied three hours, and the party embarked on canoes made of the bark of trees, sewn together. Col. Long sounded the waters of the lake, and found a depth of from 25 to 35 feet. In clear weather the opposite shore was visible, appearing "to an unnautical eye" from twelve to fifteen miles distant; he did not think he could possibly be greatly deceived in this estimate. After much negotiation and opposition, he obtained permission to return to Egyptian territory by water, and on the way, in lat 1°30, discovered a second lake, or large basin, at least twenty to twenty-five miles wide. He found the Upper Nile from Ripon Falls to Karuma Falls a fine navigable stream large enough for the *Great Eastern*. He finally reported from Gondokoro (October 20) that Col. Gordon would soon have a steamer on Albert Nyanza, and intended also to move one to the Upper Nile above Karuma.—A paper was then read "On a Journey along the East Coast of Africa, from Dar-es-Salam to Kilwa, in December 1873, by Capt. F. Elton," the chief point of which was that the Rufigi River was found above the head of the delta to have an average depth of only four to five feet.—Major Erskine (late Colonial Secretary of Natal) then read a paper on his son's (Mr. St. Vincent Erskine) recent mission to the powerful Kaffir chief Umsila, whose territory stretches along the richly-wooded and fertile interior country between the Limpopo and the Zambezi. Umsila's head-quarters are near the ruins of Zimbaye, where the German traveller, Carl Mauch, discovered sculptured stones, supposed by some to be of great antiquity. Major Erskine stated that his son had just returned from a second visit to Umsila and Sofala.

PARIS

Academy of Sciences, Jan. 4.—M. Frémy in the chair.—The following papers were read:—Note on magnetism *à propos* of a recent communication by M. Lallemand, by M. Th. du Moncel.—Memoir on the resistance of protozoids to the different dressing materials employed in surgery, by M. Demarquay.—On the decomposition and preservation of wood, by M. Max. Paulet.—On the germination of the "Chevallier" barley, by M. A. Leclerc.—Communications relating to Phylloxera were received from MM. L. Roesler, G. Beaume, P. Jolly, and others.—The French Minister in China forwarded a despatch from M. Fleuriais, dating from Shanghai, Dec. 26, and announcing the successful result of the Transit of Venus observations.—The following letters from various observing stations were also read:—From MM. Ch. André and A. Angot, at Noumea, dated Oct. 8; from M. J. Janssen, at Nagasaki, dated Nov. 4; from M. Héraud, at Saigon, dated Nov. 22; and from M. P. Tacchini, at Muddapur (Bengal), dated Dec. 10. This last communication makes known that the spectroscopic observations of the Transit were satisfactory, and tend to show that the diameter of the sun is smaller when seen in the spectroscope than when observed by the other method.—On the calculus of geodesic co-ordinates, by M. Ch. Trepied.—On the expression of work relative to an elementary transformation, by M. J. Moutier.—Analogies between the disengagement of gases from their supersaturated solutions and the decomposition of certain explosive bodies, by M. D. Gernez.—On the atomic structure of the molecules of benzene and terebene, by M. G. Hinrichs.—On the titanic ethers by M. E. Demarcay. One molecule of titanic chloride is mixed in small portions with four molecules of absolute alcohol, and the mixture heated to 80°–100° *in vacuo*, when hydrochloric acid and the excess of alcohol are removed and a crystalline mass obtained which has the composition of the chlorhydrate of monochlorhydrine, $Ti(OC_2H_5)^3Cl,HCl$. This body forms white crystals, melting at 105°–110°, and decomposable by water. Sodium ethylate dissolved in excess of alcohol is added to an alcoholic solution of the chlorhydrate, when sodium chloride is precipitated, and the alcoholic solution yields on evaporation white crystalline needles of the ether $Ti(OC_2H_5)^4$.—On the pyruvic ureides: Condensed ureides; by M. E. Grimaux. The author now considers dipyruvic triureide, $C_9H_{12}N_6O_5$; tetrapyruvic triureide, $C_{15}H_{14}N_6O_8$; and dipyruvic tetraureide, $C_{13}H_{16}N_8O_7$.—On the shooting stars of November 13 and December 10, 1874, by M. Gruey.—Aërial corpuscles and saline matters contained in snow, by M. G. Tissandier.—Researches on the gastric juice, by M. Rabuteau. The author's experiments confirm the results obtained by Braconnot, Prout, Lassaigne, and Schmidt—that the acidity of the juice is due to hydrochloric and not to lactic acid.—On the nature of syphilitic affections, and on mercurial treatment, by M. J. Hermann.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—The Microscope and its Revelations: Wm. B. Carpenter, M.B., LL.D (J. and A. Churchill).—The Apparent Absence of Air and Water from the Moon: Francis Rapier (Philosophical Society of Glasgow).—Some Reasons for doubting the Alleged Transit of Venus (Hodder and Stoughton).—Report of the Kew Committee, for year ending Oct. 31, 1874.—Remarks on the Great Logarithmetic and Trigonometrical Tables computed in the Bureau du Cadastre under the direction of M. Prony: Edward Sang.—A Short History of the English People: Rev. J. R. Green, M.A. (Macmillan and Co.)—The Amazon and Madeira Rivers: Franz Keller (Chapman and Hall).—Chemical and Geological Essays: T. Sterry Hunt, LL.D. (Trübner).—The Transit of Venus; its Meaning and Use: T. H. Rudd, F.R.A.S. (Longmans).—Two Years in Peru, with Exploration of its Antiquities: Thos. J. Hutchinson, F.R.G.S., F.R.S.L., M.A.I., &c. (Sampson Low, Marston, Low, and Searle).

AMERICAN.—Report of the Commissioner of Fish and Fisheries of the United States, 1872–73 (Washington).—Memoirs of Boston Society of Natural History: The Species of Lepidopterous Genus Pamphila: Samuel H. Scudder (Published by the Society).—Report of the Medical Commission upon the Sanitary Qualities of the Sudbury, Mystic, Shawstone, and Charles River Waters (Boston, Rockwell and Churchill).—Results derived from an Examination of the United States Weather Maps for 1872–73: Elias Loomis (From American Journal of Science and Arts).—Jeffries Wyman Memorial Meeting of the Boston Society of Natural History.

COLONIAL.—Appendix to New Vegetable Fossils of Victoria: Baron Ferd. von Mueller, C.M.G., M.D., Ph D., F.R.S.—Journal of the Asiatic Society of Bengal (G. H. Rouse, Calcutta).—Proceedings and Transactions of the Nova Scotian Institute of Natural Science (Wm. Gossip, Halifax, N.S.)—Durability of New Zealand Timber (Report read by Mr. Thomas Kirk).

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