THURSDAY, DECEMBER 14, 1882

ANCIENT SCOTTISH LAKE DWELLINGS

Ancient Scottish Lake Dwellings. By Dr. Munro. (Edinburgh: David Douglas, 1882.)

THE first account of the Irish crannoges, by Sir W. R. Wilde, dates back to the year 1839, and the Lake Dwellings of Switzerland, which have shed so much light on prehistoric archæology, were discovered in the year 1853; yet the first scientific account of any similar dwellings in Scotland was in the paper by Mr. Robertson, read before the Society of Antiquaries of Scotland in the year 1857.

Dr. Munro has now collected together in an interesting and well-illustrated volume the substance of what was previously known, and added to it an account of some interesting investigations of his own, in a general work on the ancient Scottish Lake Dwellings or Crannoges. The number of these more or less artificial islands now known is very considerable. In Wigtownshire we are told that all the lakes were once literally studded with these island habitations.

So far as can be judged at present there is no reason to refer the Scottish Crannoges to so early a period as the earlier Swiss Lake villages. The objects of stone are comparatively few, while those of bone, horn, and of wood are very numerous. None of the animal remains belong to any extinct species. The horns are mostly those of the red-deer; in one case indeed, that of the crannoge at Lochlee, some fragments have been found which may possibly have belonged to the reindeer. This however seems very doubtful. The late Dr. Rolleston, by whom the remains were examined, says of the fragmentary pieces of horn: "I incline to set them down as indicating the presence of the former animal" (the reindeer). "It is usually easy," he says, "to separate even the fragments" (of reindeer's horn), "if the fragment is fresh. Of course the surfaces of the horns in these two horns" (*i.e.* of the reindeer and of the red-deer) "are different, but here the two fragmentary horns have no brow antler left and their surfaces have been macerated so long as to be desquamated." It is obvious therefore that Dr. Rolleston felt considerable doubt on the subject.

The majority of the metallic objects are of iron, but some few gold ornaments have also been discovered, and in one case, viz. at Buston, a single coin which, curiously enough, is a forgery. It consists of two thin plates of gold fastened together by some resinous substance. It belongs to a class which has hitherto been found almost exclusively in England, and is probably Saxon, belonging most likely to the sixth or seventh century. A very similar coin has been found near Dover.

We will now leave Dr. Munro to speak for himself:

"The great and primary object," he justly observes, "of the island builder was the protection afforded by the surrounding lake or morass, the securing of which has continued to be a ruling principle in the erection of defensive works down to the Middle Ages, long after the wooden islands ceased to be constructed. The transition from an island fort to the massive mediæval castle, with its moat and drawbridge, is but another step in the progressive march of civilisation" (p. 243).

The objects discovered in the Scottish Crannoges are in the main of a domestic character:

"Indeed," says Dr. Munro, "amongst the relics military remains are only feebly represented by a few iron daggers and spearheads, one or two doubtful arrow-points, and a quantity of so-called pebbles and so-called sling-stones. On the other hand, a very large percentage of the articles consists of querns, hammer-stones, polishers, flint-flakes, and scrapers, stone and clay spindle-whorls, pins, needles, and bodkins, knife-handles of red-deer horn, together with many other implements of the same material, bowls, ladles, and other vessels of wood, some of which were turned on the lathe; knives, axes, saws, hammers, chisels, and gauges of iron; several crucibles, lumps of iron slag, and other remains of metals, &c. From all these, not to mention the great variety of armaments, there can be no ambiguity as to the testimony they afford of the peaceful prosecution of various arts and industries by the lake-dwellers" (p. 282).

As regards the mode of life of the Scotch Lake-dwellers, we can, he continues:

"From the respective reports of Professors Owen, Rolleston, and Cleland, on a selection of osseous remains taken from the lake dwellings at Dowalton, Lochlee, and Buston (see pp. 50, 139-143, 236-239), we can form a fair idea of the food of the occupiers. The Celtic short-horn (*Bos longifrons*), the so-called goat-horned sheep (*Ovis aries*, var. *brachyura*), and a domestic breed of pigs were largely consumed. The horse was only scantily used. The number of bones and horns of the red-deer and roe-buck showed that venison was by no means a rare addition to the list of their dietary. Among birds only the goose has been identified, but this is no criterion of the extent of their encroachment on the feathered tribe, as only the larger bones were collected and reported upon. To this bill of fare the occupiers of Lochspouts Crannog, being comparatively near the sea, added several kinds of shell-fish. In all the lake dwellings that have come under my own observation, the broken shells of hazel nuts were in profuse abundance'" (p. 283).

It is an interesting fact that the Lake-dwellings as yet discovered are by no means evenly distributed throughout Scotland.

"Though we cannot argue definitely from the present geographical distribution of the Scottish Lake Dwellings, the indications are so clearly suggestive of their having been peculiar to those districts formerly occupied by Celtic races, that the significance of this generalisation cannot be overlooked. Thus, adopting Skene's division of the four kingdoms into which Scotland was ultimately divided by the contending nationalities of Picts, Scots, Angles, and Strathclyde Britons, after the final withdrawal of the Romans, we see that of all the Crannoges proper none have been found within the territories of the Angles; ten and six are respectively within the confines of the Picts and Scots, while no less than twenty-eight are situated in the Scottish portion of the ancient kingdom of Strathclyde. Nor is this generalisation much affected by an extension of the list, so as to include those stony islets so frequently met with in the Highland lakes. On the other hand, that they have not been found in the south-eastern part of Scotland may suggest the theory that these districts had been occupied by the Angles before Celtic civilisation—or rather the warlike necessities of the times—gave birth to the island dwellings. In that case we would suppose that their development dates back to the unsettled events which immediately followed the withdrawal of the Roman soldiers, to whose protection the Romano-British population in the south-west of Scotland had been so long accustomed" (pp. 248 and 249).

In support of this view he also remarks that

"Fragments of Samian ware, bronze dishes (one with Roman letters), harp-shaped fibulæ of peculiar type, together with a large assortment of beads, bronze and bone pins, bone combs, jet ornaments, &c., are so similar to the class of remains found on the excavated sites of Romano-British towns, that there can hardly be any doubt that Roman civilisation had come in contact with the lake-dwellers and partially moulded their habits. The Celtic element is, however, strongly developed, not only in the general character of many of the industrial implements of stone, bone, and iron, but also in the style of art manifested in some of the ornamental objects included in the collection."

We confess that we are disposed to doubt whether the geographical distribution of the Scottish lake dwellings at present known is really connected with that of the ancient Celt, and whether it is not more due to the activity of the Ayrshire and Wigtonshire Archæological Association, of Mr. Cochran Patrick, M.P., and of Dr. Munro himself. Whilst thanking him for what he has already accomplished, we may express a hope that he will continue his researches. JOHN LUBBOCK

OUR BOOK SHELF

The Sportsman's Handbook to Practical Collecting, Preserving, and Artistic Setting up of Trophies and Specimens. To which is added a Synoptical Guide to the Hunting Grounds of the World. By Rowland Ward, F.Z.S. Second Edition. With numerous additional Illustrations. (London: the Author, and Simpkin, Marshall, and Co., 1882).

THIS very useful little book affords all requisite information for the traveller who wishes to preserve specimens of natural history, more especially large animals. The process of skinning quadrupeds and birds is so well explained, and so copiously illustrated by characteristic woodcuts, that the merest tyro would soon learn the art. The best modes of preserving reptiles, fishes, and insects are also given; and then follow instructions for the setting up of trophies, for mounting birds and fishes, and for dressing skins of large animals. A sketch of the chief hunting-fields of the world concludes the book, and in this part much useful information is given as to the more important animals characteristic of each region.

The book is especially valuable in that it does not confuse the reader by a multiplicity of details, or leave him to choose between a variety of methods. The simplest and most effective appliances are alone recommended, and the great experience of the writer in the preservation and mounting of animals renders his advice on these points of the greatest value. The introductory chapter gives good outlines of the bodies and skeletons of the chief types of large mammalia, with the vital spots marked on each, so as to guide the sportsman in killing his game.

We only notice a single point which appears to call for correction in a future edition. The use of the blow-pipe is recommended for killing small birds, and it is described as a tube of metal or wood about 3 feet long and $\frac{3}{4}$-inch in diameter, through which pellets of clay may be propelled by the breath. Such an instrument would be of very little use, and we doubt whether any ordinary person could propel a ball of clay of this size with sufficient velocity to kill any bird at ten yards off. For using clay pellets, the bore should not exceed $\frac{3}{8}$, or at utmost, $\frac{1}{2}$-inch diameter, and the length had better be 6 or 8 feet than 3. The blow-pipes used in South America are usually 8 or 10 feet long, and under $\frac{1}{2}$-inch bore, and with these, light arrows can be propelled so as to kill birds on lofty trees, while with clay pellets, humming-birds are easily killed at more moderate distances.

The book is strongly and tastefully bound, and should be the companion of every sportsman and naturalist about to visit foreign countries. A. R. W.

Diagrams of Insects Injurious to Farm Crops; suitable for Elementary Schools. Prepared by Miss E. A. Ormerod, Honorary Consulting Entomologist to the Royal Agricultural Society of England.

A SERIES of six large diagrams as follows, issued by the Society:—Large White Cabbage Butterfly, Turnip Fly, or Flea (the prospectus writes "Flee") Beetle, Beet Fly, Wire Worm and Click Beetle, Hop Aphis or Green Fly, with Ladybird, Daddy Long-legs or Crane-fly. These diagrams seem admirably adopted for the purpose intended, and are accompanied by short explanations, including remedial prescriptions. In her scientific names Miss Ormerod puts the cart before the horse, by reversing the order of things, and making the lesser include the greater. When she indicates *Agriotes* (*Elater*) *lineatus*, *Phyllotreta* (*Haltica*) *nemorum*, and *Phorodon* (*Aphis*) *humuli*, she means that the parenthetical generic term is the larger and older, and that the preceding one is a later creation by those dreadful specialists; but she does not say so.

Manuel d'Électrometrie Industrielle. Par R. V. Picou (Paris: G. Masson, 1882.)

THIS is one of the many books which owe their appearance to the recent rapid growth of the electrical industries; and may not be inappropriately termed a treatise on electric measurements, only a very small section being however devoted to electro-chemical quantities. The work begins with the ordinary laboratory processes of testing resistance, electromotive force, and strength of currents, &c. The latter half of the book deals with the practical application of such tests to the measurement of the electromotive force, resistance, &c., of batteries and dynamo-electric generators. Under the latter head the methods of MM. Pollard and Cabanellas are expounded. The author does not appear to be acquainted with the recent testing instruments invented by Professors Ayrton and Perry, nor those of Sir W. Thomson, which present many advantages over the instruments described by the author. There are several glaring defects in the work of too important a nature to be passed over. The author gives instructions for making up resistance coils without saying a word about the necessity of winding them so as to avoid self-induction, and as he cautions the reader to use a simple key in testing with Wheatstone's bridge he cannot be aware of the substantial reasons which exist for the use of the British Association key with double-successive contact. As the author professes to follow the British Association in its system of units he ought not to write "dyne = gramme-masse," because that is exactly what the dyne is not. He ought also to know that the statement he makes on p. 132 respecting the efficiency of electromotors, that the useful work is a maximum when the back-electromotive force is equal to half the electromotive force of the generator is not true, and does not refer to maximum efficiency but to maximum rate of using up power. Students will find the books on kindred subjects by Kempe and Day of much more use than the manual of M. Picou.

The Falls of Niagara and other Famous Cataracts. By G. W. Holley. Illustrations. (London: Hodder and Stoughton, 1882.)

THE bulk of this volume is devoted to Niagara, concerning which Mr. Holley has brought together a great deal of information on its history, geology, and local history and incidents, two-thirds of the space being occupied with the last section. The information seems to us in the main correct, though much of the miscellaneous matter included under local history and incidents is of trivial

importance. The space devoted to the other "Cataracts" of the world is small, though most of the important ones are mentioned. The illustrations are good, and on the whole the book is interesting.

LETTERS TO THE EDITOR

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

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Priestley and Lavoisier

If Mr. Rodwell had anything new to tell us about Lavoisier, there would have been a sufficient motive for his writing; but I do not see what useful purpose is gained by telling us what was already known, namely, that a century ago Lavoisier rendered many important services to science; or, what was not so well known, namely, that chemistry is a French science; or, that Lavoisier was "the most generous of men," "incapable of any meanness." The real question Mr. Rodwell himself asks:—"Upon what authority does Dr. Thomson assert that Dr. Priestley informs us that he prepared the gas in M. Lavoisier's house in Paris, and showed him the method of procuring it in the year 1774?"

Mr. Rodwell quotes from Thomson's notice of Priestley; had he turned to that of Lavoisier (p. 105, vol. ii. 1831, not 1830), he would have found an answer:—"Dr. Priestley discovered oxygen in August, 1774, and he informs us in his life [this ought to be "Life," *i.e.* autobiography] that in the autumn of that year he went to Paris and exhibited to Lavoisier, in his own laboratory, the mode of obtaining oxygen gas by heating red oxide of mercury in a gun-barrel, and the properties by which this gas is distinguished; indeed, the very properties which Lavoisier himself enumerates in his paper. [*Mem. Acad.* 1775, pub. 1778.] There can therefore be no doubt that Lavoisier was acquainted with oxygen gas in 1774, and that he owed his knowledge of it to Dr. Priestley."

Dr. Black complained of the publication of Lavoisier's papers without any allusion whatever to what he himself had previously done on the same subject. Cavendish complained of something more than a similar neglect. The facts, as stated in Dr. George Wilson's "Life of Cavendish," are briefly these:—Blagden went to Paris in June, 1783, and informed Lavoisier of the discovery of the composition of water. Lavoisier was incredulous, expressing his opinion that the union of the two gases (O and H) would produce, not water, but an acid. Nevertheless he repeated Cavendish's experiment on a large scale; and in his account of it to the Academy on June 25, stated that the conclusion as to the compound nature of water was drawn by Laplace and himself. The charge brought against Lavoisier by Cavendish, Blagden, and Watt, was summed up by Watt to this effect, that after Lavoisier had had the theory of the composition of water explained to him, "he invented it himself."

Mr. Rodwell "utterly denies" that the acceptance of Lavoisier's doctrine was mainly due to Cavendish's discovery. A strong objection to the oxygen theory was advanced by Berthollet and others, founded on the observation that in the action of dilute acids on metals inflammable air is produced. [The inflammable air of Cavendish, in 1766, was referred not to water, but to the metals]. Whence came this element? The discovery of the composition of water answered the objection, and converted it, as Dr. Whewell remarks, into an argument in favour of the theory.

My statement that "the compound is always equal to the sum of its elements" was already known, was elicited by a remark of Lavoisier's, quoted by Mr. Rodwell:—"I am obliged in this reasoning to suppose that the weight of the bodies employed was the same after the observation as before." My statement is new to Mr. Rodwell, and he calls for references. Many of the old writers on the idea of substance acknowledged the proposition, and its best application was Wenzel's doctrine of definite and reciprocal proportions, although its full significance did not become apparent until the aeriform elements were also taken into account.

But to return to Priestley, I am bound to admit that 1744 is a mistake into which I was misled by Whewell ("His. Ind. Sci., 1857, iii. 110), who gives that date.

Priestley was presented with the Royal Society's Copley medal, as an honourable testimony to his numerous scientific discoveries, which, considering the crude state of chemistry in his time, must be regarded as admirable. He was afterwards driven from the Royal Society and from his country, his house was pillaged, and his library, manuscripts, and apparatus destroyed, and all this persecution was on account of certain opinions which happily are now widely spread. The statue at Birmingham is a less impressive tribute to his memory than the maintenance of respect for his fame; and it is with no unfriendly feeling towards Mr. Rodwell that I express an opinion that this old quarrel between Lavoisier, Priestley, and Cavendish had better be left to repose in the history of science, where it has been discussed with sufficient fulness and fairness by such writers as Thomson, Brande, Whewell, and George Wilson.

Highgate, N., December 4 C. Tomlinson

The Forth Bridge

In some remarks made in Nature, vol. xxvii. p. 101, by Mr. Charles Shaler Smith, the following passage occurs:—"The tests of the last few years show conclusively, that iron exposed to compression within its buckling limit is compacted in texture and strengthened by such use while, if subjected to continuous tension beyond two-thirds of its elastic limit, it is attenuated and weakened." As I think that the words above quoted may perhaps to a certain extent mislead those who have not themselves made experiments on the elasticity of iron and steel, and on the alteration of density which can be produced by compression or extension, I would observe:—

1. That the increase of *density* which can be produced by compressing within the buckling-limit such rods as may be employed in the construction of bridges, would certainly not account for the strengthening of iron exposed to continuous compression. I have examined carefully the alteration of density which can be effected in iron and steel wires by longitudinal extension, &c., and even in cases where the wire was strained to breakage, and the permanent extension exceeded 20 per cent., there was no diminution of density equal to 1 per cent. Of course the words "compacted texture" may not mean that the density is increased, but the idea seems to be not uncommon among engineers, that increase of strength *necessarily* implies increase of density. Though I cannot at this moment lay hands upon it, I remember reading an account of some theories advanced respecting the hardening of steel, from which it was evident that the author of these theories assumed that the hardening is attended with *increase of density*, whereas the density of steel can be more *diminished* by this process than by any mechanical means with which I am acquainted.

2. It is quite true that iron, if subjected to continuous tension beyond two-thirds of its elastic limit, is attenuated, but whether the attenuation is attended with weakening or not depends largely upon the manner in which the tension is applied. If the latter is increased by small amounts at a time, and each amount allowed to act for a few hours before any increase of stress is made, not only is there comparatively small permanent extension, but there may be an actual increase of strength as far as resistance to extension is concerned. The fact is that whether we subject iron and steel to *long-continued* compression or extension, we increase the resistance to compression and extension respectively, mainly for the same reason, namely, that we *give time* for the molecules of the metal to take up such positions as will enable them to offer the maximum resistance. Thus I have proved that the value of "Young's Modulus" is considerably increased in the case of an iron wire which has suffered permanent extension, by allowing the wire to rest for some hours either loaded or unloaded; this increase of elasticity is not attended with any appreciable increase of density.

As I feel that too much precaution cannot be taken in a question of this kind, where life is at stake, I would venture to make the following suggestion:—That bars or rods of steel and iron which run the *slightest* risk of having at any time to undergo a considerable extending or compressing stress should before use be subjected, if possible, to the same kind of stress gradually increased in amount with intervals of some hours between each increase until a stress equal to at least three-fourths of the breaking-stress be reached. Three or four days would suffice to bring the metal to its maximum strength, both as regards resistance to permanent and to temporary strain.

Should any one be interested in the subject, I would refer them to the experiments of Mr. J. T. Bottomley (*Proc. R. Soc.*, No. 197, 1879), of Prof. Ewing (*Proc. R. Soc.*, 1880, June 10), and of myself ("Influence of Stress and Strain on the Action of Physical Forces, *Phil. Trans.*, 1882, second volume).

HERBERT TOMLINSON.

King's College, Strand, December 4

Intra-Mercurial Planets—Prof. Stewart's 24·011d. Period, Leverrier's and Gaillot's 24·25d., and Leverrier's 33·0225d. Sidereal Periods Considered

As your regular monthly numbers did not reach our Free Library from September, 1881, until comparatively recently, and I was absent from home when they did arrive, it was only quite lately that I had an opportunity of seeing Prof. Balfour Stewart's very interesting paper "On the Possibility of Intra-Mercurial Planets," read at last year's meeting of the British Association, and published at length in your issue of September 15, 1881. "The possibility" has been almost an admitted fact for over a century, but Prof. Stewart's valuable paper discusses the relation of certain sun-spot periods to a probable sidereal period, approximately at least, of an intra-Mercurial planet of 24·011 days.

On looking through your subsequent numbers, I was rather surprised that so suggestive a paper had not elicited quite a discussion, although it is true that Prof. Stewart remarked that "the test was not yet complete," and many may have waited to see the final results, which have not yet appeared, but perhaps will be forthcoming at the next meeting of the British Association. But the first point that struck me, although not referred to by Prof. Stewart, was the near approximation periods of 24·011 days affords to Leverrier's and Gaillot's period of 24·25 days noticed in your columns of August 22, 1878, which M. Gaillot endeavoured to fit to Prof. Watson's observation, in Wyoming State, of a supposed intra-Mercurial planet at 2° 9′ from the Sun, during *the total eclipse*, July 29, 1878. M. Gaillot's difficulty seemed to be to reconcile Leverrier's formula with Prof. Watson's reasonable belief that he saw the planet in the superior part of the orbit, while Gaillot made the formula and interval require it to be in the inferior part of the orbit July 29, 1878. The only interval that Gaillot referred to was from 1750 (January 1, I presume); it might have been obvious, therefore, that quite a small fractional difference in each of so many revolutions would suffice to make the period accord with either condition that Prof. Watson's observation required; namely, *that the planet was seen at 2° 9′ from superior conjunction*, or 2°·9′ *past inferior conjunction*. For instance, I have obtained these two result for the synodical periods. The same interval for both about 46962½ days, requiring 1808¼¼ revolutions of 25·96825104d., each ¼¼ being equal to 11·90211506d.; that accords very closely with Prof. Watson's belief, while 1808¾¼ revolutions of 25·9742355d. each, and 1·08226d. remainder, meet the condition of its being 2° 9′ past the inferior conjunction. Of course, as a matter of opinion, I presume it would be impossible to see the planet so near its inferior conjunction during any total eclipse of the Sun, the planet's crescent being altogether too fine. These results are simply what the conditions require in relation to approximate 26-day apparent-periods, but we must avoid exactly 26 days, or the interval would put the planet at *its elongation*, perhaps apparently 10° from the Sun, and if we tried the Lescarbault interval, from March 26, 1859, 7065¼ days, singularly enough it would put the planet *in the other elongation*. Fractional differences are of course very important therefore. And I do not find either that M. Gaillot's figures 24·25d. for the sidereal time, and 14°·8462 for the diurnal motion exactly accord, and neither fills the conditions required by Prof. Watson's observation, if I am approximately correct, which I think I am. For instance, 14°·8462 diurnal motion, gives us 24·24862928d. for the sidereal periods, not 24·25d., and the synodical period would be 25·9729903466d., and the planet's position would be about 46° 12′ in its orbit past inferior conjunction, or apparently about 8° 24′ from the Sun, and 46° 12′ would be about 3¼ days.

The sidereal period of 24·25 days, makes the diurnal motion 14°·8453608247, and puts the planet at about 6°·8 past inferior conjunction, or apparently less than 1°. The synodical revolutions would be 25·9745626 24d. and fractional remainder ·0188945, or 11h. 46m. 43s., which of course would be too close to the sun. But the sidereal period and the diurnal motion should both agree, instead of producing such a difference as I have here indicated, of nearly 45° in the revolutions. But although I believe we cannot accept the exact published figures, 24·25d., or 14°·8462, still I have shown how near we may make the final results conform to them.

Adopting the same number of synodical revolutions, and practically making the best use of the formula, obtaining 1808¼¼ revolutions, and 1808¾¼. The revolution being 25·96825104d., or 25·9742355d., and the remainders 11·90211506d., or 1·08226. Reduced to clock time they stand as follows: 1808¼¼ being equal to 25d. 23h. 14m. 16·9s. each, and 11d. 23h. 39m. 2·7s. remainder, and 1808¾¼ being equal to 25d. 23h. 22m. 54s. each, and 1d. 1h. 58m. 27¼s. remainder. *The latter is almost absolutely identical* with the periods that would fit the Fritsch and Stark interval from October 10, 1802, to October 9, 1819, 6208 days, or 239 periods of 25d. 23h. 23m. 51s. And from Stark to Lescarbault makes 14,413 days, which would require 555 periods of 25d. 23h. 15m. 53½s., *which affords almost exact identity* with the general mean, placing Prof. Watson's observation in the superior part of the orbit. Thus, then, we have almost positive assurance that Fritsch, Stark, Lescarbault, and Prof. Watson's planet were identical, and that Prof. Watson was correct about it being 2° 9′ from superior conjunction: these interesting facts, giving a record to Lescarbault's planet of 80 years from Fritsch's observance October 10, 1802, to October next. What other "myths" will stand such satisfactory results? I am afraid that Prof. Proctor and some other astronomers have not given the attention to this question that it deserves. But there are a few exceptions deserving credit: M. de la Baume, in Paris, was engaged last year in a classification of reported observed transits, although he did not then draw any inferences respecting apparent revolutions. He regarded Fritsch, De Cuppe, Lescarbault, and Lummis' transits as the same planets, agreeing relatively with the nodes. While Lichtenburg, November 19, 1762, Hoffman, about May 10, 1764, Scott, June 28, 1847, Ritter and Schmidt, June 11, 1855, and W. G. Wright, of San Bernardino, California, October 24, 1876, whose transit was illustrated in the *Scientific American* of November 18, 1876, he regarded as another larger planet than Lescarbault's.

Adopting the same principle with Prof. Stewart's hypothetical sidereal periods of 24·011d., I first find what results that gives, as applied to the same interval from January 1, 1750, and then take the nearest modification I can to the conditions of Prof. Watson's observation. 360° divided by 24·011d. gives us 14°·99312818 for the planet's diurnal motion, which, multiplied by 46,962½ days, gives us 704114°·78215325, from which, subtracting the earth's motion, 46288°·463941, leaves a residue of 657826°·318213, which, divided by 360° gives us 1827·29533 synodical revolutions; using that to divide the 46962½ days, we obtain the synodical periods of 25·700553d. The fractional revolution ·29533 is equal to 106° 19′ 17″, or 7d. 14h. 10m. Now while that would put the planet in the superior part of the orbit, it would still be nearly 60° from where Prof. Watson observed it. I ought to have explained before that 2° 9′, or 2° 10′ apparently, is about equivalent to 15° from *superior* conjunction, or, 15° past *inferior* conjunction in the planet's orbit; 15° from 180°, therefore, leaves 165° as the required position, instead of 106° 19′ 17″. Perhaps I am only approximately correct, but sufficient for illustration. It is very evident, however, that a very slight modification of Prof. Stewart's inferential sidereal periods, 24·011d., would give us the 60° more required, or exact accord with Prof. Watson's observation, and the evidence would be rather in favour of 1827¼¼ revolutions, obtained from such a solar analogy, and may still have an incidental bearing or relation to the Leverrier-Gaillot formula I have construed to require 1808¼¼ or 1808¾¼ revolutions. 1827¼¼ revolutions would give us 25·6982603342 53d. for the synodical periods, and a remainder of 11·778369319 86d. Reduced to clock time, that would give us 25d. 16h. 45m. 29·7s. for each apparent revolution, and 11d. 18h. 40m. 51·11s. for the remainder. It must be understood that these definitions, 1808¼¼ and 1827¼¼, with their results, are intended only to express possible general mean periods of apparent revolutions, and may not exactly apply to any of the intervals between the long list of recorded observations of supposed transits. When Leverrier, October 1876, had strong faith in sidereal periods of 33·0225d., it was probably a general mean from January 1, 1750, to Lescarbault, March 26, 1859, and only approximately fitted Lummis, De Cuppis, Stark, Fritsch, and others, but still in a general sense applied to some of them, while Leverrier was led to predi-

cate a transit, March 22, 1877, which probably did not occur. And yet, viewed in connection with a reported transit, October 24, 1876, seen by Mr. W. G. Wright at San Bernardino, California, and illustrated and fully reported in the *Scientific American* of November 18, 1876, which circumstance Leverrier probably had no knowledge of, was by no means as unsatisfactory as the public imagined; for practically *Wright's transit and Leverrier's hypothetical period mutually confirmed each other.* The *Scientific American* Supplement of August 27, 1881, published some remarks I sent them, which may have reached England. One point I directed attention to was that Leverrier indicated that a conjunction was due September 21, 1876, and I found that there were thirty-three days between that and October 24, 1876, so if Leverrier took 176 synodical periods from Lescarbault to September 21, it was nearly the same thing to take 177 to October 24; but extending the interval to January 1, 1750, there would be much nearer similarity in the synodical periods to accord with Wright's transit, October 24, 1876. I also noticed that the ratio of displacement of the node from Lescarbault and Lummis was 7 days retrograde in 3 years' advance, and on that data, applied to Wright's transit, another transit would be due 11⅝ days earlier in 1881, while Leverrier, in October, 1876, remarked that *for a transit at this node we must wait till about* 1881." My computation made it fall due, therefore, October 12 or 13, 1881, and I was anxious that it might be looked for. The computation made the Hawaiian Islands the most favourable place; but although I believe it was not seen there, nor was it observed from Sacramento or Salt Lake City, where Mr. W. R. Frink looked for it with a 4-inch aperture achromatic telescope, we have no evidence to show whether it might not have occurred in Europe or elsewhere, and been noticed if it had been looked for.

Sacramento, California A. F. GODDARD

[The subject of this communication is a very interesting one, as relating to the possibility of changes on the sun's surface being due in some way to the positions of the various planets of the system. But before this relation can be considered as established, it will be necessary to increase the accuracy of our solar information by collecting our past observations, as well as by securing a set of daily observations for the future.—ED.]

An Extraordinary Meteor

I BEG to send you the following, in case you consider it worth inserting:—At about 1.10 a.m. on the night between November 18 and 19, whilst going in the s.s. *Bokhara* in the Red Sea, about midway from Aden to Suez, the quarter-master on duty called me, saying he had just seen a new comet, or shooting star, which was still visible many minutes after its first appearance. He said that whilst he was looking out ahead, or in a northerly direction, he suddenly noticed the effect of a bright light shining from astern, and on turning round saw a very bright shooting star still moving from left to right, and slightly downwards, in the south, at an altitude of about 40°. The star speedily disappeared, but left a bright train of light behind it, which continued so long (from five to ten minutes he guessed) that he thought I might like to see it. I came on deck a little before a quarter past one by the ship's clock, and found a streak of light which I estimated as 8° or 10° in length, and rather less than half a degree in width, apparently stationary, midway between Sirius and Canopus, and nearly as bright as *the* comet, the head of which must have risen half an hour or more previously. I watched the streak till half-past one o'clock, when it seemed sensibly fainter, though still a conspicuous object, notwithstanding the presence of the moon, the comet, and a number of bright stars. Whilst watching I noticed two small meteors shooting from left to right across the southern sky, which struck me as probably belonging to the same group as the large one whose train I was watching.

At half-past one o'clock I went below, and did not return on deck till 5 o'clock, when the apparition had disappeared. The quarter-master told me afterwards that it had faded away soon after I left the deck, but he believed that from first to last it had remained conspicuously bright for more than half an hour.

Clewer, December 6 B. R. BRANFILL

British Rainfall

I AM just preparing to issue to all the observers of rainfall known to me, blank forms for the entry of their records for the year shortly about to close. This staff now exceeds 2000, but still as they are not unfrequently rather clustered there are many parts of the country where additional records are needed. I have no doubt that records are already kept in many places unknown to me, and I shall be glad if you will allow me to invite communications from any one who has kept an accurate record, and to supply either those already observing or contemplating doing so with a copy of the rules adopted by British observers, and with all necessary blank forms—all, I may perhaps as well add, free of charge, as our greatest requirements are *ample* and *accurate* records. G. J. SYMONS

62, Camden Square, London, N.W.

Swan Lamp Spectrum and the Aurora

IN NATURE, vol. xxv. p. 347, is a description of the spectrum of carbon as found by Professors Liveing and Dewar in a Swan lamp rendered incandescent in the ordinary way. Finding one of these lamps only feebly lighted by ten pint Grove cells, it occurred to me to test it by the secondary current. The coil was nominally a 6-inch spark one, but little battery power was used, and the spark considerably reduced. One wire was connected with the filament holders, the one made into a little coil and laid on the top of the lamp.

The first effect was a fine silver glow filling the lamp, and showing Plücker tube changes when the circuit was reversed. This gave a carbon spectrum of bright lines. Soon, however, the colour of the discharge changed to pink, and the carbon spectrum gave way to a nitrogen banded one. A yellow spark had been noticed where the wire lay on the top of the lamp, and it was evident air had found its way into it.

At one point perforation had taken place by a single spark, while near this the glass was pounded into a sponge-like mass by a series of these.

The sodium lines due to disintegration of the glass were observed in the spark and glow. I was much struck by the rapidity with which, as what was probably only a small quantity of air found its way into the lamp, the nitrogen-spectrum swept away and took the place of the carbon one, a matter which seems to present another difficulty to the favourite theory which makes the aurora, with its bright, sharp unrecognized lines, an electric discharge in rarified air. J. RAND CAPRON

Guildown, November 30

The Aurora

ALREADY we have for the height of the "auroral beam" the varying estimates of 44, 170, 200, and 212 miles, and assuming the correctness of any one of the three last figures, we seem drifting from the improbable to the impossible, for are we not told by Messrs. De la Rue and Müller (NATURE, vol. xxii. p. 24) that while at 81·47 miles' height, the discharge is "pale and faint, at 124·15" *no discharge could pass?* Lest this addition to the aurora's mysteries be for want of definite particulars in the observations, I add mine as nearly as I can—Time 6h. G.M.T. and a few minutes? Altitude of moon above horizon 28°. Distance from moon's centre to centre of beam as it floated *above* 2°, direction east to west (nearly). Lat. 51° 13′ 46″ N., Long. 0° 28′ 47″ W. (observatory).

Guildown, Guildford, December 11 J. RAND CAPRON

Fertilisation of the Speedwell

IF Mr. Stapley, who wrote on this subject in last week's NATURE, can refer to Dr. H. Müller's treatise on the relations between flowers and insects, in the first volume of Shenk's *Handbuch der Botanik* (now publishing as part of Trewendt's *Encyclopædie der Naturwissenschaften*), he will see that his own observations are very similar to those of Dr. Müller. The latter, however, refers to and figures the Germander, not the Common Speedwell. Is it possible that Mr. Stapley—who speaks of the *Veronica officinalis* as having larger flowers than the *V. hederæfolia*, whereas they have flowers of about the same size—mistakes the *V. chamædrys* for the *V. officinalis*?

The insects which Dr. Müller found bending down the stamens, as Mr. Stapley describes, were small Diptera chiefly of the genera *Ascia* and *Melanostoma*. He mentions this also in *Kosmos*, iii. p. 497, and a few pages earlier (*ib.* p. 493) he gives a large drawing of *V. urticæfolia*.

I have not Darwin's book at hand while I write, but does he not mention the Germander Speedwell?

Bedford, December 9 ARTHUR RANSOM

Shadows after Sunset

FIVE years ago my attention was attracted to the phenomenon now under discussion. I was then at San Fernando, and could perceive almost every evening the rosy and blue or black and white rays converging to a point apparently below the horizon. I was able to trace the rays from west to east many times, and frequently also to trace the black or blue spaces to visible prominences in the cumuli in the western horizon, to whose shadows there is no doubt the rays were due, as they swept the sky with such a rapidity; and they were so persistently traceable to the bright bordered cumuli, that even though there were any hills in the direction of the setting sun (which there were not), the phenomenon could not be attributed to them. Besides, I have observed it when off the coast of Portugal, which leaves the hill shadows out of the question, as the observations were made in the (two consecutive) evenings. Though the sky is too cloudy in this part of Spain, by looking at the right place at the right time I have been able to see it many times. The mock sun described by Mr. Rand Capron in the last number of NATURE (p. 102) was seen once by me, but the phenomenon was but little conspicuous. The rays are seldom equidistant.

Naval School, Ferrol, Spain, December 5 PROF. DIER

Complementary Colours

IN connection with recent correspondence in NATURE it may be worthy of remark that I have often noticed the appearance of strong complementary colours in water from contrast-effects, in the case of a wave, breaking on the shore. If the water is properly illuminated so as to be of a decidedly green tinge, the crest of the wave often appears of a delicate pink, and this even in strong sunlight. The purplish hue of cloud-shadows on the ocean is also a familiar example of the phenomenon under discussion. CHAS. R. CROSS

Mass. Institute of Technology, Boston, November 23

An Extraordinary Lunar Halo

I PURCHASED a copy of NATURE of November 30 in the hopes of finding some account of a lunar halo observed by myself and several friends on Saturday night, November 18, about 10.30. Instead of which I find that Mr. Barkas has sent you an account of one seen by him on the following Monday. His description tallies almost exactly with the one seen by me, with the exception of date and hour. Can any of your readers give any information respecting them? S. A. GOOD

751, Wandsworth Road, S.W.

"Lepidoptera of Ceylon"

ALLOW us to correct a slight error in the address of the President of the Royal Society, as reported in NATURE last week. He speaks of the "*completion*" of the "Lepidoptera of Ceylon" having been presented to the Library, whereas it is only the first of the three volumes of that work which is as yet complete. Part vi., being the second part of the second volume, will be ready next week, and the succeeding parts will follow in due course. The error is not very important, but might mislead subscribers and others interested in the work.

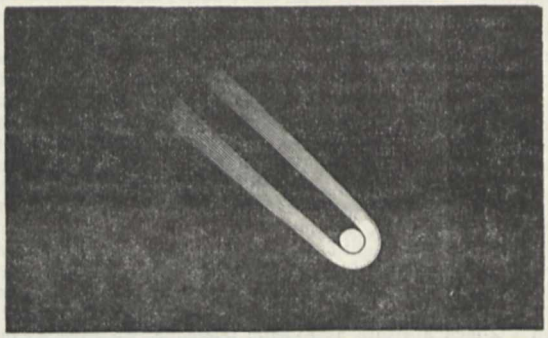
L. REEVE AND CO.

5, Henrietta Street, Covent Garden, London, W.C., December 11

THE COMET

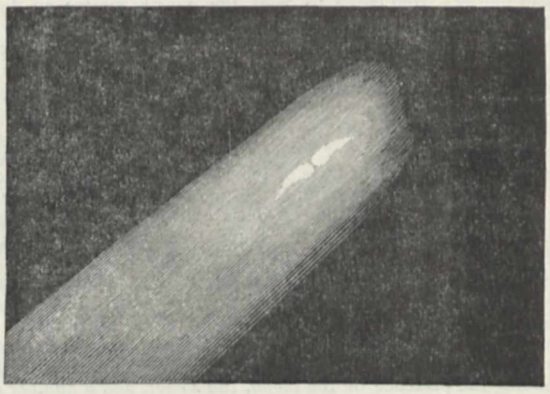
WHEN the comet was first seen on September 16 at 22h. 45m. its appearance was most symmetrical, in colour a most intense white. The sketch shows the appearance on such a scale that the nucleus would have a diameter of about 45″, by a comparison made at the time with a sunspot, the exact size of which has since been kindly furnished by the Astronomer Royal from the Greenwich photographs of the sun. The direction of the comet was to the centre of the sun, as far as could be estimated. On p. 81 of this volume there is a diagram of the sun and the comet; the size of the comet as there given compared with the sun is about as it appeared; and if one imagines the sketch I give, reduced to the length of the sign for the comet on the diagram, and placed some two diameters of the sun to the south-west and *radial*, he will have a good idea of the appearance on the morning of September 17.

The general appearance of the comet has been so fully described that I will confine myself to some points that I have observed with the three-foot reflector, which I did not get to bear, however, till October 29 at 16h. 40m.



September 16, 22h. 45m.

Although the moon was very bright the comet was well seen, the nucleus appearing as an oval bright spot fading into the head gradually (this is called the nucleus in my note-book, but subsequent observations show it ought to be called the bright part of the head). The most noticeable feature of this morning's observation is the peculiar termination to the head; at the n.f. side of head (see sketch for October 30), there was noted an absence of light, while the extension on the south side was particularly noticed, there may have been some extension on the corresponding north side, but I have not recorded it, if so the appearance would then be similar to that in sketch No. 2 (NATURE, vol. xxvii. p. 109). This oblique termination appears in all my sketches made at the telescope. The length of this nucleus or bright part of head was measured as 55″. An absence of stripes in the tail was particularly noticed, if there was a difference the south side was a little the brightest.



October 30, 16h. 50m.

On this morning the brightness of the moonlight had a marked effect on the visibility of the broader part of the tail, so much so that it was easier to trace it in the sky with the naked eye, than with either a binocular, a 3-inch achromatic, or a 3-foot reflector.

The following morning, October 30, 16h. 50m., the appearance of the comet was so altered that either a

remarkable change had taken place, or the details had not been properly made out on the previous morning—the head had become brighter, narrower, and longer, with a decided nucleus, situated a little less than half way from the following end; further examination showed a break in the line of light forming the head, a comparatively dark space splitting it in two, the nucleus being on the border of this space, while a brightening of the head near the other side of this space gave an appearance of another nucleus. The sketch for this date shows the position of these brighter parts or nuclei, and the space between.

A careful measurement at 17h. 41m. gives the pos. angle of the line of light forming head as 115° 5′. The distance of the nuclei was 11″·5, and the width of the head 10″. On November 1, 17h. 18m., the pos. angle of head was 117° 5′, the breadth of the head 11″, and the length 100″, the general appearance being as that given for October 30, excepting that on this morning a brightening is recorded as observed at the extremity of the *following* part of the head, giving a tri-nuclear appearance. Subsequent observations made at intervals (on November 5, 8, 9, 10, and 17) show little deviation from the last sketch. Particular attention has not since been given to eye-observations, as the 3-foot has been used on these dates for photography (with doubtful advantage). The brightness of this comet is, as far as can be judged from a comparison of similar exposures, about the same as the great comet of 1881. One minute gives an image faint, but certain, about 25 minutes' exposure gives an intense image of the head and a trace of the tail; but the result is not at present worth the great trouble it causes. One of the November 9 plates shows the dark space in the head, and this is all that can be said for it; longer exposures without a proper means of following the motion of the comet give only a trail. This however I propose to get over by having motions adapted to the plate-holder and an eye-piece attached to the holder for the purpose of running a second image of the comet, taken out of the cone of rays from the speculum by another diagonal mirror properly placed for the purpose. A. AINSLIE COMMON

Ealing, December 4

IN a clear sky at 4.50 a.m. November 26, not a vestige of the comet was to be seen by the naked eye, though its position was known exactly. On applying a telescope to the spot the nucleus appeared as a round nebula, with four small stars near it; as for the comet's tail, I presume it was "left behind," for no trace of it could be discerned, except by the eyes of the imagination. This is singularly corroborative of the statement that has appeared in these columns, viz. that the moonlight obscures the comet, although it seems to be doubted.

Oxford, December 5 FRANK STAPLETON

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION[1]

X.

26. THE MALAYAN TAPIR (*Tapirus indicus*).—In the present condition of zoological life on the world's surface there is no better instance of discontinuous distribution than that of the Tapirs. While Tropical America contains several species of *Tapirus*, and may be regarded as the *focus* of the genus, a single well-marked species—not, however, sufficiently distinct, even in the eyes of those most fond of inventing new names, for generic separation—occurs in Tropical Asia. This is the Malayan or Indian Tapir, *Tapirus indicus* (sive *malayanus*) of systematists.

The discovery of this Tapir in Sumatra, where it was first met with, though claimed by Cuvier for French naturalists, is undoubtedly due to those of our own country. Marsden described the animal in his work on Sumatra as long ago as 1785, and Raffles obtained a knowledge of it in 1805. In 1818 a living example, captured near Bencoolen, was sent to the menagerie at Barrackpore, and was the subject of a drawing, forwarded to Cuvier by Diard and Duvaneel, which first made the great French philosopher acquainted with the existence of this animal.

The first example of the Malayan Tapir sent to Europe likewise came to this country. It was received in September, 1820, from Sir Stamford Raffles, and was the subject of an excellent memoir by the great surgeon and anatomist, Sir Everard Home, which was published in the *Philosophical Transactions* for 1821.

The Zoological Society of London acquired their first living specimen of this animal by purchase of Capt. Miland in September, 1840. This example died on April 17 in the following year. Although one or two specimens of the Indian Tapir passed through this country at subsequent intervals, it was not until the present year that the Society succeeded in obtaining possession of a second specimen. This was a young individual of the male sex, from which our illustration (Fig. 26) was taken by Mr. Smit in August last. It will be observed that although the large white area which covers the hinder quarters like a sheet, and renders the Indian Tapir so readily distinguishable from all its American brethren, is easily distinguishable in this drawing, the stripes and spots, which prevail in the younger dress of all the Tapirs, are still quite distinct. These disappear altogether when the animal is quite adult, leaving the entire body, with exception of the white back, of a glossy brownish black. The Indian Tapir is further distinguishable from all the American species by the absence of the mane, and by the minute structure of the teeth.[1] Unfortunately the Zoological Society's second specimen did not live to exhibit its adult characters, but died in October last in consequence of a disease of the rectum, which seems often to afflict these animals in captivity.

Besides Sumatra, where the Dutch naturalist, Salomon Müller, found it on the west coast up to a height of 2000 feet above the sea-level, the Malayan Tapir inhabits the interior of Borneo and the Malay Peninsula. There is also good evidence that a Tapir of some sort is found in the south-western provinces of China, which is probably of the same species.

In its native state the Indian Tapir is exclusively an inhabitant of the forest, keeping principally to the vicinity of the rivers and treading paths by following the same routes during its excursions from the banks in search of food. In captivity it becomes very tame and familiar. Dr. Cantor gives us the following account of a young female specimen which was captured in Keddah in 1845, and lived many months at his station in Malacca:—

"From the first, although fresh from its native wilds, this young Tapir showed a remarkably gentle disposition. The daytime it spent in sleeping in a dark recess of the portico of my house, though it would rouse itself if noticed. Towards sunset it became lively, would bathe, feed, saunter abroad, and with its lengthened nose examine objects in the way. Within a few days after its arrival it commenced to exhibit a marked partiality to the society of man, not indeed to its keeper in particular, whom it scarcely had discrimination enough to distinguish, but to anybody who happened to notice or caress it. Towards sunset it would follow a servant on the green in front of the house, and punctually imitate his movements, whether standing, walking, or running. If the man suddenly hid himself, the Tapir would hasten to the spot where it had lost sight of its keeper, look about in all directions, and if unsuccessful in discovering him, express its disappointment by a peculiar loud whistling. On the reappearance of the man, it expressed its pleasure

[1] Continued from vol. xxvi. p. 606.

[1] *Cf.* Tomes in *Proc. Zool. Soc.*, 1851, p. 121.

by rubbing its side against his legs, running between them, occasionally giving out a short singular sound, resembling that produced when the larger woodpeckers tap the trees, but more sonorous. When of an evening it heard the voices of people in the verandah above the portico, it exhibited strong marks of impatience till let

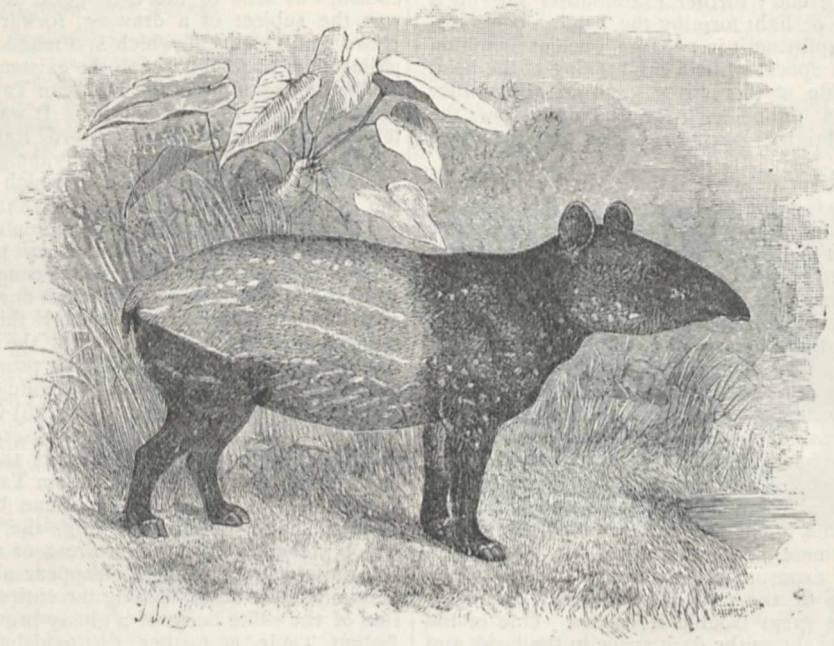


FIG. 26.—The Malayan Tapir.

loose, when of its own accord it would, awkwardly enough, ascend a flight of stairs leading to the verandah. It would then quietly lie down at their feet, and by stretching its limbs and shaking its head, express the

FIG. 27.—The One-wattled Cassowary.

satisfaction it derived from being caressed, and it was only by compulsion that it could be made to leave the company. Its food consisted of plantains, pine-apples mangustins, jambu, leaves of *Ficus pipul*, sugar-cane, and boiled rice, of which latter it was particularly fond, if mixed with a little salt. Its drink was water and also

milk and cocoa-nut oil, which latter taste the Tapir possesses in common with the O'rang-'utan. It delighted in bathing, and was otherwise cleanly.

27. THE ONE-WATTLED CASSOWARY (*Casuarius uniappendiculatus*).—The Cassowaries of the Moluccas and Papuan Islands, together with the Emeu of Australia, constitute a very well-marked division of the Struthiones, or ostrich-like order of birds, and occupy a large area of the Australian region. But while the Emeu (*Dromæus*) is spread over the whole of the Australian continent, the Cassowary is only met with in the northern parts of Queensland and in the peninsula of Cape York, and we must cross Torres Straits into New Guinea and its adjoining islets before we arrive at the true metropolis of the Cassowaries. Here we shall find them scattered over the different islands to the number of nine, as indicated in Count Tommaso Salvadori's recent essay on the group,[1] and but one, or at most two species being ever found exactly within the same area.

A characteristic of the Cassowaries is the large horny casque which covers the head, and is devoid of feathers. In one division of the genus this is much elevated and laterally compressed, in the other the casque is pyramidal in shape, and flattened cross-ways behind. The One-wattled Cassowary belongs to the second division, and is further distinguished by having (in common with its near ally *C. occipitalis*) but a single wattle in the middle of its throat.

This Cassowary was first made known to science in 1860 by Blyth, from an example brought alive to Calcutta, of which the exact origin was uncertain. It has, however, since been ascertained that it inhabits the Island of Salawatty, and adjacent western portions of New Guinea, where the naturalists Bernstein, v. Rosenberg, D'Albertis, and Beccari, who have visited these districts, have obtained specimens. Like other members of the group, it is a forest-hunting bird, living principally on various fruits, but also occasionally indulging in such animal food as lizards, fishes, and insects.

Our figure of this Cassowary (Fig. 27) is taken from a nearly adult individual of this fine species, now living in the Zoological Society's Gardens, which was obtained by purchase in July last.

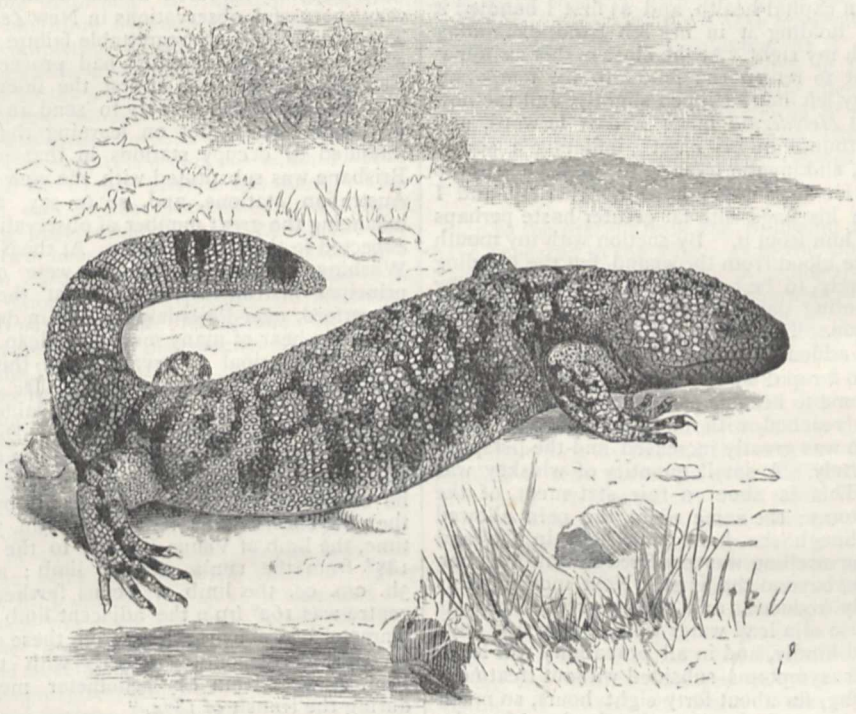


FIG. 28.—The Sonoran Heloderm.

28. THE SONORAN HELODERM (*Heloderma suspectum*).—Lizards, as a general rule, are perfectly harmless animals, whose only object when approached is to get out of sight as fast as possible. In almost every country, it is true, some sorts of lizards have a dreadful reputation amongst the ignorant. The Slowworm, in England, and the Gecko, in India, are alike reputed to be highly venomous, but naturalists well know that there is not the slightest foundation for these fancies, and that both these little creatures are, in fact, quite innocuous. It was, in fact, until within a comparatively recent period, the generally received opinion among the best authorities, that no member of the Lacertilian order was really venomous. It is only within the last few years that the evil reputation which certain lizards of Mexico and the adjoining districts of the United States have long borne among the natives of those countries, has been confirmed by an accurate examination of their teeth, and the conclusion thus forced upon us that at least one form of lizard is endowed with the faculty of producing a poisonous bite. The possesssors of these formidable weapons of defence are the members of the genus *Heloderma* of naturalists, one species of which was long ago described from Mexico under the appropriate name *Heloderma horridum*. It has been shown by MM. Dumeril and Bocourt in France, and Dr. J. G. Fischer in Germany, that this lizard has not only grooved teeth, after the manner of many of the poisonous serpents, but likewise highly developed salivary glands, which issue at the bases of the teeth with the evident purpose of carrying the poisonous saliva into the grooves. It has been likewise shown by the evidence of careful observers that the bite of the *Heloderma horridum* is fatal to small mammals and birds, and highly injurious to man, although not perhaps under ordinary circumstances capable of inflicting a fatal wound.

[1] "Monographia del gen. Casuarius, Briss. Per Tommaso Salvadori." (*Mem. R. Acc. Sc. di Torino*). Ser. ii. tom. xxxiv.

The same seems to be nearly the case with a second species of *Heloderma*, *H. suspectum* of Cope,[1] a portrait of which we give (Fig. 28) from a fine specimen recently added to the Zoological Society's collection. Experiments made with this animal have shown that it is sufficiently venomous to kill a small guinea-pig, and, as hereafter shown, there is no doubt that its bite inflicts serious injury upon any one handling it carelessly.

The Sonoran Heloderm, or "Gila Monster," as the inhabitants of Arizona call this reptile, is one of the largest lizards in North America, and is found all through New Mexico, Arizona, and Texas. It inhabits the sandy deserts of that arid land, and is said to be a wonderfully striking object as it darts about the rocks, and shows its brilliant armour of jet black and orange scales. In a recent number of the *American Naturalist*. Dr. Shufeldt gives the following account of his experiences with one of these "monsters":—

On the 18th inst, in company of Prof. Gill, of the Institution, I examined for the first time Dr. Burr's specimens of the Heloderm, then in a cage in the Herpetological Room. It was in capital health, and at first I handled it with great care, holding it in my left hand, examining special parts with my right. At the close of this examination I was about to return the fellow to his temporary quarters when my left hand slipped slightly, and the now highly indignant *Heloderma* made a dart forward, and seized my right thumb in his mouth, inflicting a severe lacerated wound, sinking the teeth in his upper maxilla to the very bone. He loosed his hold immediately, and I replaced him in his cage with far greater haste perhaps than I removed him from it. By suction with my mouth I drew out a little blood from the wound, but the bleeding soon ceased entirely, to be followed in a few moments by very severe shooting pains up my arm and down the corresponding side. The severity of these pains was so unexpected, that added to the nervous shock already experienced, and to a rapid swelling of the parts that now set in, it caused me to become so faint as to fall, and Dr. Gill's study was reached with no little difficulty. The action of the skin was greatly increased and the perspiration flowed profusely. A small quantity of whiskey was administered. This is about a fair statement of the immediate symptoms: the same night the pain allowed of no rest, although the hand was kept in ice and laudanum, but the swelling was confined to this member alone, not passing beyond the wrist. Next morning this was considerably reduced, and further reduction was assisted by the use of a lead water wash. In a few days the wound healed kindly, and in all probability will leave no scar; all other symptoms subsided without treatment beyond the wearing, for about forty-eight hours, so much of a kid glove as covered the parts involved. After the bite our specimen was dull and sluggish, simulating the torpidity of the venomous serpent after it has inflicted its deadly wound, but it soon resumed its usual action and appearance, crawling in rather an awkward manner about its cage."

The specimen of the Sonoran Heloderm in the Zoological Society's Garden's Reptile House was presented to the collection in July last by Sir John Lubbock, Bart., F.Z.S., by whom it was received from Mr. G. A. Treadwell, of the Central Arizona Mining Company, of Vulture, in Arizona territory. There was much difficulty at first experienced in getting the reptile to take food. After articles of diet of various kinds had been presented to it, and successively refused, it was found that small hen's eggs were sufficiently attractive to induce it to break its fast. Since then the Heloderm has grown less dainty, and has actually condescended to take a small rat, though it prefers eggs to any other kind of food. It may be remarked that it is difficult to conjecture of what use venom can be to an egg-eating lizard.

[1] Described in. *Proc. Acad Sc. Phil.*, 1869, p 5.

It may be added in conclusion that Dr. Steindachner, the well-known herpetologist of Vienna, has recently described and figured a new form of lizard from Borneo,[1] under the name *Lanthanotus borneensis*, which is nearly allied to *Heloderma*, and has similarly grooved teeth. It would be of great interest to know whether the Bornean lizard has likewise venomous qualities.

THE TRANSIT OF VENUS

A VERY fair amount of success appears from the telegrams to have attended the British expeditions for the observation of the late transit of Venus. In Jamaica Dr. Copeland and his colleague secured all four contacts; at Barbados Mr. Talmage, though he lost the first external contact, observed the other three; we have no intelligence yet from the station at Bermuda, occupied by Mr. Plummer, nor, of course, from the expedition on the west coast of Madagascar. At the Cape the observers were similarly favoured by the weather, and we hear of very successful observations in New Zealand by Colonel Tupman. The only regrettable failure was at Brisbane, whither Capt. Morris, R.E., had proceeded, with Mr. C. E. Peek. It had been at first the intention of the Committee of the Royal Society to send an expedition to the Falkland Islands, but on learning that other countries intended to occupy stations in that part of the globe, Brisbane was substituted with the view to strengthen the Australian stations, and, so to say, assist in counterbalancing the great number of observations that might be expected in the United States. At the Naval Observatory, Washington, all four contacts were observed with the principal instruments, as also at the Observatory of Haverford, near Philadelphia, and in due course we shall doubtless hear of many more American successes.

At the principal observatories in this country little or nothing was seen of the transit. Dr. Ball, so far as we are aware, was most successful at Dublin; though he did not secure either contact at 2h. 37m. Dublin time he was able to commence a series of measures of distance of the outer and inner limb of Venus from the sun's limb, which he continued to 3h. 3m. He found by calculation from the time observations that at 2h. 43m. 30s. Dublin mean time, the limb of Venus nearest to the sun's centre was 188″ from the sun's nearest limb; and also, that at 3h. om. os. the limb of Venus furthest from the sun's centre was 162″ from the adjacent limb of the sun. The diameter of Venus resulting from these observations is 64 seconds, corresponding exactly with that deduced by Prof. Auwers from his heliometer measures at Luxor, during the transit of 1874.

On comparing the times calculated from the elements of the transit which have been adopted in NATURE when referring to the phenomenon with those telegraphed to the *Times*, as having been noted by two observers at Washington, and one at Haverford, the following differences between calculation and observation are shown:—

		Washington.		Haverford.
		Frisby.	Sampson.	
		s.	s.	s.
Contact	I. ...	−80 ...	+16	−41
,,	II. ...	+13 ...	+ 3	+33
,,	III. ...	+21 ...	−38	−29
,,	IV. ...	+80 ...	+38	+19

Mr. Neison observed the first external contact at Durban at 3h. 54m. 41s. local mean time; if we assume his longitude to have been 2h. 3m. 30s. east, the difference of the calculated time would be −15s. The view from the observatory there was almost perfect. The conditions were, cloudless sky, but the air was unsteady.

Mr. Marth, writing on November 21, places his

[1] *Denkschr. k. Ak. Wien.*, xxxviii p. 95 (1878).

station at Montagu Road, Cape Colony, in longitude 20° 3′ E., with 33° 20′ south latitude. At the date of his letter he was fearful that one of the whirlwinds of sand and dust of which he had had much experience might at the last moment spoil all. The heat during the day was overpowering, but at night he was in need of his winter overcoat. The transit observations, however, were very successful.

The following telegram from Mr. Talmage, chief of the British party at Barbados, was forwarded to the *Times* by Mr. Stone :—"Internal contact at ingress, and internal and external contacts at egress were well observed." The observers were Mr. Talmage and Lieutenant Thomson, R.A. On this the *Times* remarks :—

"The observations at ingress will combine with those made at the Cape and those at egress with the Australian and New Zealand observations. An official telegram received from Captain Morris, R.E., confirms that from Mr. Peek, announcing a complete failure at Brisbane. Lieutenant Darwin, R.E., who accompanied Captain Morris, will, before returning to England, determine the difference of longitude between Point Darwin and Singapore, thus completing a connection between the Australian and English longitudes. Information has now been received from all the British stations with the exception of Madagascar and Bermuda.

"From the Paris telegram it will be seen that no news is expected from the Patagonian stations for about a week, and it is feared that the Chilian mission has failed. The Russian, Austrian, and Italian Governments have sent no parties out for observation of this transit; but the former have lent two heliometers to MM. Perrotin and Tisserand, and an equatorial to Dr. Pechüle, who has been sent to St. Thomas by the Danish Government. Spain has sent two parties to the Havannah and Porto Rico ; these are provided with instruments of the same class as those of the British parties.

"Many observers have noticed the phenomenon known as the 'black drop,' and in some cases a grayish light, probably similar to that seen by Winthrop in observing the transit of 1769 at Cambridge, U.S., the American observers appear to have specially looked for traces of a satellite of the planet but could see none. A very curious phenomenon was seen by Prof. Langley and others observing at the same station. When half the planet was on the sun's disc a small patch of light appeared near the limb outside the sun ; it extended for about 30 deg. along the limb, and was totally distinct from the luminous ring seen surrounding the planet by Prof. Langley and several other observers at different places. Spectroscopic observations were taken at several places in the United States ; the spectrum showed some strange lines, and a watery vapour was suspected in the atmosphere of the planet. With regard to the observations made by M. Janssen at Oran, no details have been received, but it would appear that they are likely to prove of considerable value, and will add to our knowledge of the physical condition of the planet.

"The phenomenon of the 'black drop' takes place at the contacts of the limb of Venus when the planet last touches the sun's edge at entry on, and first touches when about to pass off, the disc ; it has been noticed by some observers at all preceding transits which have been observed, while others have noticed a brown or greyish ligament joining the limbs of the sun and planet. The atmosphere of Venus was remarked by Hirst, who observed the transit of 1761 at Madras, and subsequently by other observers. When part of the planet has entered on or has moved off the sun, a ring of light has been seen surrounding Venus ; this arises from the reflection of the solar light on the atmosphere surrounding the planet. This ring of light was noticed during the transit of 1761, and has been seen at all those of 1769, 1874, and on Wednesday. The phenomenon observed by Prof. Langley has not been observed at previous transits, and is probably due to some local causes. This is the only phenomenon mentioned in the accounts received which has not been previously noticed."

Under date December 12, Mr. Stone sends the following to the *Times* :—I have received the following telegram from Mr. Plummer, at Bermuda :—"Ingress well observed. Egress observed amid clouds." The telegram probably indicates that the observations at egress are not of much value. The egress, however, appears to have been better observed than the ingress at some of the American stations, and there will be plenty of observations of accelerated egress to balance the observations which will be available of retarded egress for New Zealand and Australia. Reports have now been received from all the British stations except Madagascar, which is a most important ingress station, and from Captain Wharton, H.M.S. *Sylvia*. Captain Wharton has two good telescopes, and will have established his party somewhere on the South American coast, where he may, if the weather was favourable, have observed both the ingress and egress, but with small factors of parallax. These observations, if secured, would however be very valuable, as a check upon the results obtained from the discussion of the observations at stations where the time is largely affected by parallax. We are not likely to hear any news of the Madagascar expedition for some weeks. The British expeditions have, on the whole, been most successful, and a valuable result is assured.

Up to the present time the following additional details have appeared in the *Times* as to the observation of the transit at home and abroad. At home the meteorological conditions were generally unfavourable :—

At Greenwich Royal Observatory the Astronomer Royal had made considerable preparations for observation, and shortly before two o'clock the whole of the staff were at their instruments, ready to take advantage of even a break in the clouds ; but unfortunately the dense stratum of cloud which lay beyond the occasional rapidly passing patches of scud prevented even the sun's position being discerned. Arrangements were made for taking a number of photographs, a photoheliograph having been specially erected to view the sun until it reached the horizon. At the Radcliffe Observatory, Oxford, Mr. E. J. Stone had made considerable preparations for observation, but the sun was only visible for about five seconds, when the planet was seen on the solar disc, well separated from the limb. At Bath the haze which was prevalent during the morning cleared away, and the transit was visible till sunset. In South Wales the sky was clear until shortly before sunset. At Penzance, Plymouth, and Cork the sky was cloudless. Mr. J. Burns, at the Castle, Wemyss Bay, observed the external contact at 2h. 6m. 38s., and internal contact at 2h. 20m. 32s. (Greenwich mean time). The Rev. W. S. Lach-Szyrma, at Penzance, saw the transit from the time of contact to sunset ; the black drop was clearly seen.

The astronomers at Potsdam succeeded in taking good photographs of the transit. In France, no observation could be made. At Paris, Bordeaux, Grenoble, Lyons, and Marseilles it was cloudy. MM. Thollon and Gouz, in Portugal, could also take no observations. M. Dumas received telegrams giving the main results of the observations of the transit in Oran, Martinique, and Mexico. In Martinique, M. Tisserand detected the first contact of the planet and the sun, but unfortunately he had scarcely commenced recording his observations when a cloud came over and concealed the rest of the phenomenon. At Puebla, on the other hand, M. Bouquet de la Grye had an unmixed success. The entire transit was visible, and he was able to take observations for deter-

mining the parallax. He will now, of course, work out these calculations, which promise to be amongst the most important of all the observations. At Oran M. Janssen was likewise favoured with sunshine. He was not commissioned by the Academy, but made spectroscopic observations on his own account. In this department he seems to have admirably succeeded, having obtained capital photographs 30 centimetres in size. He telegraphs that he has not only taken excellent photographs, but that he has further been able to observe atmospheric phenomena. As to Col. Perrier, who was posted in Florida, the French Foreign Office have received a telegram reporting full success, but giving no details. No telegrams from the missions in Patagonia, Chili, and Port-au-Prince have as yet been received. In short, of the results thus far known only observations in Mexico and Florida for the calculation of parallax, and those of Oran with the spectroscope seem to have been successful.

The transit was observed at many places in the United States. Special observations were made at the Observatory of the Central High School of Philadelphia by Professors Snyder and Ritter. The weather was favourable, but clouds obscured the sun during part of the time that Venus was crossing the sun's disc. The sky was cloudy all day. All four contacts were observed, and the last two well observed. The weather was not so favourable for the observation of the first two. The planet was seen off the disc at first, and in the fourth with a ring of light frequently visible. While the exact time has not yet been computed, it is known that the first two contacts were in advance of the ephemeris. Prof. Snyder says that just at or before the first contact the planet was projected on the chromosphere. The point where this occurred was verified by a notch of the advancing planet. As Venus approached the second contact a bright luminous horn darted out from the sun round the planet, but not encircling it, being only visible on one side. The same thing was also visible at the third contact. Just before the second contact the edge still off the sun was illuminated by a most beautiful hazy ring of light, seeming to have a sensible breadth. During the second contact the ligament phenomenon was visible, but not so markedly as it was observed in the case of the transit of Mercury in 1878. Just preceding and during the second contact the atmosphere was hazy, but the phenomena were well observed nevertheless. The weather at the third contact was much better, and the ligament phenomenon was not noticed, though a faint obscuration of the luminous line existed just before the geometrical contact, the latter being well observed. After the third contact the horn appearance again came, there being several times noticed evidences of a ring of light. At the last contact, and after the notch had disappeared, the planet seemed to linger off the edge of the sun. The Philadelphia observations of all four contacts are considered to have been successful. A snowstorm prevailed in Canada and the Northern portion of the United States, seriously interfering with the observations elsewhere. But successful views of at least part of the contacts are reported from Ottawa, Albany, Howard University, near Boston; the Naval Observatory, Washington; and the Johns Hopkins University, Baltimore.

Prof. Sharpless, posted at Haverford College Observatory, near Philadelphia, reports the Washington mean time of the contacts as follows:—First contact, 9h. 56m. 5s.; second contact, 9h. 15m. 49s.; third contact, 2h. 39m. 43s.; fourth contact, 2h. 59m. 51s.

At the Washington Naval Observatory the observers slightly differ in the times recorded for the contacts. Prof. Frisby, who had a six-inch equatorial, reports that the first contact occurred at 8h. 56m. 45s.; the second contact at 9h. 16m. 9s.; the third at 2h. 38m. 57s.; the fourth at 2h. 58m. 55s. Prof. Sampson, with a nine-inch equatorial, reports the first contact to have happened at 8h. 55m. 9s.; the second at 9h. 16m. 19s.; the third at 2h. 39m. 56s.; the fourth at 2h. 59m. 37s.; the time of the fourth contact is somewhat uncertain, owing to the prevalence of clouds. Washington mean time was used. Fifty-three photographs were taken during the transit. The professors report that their labours were generally successful, and that if other stations were equally fortunate the result ought to be computed within two years.

Successful observations were made at Yale College, Newhaven, and also by Professor Draper in New York, who got good photographs. The French Astronomical Commission succeeded, at St. Augustine, Florida, in taking 200 photographs. Partially successful results were obtained by the Belgian Commission at San Antonio, in Texas, where 204 photographs were taken of the later phases, the first two contacts being lost. Fully successful observations were made at San Francisco, with 48 photographs; and partly successful ones at Cedar Keys, Florida, where the first contact was lost, while the other three were well observed.

One hundred and eighty photographs were successfully taken by the German Commission at Hartford, Connecticut. They failed to observe the first contact, but afterwards got eight full sets of heliometric observations, which made all they desired, and which they consider very satisfactory. No trace of a satellite was visible. Partly successful results were further obtained by the Germans at Aiken, South Carolina, where they lost the first two contacts, but got three sets of heliometric measurements in the afternoon.

At the Harvard College Observatory spectroscopic observation showed no perceptible absorp-tion of the sun's light by the planet's atmosphere.

Telegrams announce a complete success in New Zealand, Panama, New Mexico, Jamaica, and some parts of Australia. In New Zealand, England was represented by Colonel Tupman and Lieutenant Coke, R.N., both observers in 1874. The observations of the transit are described as very successful, and Colonel Tupman expected that the observations for determination of the longitude would be complete by Sunday last. The United States party, under Mr. Edwin Smith, observed at Wellington, and were successful in taking two hundred and thirty-six photographs. Of the Australian stations perfectly successful observations were secured at Hobart Town (Tasmania), Wentworth (New South Wales), and in South Australia. At Adelaide the transit was slightly obscured by clouds, but no information to hand states whether the contacts were observed or not. In Queensland no success was obtained. Mr. Russell at Sydney arranged to provide about ten observers at lofty stations along the east coast; heavy rain fell in Sydney and Gippsland, but it is probable that observations have been secured by some of the observers, although no success was obtained at the Sydney Observatory. At Melbourne observations were secured, and twenty-three photographs taken. The Government of Victoria provided for two or three stations respecting which no information has been received, but judging from the state of the weather in Melbourne, there is a probability of success.

We have received the following communications on this subject:—

IN a communication from the observatory of the Collegio Romano we are informed that the observations of the transit at Rome were quite successful, although the sky a few minutes before contact was cloudy. Signor Tacchini observed the contacts with the grating spectroscope applied to a Merz refractor of 25 c., and M. Milloseisch simply used a Cauchoix refractor of 15 c. in the ordinary way. In the morning, Signor Tacchini,

was able to make his usual spectroscopic observations on the limb of the sun, and he saw that on that part of the limb at which the first contact would take place, the chromosphere was regular, but composed of very active flames, and two protuberances bounded the section (*trait*) of the chromosphere, on which the planet might be looked for before the first external contact. In fact, Signor Tacchini, at 2h. 24m. 33·8s. mean Roman time, saw the edge of the planet on the sharp points of the chromospheric planes He continued to see very clearly the planet advance towards the base of the chromosphere, and he observed the first external contact at 2h. 48m. 54·43s. Afterwards he watched the complete reappearance of the chromosphere, and then he noted the first internal contact at 3h. 9m. 34·79s. The image of the chromosphere was always very well preserved, and the size of the planet projected upon it always very clear. Prof. Milloseisch observed the contacts at the following times :—First external contact, 2h. 49m. 48·14s.; first internal contact, 3h. 9m. 29·34s., for the moment of the appearance of the black drop, and 3h. 10m. 10·14s. for the moment of the disappearance of the drop. Between the times noted by the two observers for the first contact, the difference amounts to 94 seconds, which clearly proves the great advantages of making use of the spectroscope. Shortly after the first contact, Prof. Milloseisch perceived for the first time the presence of the planet's atmosphere, verified by Signor Tacchini and his assistant. Signor Tacchini even observed in the spectroscope the phenomenon of absorption by that atmosphere, as in Bengal in 1874, and even at Palermo something of the same kind has been seen. MM. Tacchini and Milloseisch did not see the entire planet before the first contact. The atmosphere of the planet was more active near the edge of the sun. Prof. Milloseisch estimates the height of the atmosphere of Venus at one-fourteenth of the planet's diameter. Signor Tacchini found the diameter of Venus to be equal to 67″·25.

I HAD the advantage of seeing here yesterday the transit of Venus, under exceptionally favourable circumstances, by means of a very simple and ingenious apparatus fitted up by my cousin, Mr. J. Campbell, of Islay. The image of the sun was thrown from a small telescope, properly focussed, upon a large sheet of cardboard paper, in a dark room. The size of this solar image was a little more than two feet in diameter. Upon this image the solar spots and some brilliant "faculæ" were very distinctly visible. As the time approached, Mr. Campbell expected that we might see the planet whilst yet some little distance from the illuminated edge of the sun, owing to the atmosphere of the planet catching and reflecting some solar light before the apparent contact. I believe Mr. Campbell had seen this on the occasion of the transit, in the clearer atmosphere of Japan. Here, none of the party could detect the planet before its disc began to impinge on the edge of the sun. But when the planet's disc had advanced about one quarter of its own diameter upon the solar image, then a faintly luminous ring was distinctly seen defining the rest of the planet's disc, in the darkness out of which it was moving. For some time I was incredulous as to this appearance; but before one half of the planet's disc had crossed the illuminated edge of the sun, the luminosity of the other side of that disc was too distinct to be doubted, and the appearance was very striking and beautiful. I may mention that the size of the planet's disc was, as nearly as possible, seven-tenths of an inch. The time of contact was exactly 2.28 p.m.

Cannes, December 7 ARGYLL

AT 1h. 48m. 28s. Dunsink mean time, I first saw the sun through an opening in the clouds. Venus was at once seen (in the finder of three inches aperture attached to the south equatorial), and was estimated to be about one-third of the way on the sun. But the snow and clouds again intervening, there was nothing more to be seen until 2h. 37m. 19s., when I was enabled to commence a series of micrometric measures with the large instrument. I used a polarising eye-piece and a power of 177 with the Piston and Martin filar micrometer. The limb of the sun was boiling furiously, and Venus was often of any shape but a circular disk. The measures were consequently by no means easy. I set one wire tangentially on the sun's limb, and the other on that of Venus. Altogether I was able to make sixteen of such sets, nine being made with the limb of Venus nearest the sun's centre and the remainder with the other limb. The following are the results :—

Dunsink mean time.	Far limb of Venus.	Near limb of Venus.
h. m. s.	″	″
2 37 19	171	—
39 24	177	—
40 42	185	—
42 18	187	—
44 13	191	—
45 20	190	—
46 22	198	—
48 17	196	—
52 16	—	142
54 16	—	149
55 36	215	—
58 17	—	161
59 36	—	164
3 0 46	—	161
1 41	—	164
2 51	—	170

These results have not been corrected for refraction.

I conclude from the mean of the first series that at 2h. 43m. 30s. the far limb of Venus was 188″ from the limb of the sun, while at 3h. 0m 0s. I conclude from the second series that the near limb of Venus was 162″ from the sun. By a projection of the results it is easy to see that the diameter of Venus must have been 64″.

My assistant, Mr. Rambant, was observing with the small equatorial, which is 78 metres from where I was observing. He reports as follows: "At 1h. 45m. the clouds, which up to that time had obscured the sun, cleared away, and I saw the planet with about one-half of its disc projected on that of the sun, but a snow-shower coming on almost immediately, I was unable to perceive any trace of light round Venus, or even to follow its outline beyond the limb of the sun. By the time the snow cleared away the internal contact was passed, and Venus appeared at about twice of its own diameter from the sun's limb; the sun's light appeared of great brightness right up to the dark disc of the planet except at the northern limb, where I suspected a dark brown fringe, but the boiling was such that I could not be certain of this.

R. S. BALL,
Astronomer Royal of Ireland

Dunsink Observatory, Dublin

THE transit of Venus was well seen at this observatory owing to the unusually favourable state of the weather. I observed it in the Markree refractor with an aperture reduced to five inches. I did not meet with any difficulties and saw no "black drop," perhaps because I had focussed the eyepiece on double stars the night before. Owing to the boiling of the sun's edge, I did not see Venus till 1h. 27m. 38s., external contact having taken place previous to this. I then measured the distance between the cusps micrometrically, and from a provisional reduction of these observations it appears that Venus was bisected at 1h. 37m. 53s. The internal contact was first noticed at 1h. 46m. 40s., when a fine line of light appeared at the outer edge of Venus. At 1h. 47m. 58s. the cusps

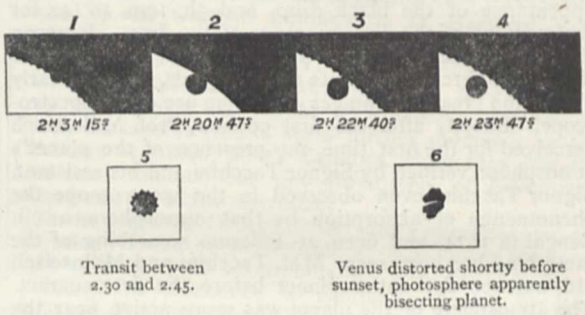
met for an instant, but did not unite permanently till 1h. 48m. 28s. (Markree mean time). Venus was visible on the sun till sunset. I measured its semi-diameter =29″·07. W. DOBERCK

Markree Observatory, December 7

THE ingress of Venus was observed at the Armagh Observatory under very favourable circumstances. I employed the 15-inch reflector in the Newtonian form with an unsilvered flat mirror and a negative eyepiece (power 140) and glass wedge. With an aperture of eleven inches the sun's limb was "boiling" considerably, so that I missed the exact moment of external contact; but having reduced the aperture to seven inches, the internal contact was very well seen. At 1h. 49m. 31s. local M.T. the whole circumference of Venus could be seen; at 1h. 54m. 49s. I saw a faint shade-like object between the cusps, which broke at 1h. 55m. 24s., when a very thin bright line separated Venus from the sky outside; 27s. afterwards the interval was very conspicuous. Rev. Ch. Faris, assistant astronomer, observed with the 4-inch finder attached to the same instrument, and every care was taken to make the two observations independent of one another. He observed external contact at 1h. 35m. 34s., and saw the cusps meeting at 1h. 55m. 10s. without observing any disturbance of the limb. Good determinations of time were obtained on the previous and following evenings. J. L. E. DREYER

Armagh Observatory, December 9

THE all-important 6th of December, 1882, will long be remembered by us in Lochaber, who had eagerly looked forward to a sight of the transit of Venus. Our hopes were realised to the full, and considering our somewhat high latitude, we were privileged indeed. An account of the meteorological conditions will be of introductory interest. A barometric depression had two days previously travelled down from the vicinity of the Faroe Islands, bringing overcast weather and rain—very discouraging—but the mercury rapidly rose in its rear on the night of the 4th, light north-easterly winds set in, the sky cleared on the 5th, and free radiation, and a hard frost followed with charming winter weather. At 9 a.m. on the 6th the barometer, corrected and reduced to 32° F. and mean sea-level read 29·677, and was steady, dry bulb 27·3, iced bulb 26·1, giving a vapour tension of ·112, relative humidity 76 per cent., and a dew point of 20·9. Light airs were noted from north-east by east, and some pieces of innocent-looking cumulus clouds were observed. Browning's spectroscope, soon after 9 a.m., showed an entire absence of rain-band to the left of the D line, in the solar spectrum, but a broad telluric band stronger than usual was observed on the right of D; this, however, did not much distress me. The meteorological conditions generally continued much the same, the weather being very fine. When the hour for the beginning of the transit drew nigh, I repaired to a field adjacent, entirely open to south-west, with telescope and sketching equipment. Here an uninterrupted view of the sun could be obtained. The instrument employed has a clear aperture of 2¾ inches, object-glass of first quality by Dancer of Manchester, power used 70. A few clouds near the sun about 1.53 caused anxiety, but they soon cleared off, and a perfect and continuous view of the sun was obtained. Two good watches and clock were set to Greenwich mean time, obtained with all possible accuracy from post-office signal in the morning. Considering the sun's low altitude, the thick stratum of atmosphere traversed by the oblique rays, tremors of the air, and effects of atmospheric refraction, the phenomenon of the ingress was well observed in the telescope. The external contact, when the dark body of Venus just indented the sun's limb, south-east by south, took place at 2h. 3m. 15s. Greenwich mean time (see sketch No. 1), by 2h. 13m. 0s. the half of the planet was upon the sun; sketch numbered here 2 (several others not now given were taken) was made just before the internal contact; and at 2h. 22m. 40s. I noted the internal contact. At this time (sketch No. 3) I observed the ligament joining the edges of Venus and the sun, like the thread between two drops of water when about to part, and the planet was much in shape as an apple with the stem joining on to the edge of the solar orb. At 2h. 23m. 47s. (sketch No. 4) Venus was as a round black spot upon the sun, and clear of his edge, and a narrow streak of light intervened. By this time friends had gathered around, and as the chief observations had been made they were enabled to take turn at the instrument and watch the progress of the planet in its course across the sun's disc, until a mass of cumulus cloud at 2.45 put a stop to observation. The outline of Venus against the sun was very irregular (sketch No. 5). Mr. Colin Livingston, of the public schools, also observed the ingress independently, and we agree to the very second that the internal contact took place 19m. 25s. after the external contact. The sun's



The Transit of Venus (Ingress) as observed by Clement L. Wragge.

photosphere by the way was almost wholly free from spots. Just a stippling was observed a little west from the centre, and a small disturbance was noted in perspective near the eastern limb—in marked contrast with the great spot regions well observed here on November 16, and now probably existing in the opposite hemisphere. The sun's edge was very uneven, as I have attempted to show in the sketches. The highest temperature during the day, it is worthy of mention, was only 30·9, and pressure remained fairly steady at a mean of 29·670 at sea-level. Views of the transit were again obtained before sunset, but the intensity of refraction near the horizon so distorted both the sun and Venus—the former being like an egg in shape, and the latter at times as shown in sketch No. 6—that I could but wistfully watch them go down together on a gorgeous sky behind the snow-clad heights of Beinn na Cille, envy our cousins in the west their sight of the egress, and wonder under what strange circumstances the next transit will be observed in the year of our Lord, 2004. CLEMENT LINDLEY WRAGGE

Fort William, December 10

THIS rare phenomenon was well observed here on the 6th inst. The few clouds which partially hid the sun during the first stages of the transit, only served a useful purpose in moderating the sun's brilliancy. At about 2 p.m. a dark indentation was observed on the south-east margin of the sun's limb, and it was evident the phenomenon had commenced. A few minutes later this indentation had developed into a semicircular notch, and at about 2.21 p.m. the black and now complete circle of Venus had fully entered upon the solar disc. It was very large and conspicuous, and its effect, even as observed in small telescopes, was very striking. The opaque and well-defined globe of the planet was projected with remarkable boldness upon the sun's bright photosphere. Protecting the naked eye with deeply tinted glass, the planet was very plainly seen; indeed, the dark spot was thus clearly distinguishable before it had entered fully

upon the sun, and while it had notched the disc. The planet appeared to be surrounded by an annulus of reddish hue, and over the central parts there was diffused a patch of faint light. The region of the disc just within the margin was very black. These effects may, however, have been purely telescopic. I used a reflector of 4-inch aperture, with which the definition was not all that could be desired. There were very few of the ordinary sun-spots visible. A small irregular group lay slightly to the south-west of the centre, and another with much feculæ, near the eastern limit, but they were of very insignificant character, and not at all comparable to some of the fine spots which have been recently visible on the solar surface. To an observer accustomed to the appearance of these objects, the view of Venus now in transit must have been of extreme interest, and he could not fail to be struck with the marked difference between the black circular disc of the planet, and the more irregular and far less intense forms of the ordinary sun spots. As the transit progressed, the sky continued clear, so that it could be watched until near sunset, but the telescopic view became less effective, owing to increasing atmospheric undulation, which, as usual with objects at low altitudes, greatly impaired the definition. W. F. DENNING

Bristol, December 9

SOME parts of the transit were well seen here. I used a 3¼ Merz refractor, power 60. The external contact was excellently seen. I watched for those peculiar phenomena (black drop, &c.) which have created so much interest, but was able to see nothing of them. At the moment of external contact, I had the point of impact in the centre of my field, and the planet indented the edge of the sun with a black and perfectly circular segment, disturbed only by the "boiling" appearance characteristic of the solar edge. I watched the planet advance upon the sun to within, I guess, a few seconds of internal contact, when unfortunately the sun became obscured by a small cloud. At the time of observation, so near was internal contact, that I could every now and then see the boiling appearance of the solar edge peeping out from behind the black edge of the planet; but no other distortion of the planetary or solar edge was observable, except what arose from the "boiling" appearance referred to. D. TRAILL

Raleigh Lodge, Exmouth, December 7

THE transit of Venus was perfectly seen here yesterday. The sky was overcast quarter of an hour before, but the first and second contacts took place on a clear disk, and the first was almost instantly apparent with a hand glass. The sky remained clear till considerably past three. Considering the total failure in London and Paris, one could wish that some trained observers had selected our south coast. HENRY CECIL

Bregner, Bournemouth, December 7

P.S. As a consequence of popular ideas and anticipations as to celestial phenomena having got "a little mixed" lately, my gardener asked me this morning "*if I saw the star fall into the sun yesterday.*"—H. C.

THE transit was seen here to great advantage, the day being exceptionally fine, the sun shining brightly from about 9·30 till sunset, with the exception of a few passing clouds at noon, and one small cloud obscuring the sun from 2.30 to 2.35 p.m. According to the times and positions of the sun and planet, given in the *Nautical Almanack*, I had made a diagram as correct as I could of the sun with the path of Venus across his disc; but if I had relied entirely upon the diagram I should have missed the place of external contact, as I found afterwards I had drawn the position of Venus considerably too high. To make sure of my object I depressed the telescope so as to keep as much of the sun as possible out of the field of view, and only allowing a portion of his limb to appear, and at 2h. 3m. 11s. I picked up Venus depicted against the sky, and just coming in contact with the sun's limb. Her disc appeared a trifle paler than the background, and was surrounded with a very thin circle of light which appeared a little wider on that side furthest from the sun. It was this light which attracted my attention, and enabled me to identify the planet. At 2h. 3m. 20s. the first *touch* of Venus upon the sun's limb took place. I now watched with much interest to see if it was possible to detect signs of an atmosphere to Venus—changing the eye-pieces. Sometimes I thought there were visible signs of it, but I would not say decidedly that it was so. I noted with some surprise that the planet appeared much smaller upon the sun than it did immediately previous to contact. At 2h. 23m. 31s. internal contact took place. The planet appeared to pass clear off and away from the sun's limb, without showing the least sign of a "black drop," or any appearance of a lingering connection between her limb and that of the sun. The telescope used is an equatorial with driving-clock, silvered glass reflector 8½-inch diameter and 7 feet focal length; eye-pieces ranging from 30 to 170 of magnifying power. I took three photographs between 2h. 35m. and 2.45, but the spring of my instantaneous shutter did not act as it should, and therefore the photographs are not so good as I could wish, but Venus can be readily seen upon the sun's image in the negative.

Silverton, Devon, December 9 R. LANGDON

NOTES

THE following are the probable arrangements for the Friday evening meetings before Easter, 1883, at the Royal Institution:—January 19, R. Bosworth Smith, M.A., The Early Life of Lord Lawrence in India; January 26, George J. Romanes, F.R.S., Recent Work on Starfishes; February 2, Sir William Thomson, F.R.S., The Size of Atoms; February 9, Moncure D. Conway, M.A., Emerson and his Views of Nature; February 16, Prof. William C. Williamson, F.R.S., Some of the Anomalous Forms of Primæval Vegetation; February 23, Walter H. Pollock, M.A., Sir Francis Drake; March 2, C. Vernon Boys, A.R.S.M., Meters for Power and Electricity; March 9, Prof. George D. Liveing, F.R.S., The Ultra-Violet Spectra of the Elements; March 16, Prof. Tyndall, F.R.S.

MR. H. O. FORBES, on his return to Amboina from his first visit to Timor-laut, writes as follows:—"Extended movements were impossible, so that my botanical collections are not very extensive, but the ornithological and anthropological parts are very good. I am now engaged in packing them up for despatch, and hope to send them off soon. My intention is to return to Timor-laut in a few days, if my health will permit, by the Government steamer which leaves for the Tenimber Islands. I shall settle in some more quiet spot than Ritabel. A full report on this interesting country shall be sent by next mail. One of the singular facts I observed is the immense herds of wild buffalo existing on the mainland of the island. They must have, of course been introduced, but by whom, and how long ago, is an interesting question. I was unable to get a specimen unfortunately. My wife, who accompanied me, aided me greatly, so that when I was down with fever (and the fever is of extreme severity) the work was still able to go on." Mr. Forbes' collections will be consigned to the Committee of the British Association for the exploration of Timor-laut, as arranged when the expedition was determined on.

THE Accademia delle Scienze dell' Istituto di Bologna has lately announced that a gold medal of the value of 1000 lire (say 40*l.*) will be presented "to the author of that memoir which, proceeding on sure data either of Chemistry or of Physics, or of Applied Mechanics, will indicate new and efficacious practical systems, or new apparatus for the prevention, or extinction of fires." Memoirs must be written in Italian, Latin, or French,

and sent in (in MS. or printed form, and in the usual anonymous way) before May 30, 1884.

ANOTHER well-known naturalist has passed away. Prof. Andrea Aradas, of Catania, died on November 1 last, after a long and laborious life, which was devoted to the study of marine zoology and palæontology. His publications were very numerous, and extended over nearly forty years. He was a man of great amiability as well as learning.

THE death is announced of Sir Thomas Watson, M.D., F.R.S., the eminent physician, at the age of ninety years.

ON Monday evening the annual dinner of the Professors and Members of the Royal School of Mines was held in the Victoria Room of the Criterion, Piccadilly. Mr. E. L. J. Ridsdale, late of the Royal Mint, presided. It was announced that Major-General Martin was about to retire, owing to ill-health. Prof. Huxley made a long and interesting speech, in the course of which he recalled the personal characteristics of the professors who filled the chairs at the school. Prof. Judd proposed "The Geological Survey," to which Dr. A. Geikie responded.

PROF. KENNEDY has issued invitations for an inspection of the experimental engine and other apparatus just completed at the Engineering Laboratory, University College, London. Prof. Kennedy draws attention to the fact that the laboratory was the first of its kind established in England, and was at the time of its establishment an entirely new departure in technical education in this country. Since that time (1878), its principle has been more or less formally adopted by all the recently-established technical colleges. A very large number of the leading engineers of the country have also formally expressed their approval of the scheme, which, too, came in considerable detail before the present Royal Commission on Technical Education. The additions now just finished to the Laboratory render it already probably the most complete of its kind in Europe.

A RECENT writer in the *China Review* exemplifies the difficulties surrounding interpretation from Chinese into English, or *vice versâ*, by mentioning that the simple question, *Was he (or she) dead?* which occurs so frequently in inquests and other judical proceedings, admits of a positive or negative reply according to whether the European or the Chinese idea as to when death occurs be followed. We believe that a man is dead when he has ceased to breathe, and when his blood no longer circulates; the Chinese consider him still alive whilst a trace of warmth lingers in the body. The two estimates may thus differ by several hours. Hence it was that in inquests in Hongkong the time of death formed a stumbling-block in almost every Chinese case. The medical evidence would show that the deceased must have been dead when brought to the hospital, while the relatives would swear he was alive at the gate. Subsequent inquiry showed that the general view among the Chinese was that a person is considered to be dead when the body is cold, and not before. It does not speak very well for the Chinese scholarship of the officials of Hongkong that it took about forty years to discover this important distinction.

AN aurora was seen in Belgium on October 2, and one feature of it was (according to M. Montigny) the formation of a broad luminous arc extending across the sky from east to west, and passing a little to the south of the zenith. After a little time it broke up and gradually disappeared. M. Montigny observed the stars during this aurora, and found his former conclusions (as to increased scintillation during auroras greater in winter, and in the northern region, and towards the zenith, &c.) confirmed. He notes, however, an interesting new phenomenon of scintillation. For more than a year, when a magnetic perturbation has been observed to occur at Brussels Observatory, he has very often observed a simultaneous sudden increase in the scintillation. No auroral phenomena were reported at those times, as during aurora the increase is more marked for the north and west, and the circular line in the scintillometer becomes irregular. M. Montigny is prosecuting his study of the phenomena.

IN the same *Bulletin* of the Belgian Academy, with M. Montigny's paper (November 9–10) is a full description, by M. Tarby, of the aurora of October 2, as observed at Louvain. Besides the luminous arc referred to above (which moved towards the south), he notes that the aurora had not the pronounced red tint characteristic of large phenomena of this class; white streamers constantly predominated. The successive displacement of the manifestations was from east to west, by north, a direction presented in certain previous auroras (which he specifies); while the opposite direction was observed in others. M. Tarby tabulates several years' observations of aurora in Belgium, and finds striking confirmation of an observation of M. Quetelet's in 1870, that auroras (through some unknown periodic influence) tend to appear at about monthly intervals.

IN the pile-dwellings near Bobenhausen (Zürich), a hatchet made of pure copper has been discovered. Special importance is attached to this discovery by students of prehistoric archæology.

THE fourth edition of the Micrographic Dictionary is now more than two-thirds completed. The book will always be an indispensable work of reference to the student of the lower forms of animal and vegetable life. Very little attempt appears, however, to have been made by the editors to keep pace with the advance of biological science during the eight years that have elapsed since the publication of the last edition; notwithstanding the number of new forms that have been discovered during that period, the work so far occupies rather less space than before. In order to test the extent to which recent knowledge has been incorporated, we turned to two or three of the cryptogamic articles. Under "Fungi," we find it still stated that "the structure of all fungi exhibits a well-defined separation into two parts, namely: (1) a *mycelium* . . . and (2) the *reproductive structure*, or *fruit*"; and this although Schizomycetes are given as one of the groups of fungi; while the classification of "Fungi" into "I. Schizomycetes; II. Phycomycetes; III. Hypodermiæ; IV. Basidiomycetes; V. Ascomycetes; and VI. Myxomycetes" is stated to be "that of Sachs (!) slightly modified." Under "Lichens," the theory of the symbiosis of algæ and fungi is dismissed in a few sentences, without adducing any of the evidence in its favour, as "one of the modern natural-history romances." A new paragraph appears under the head "Gongrosira," which is described as a genus of Chætophoraceæ, without any reference to its genetic connection with *Vaucheria*. These and similar deficiencies suggest the question how far the text can have been revised by the eminent cryptogamist whose name still appears on the title-page.

THE concluding volume of the new edition of "The Imperial Dictionary," edited by Mr. C. Annandale, has been issued with praiseworthy promptitude by Messrs. Blackie and Son. In a supplement Mr. Annandale has added a considerable number of words omitted from their places in the body of the work, including not a few scientific terms. In the Appendix are copious lists of classical, scriptural, and geographical names, foreign words and phrases. In the preface the editor explains his method, which we think rational and judicious, and which has led to an excellent result. The list of authors consulted for quotations contains about 2000 names.

THE French official paper publishes an *arrêté* from the Minister of Public Works requiring that all trains be furnished with continuous brakes, and if possible automatic.

THE inundation of the Seine, which had reached a level of about 6½ metres above the summer season, and has caused many disasters, has terminated abruptly by the cold weather which has set in with the new moon.

AT the last meeting of the St Petersburg Society of Naturalists, M. Beketoff reported that the expedition for the exploration of the Altai sent out during last summer was very successful. MM. Sokoloff, Polenoff, Nikolskiy, and Krasnoff have returned with very rich botanical, zoological, mineralogical, and geological collections. He added also that the appeal of the Society for botanical collections (addressing them to the St. Petersburg University) had been responded to. No less than eighteen very good collections had been received, among which one by the scholars of all *Realschulen* of Western Siberia merits special attention.

IT is worthy of note that snow fell on Sunday in Madrid to the depth of one foot. It is said that no such weather has been experienced in the Spanish capital for twenty years.

THE diaries, pocket-books, cards, and the other useful and beautiful things issued by Messrs. De La Rue for the coming year are in all respects equal to those of which we were able to speak so highly last year. It would be difficult to imagine anything more beautiful of their kind than the cards, and what with Japanese beauties, flowers, birds, and insects, they might be utilised for giving the young ones a liking for natural history. The astronomical and other useful information contained in the diaries is as full and accurate as ever, and adds greatly to their value in our eyes.

AMONG the articles in the *Companion to the British Almanac* for 1883 are "Halley's Comet," by Mr. W. T. Lynn; "Modern Fish Culture" and "Fishery Exhibitions," by Mr. J. G. Bertram; "Insects Injurious to Agriculture," by Mr. W. E. A. Axon; "Electric Lighting," by Mr. L. T. Thorne; "The British Museum," by Mr. Charles Makeson; and a brief sketch of the Science of the Year, by Mr. J. F. Iselin.

HARTLEBEN, of Vienna, has sent us a catalogue of German works, some of which might commend themselves to those who may wish to entice their young friends to the study of German.

A GERMAN translation is announced of Dr. Ingvald Undset's "Study in Comparative Prehistoric Archæology"; Meissner, of Hamburg, is the publisher, and the last number (23) of *Globus* contains an abstract of Dr. Undset's researches into the first appearance of iron in Northern Europe.

THE last number (vol. xvii. part 1) of the *Journal* of the North China Branch of the Royal Asiatic Society contains a short article by Dr. Guppy, R.N., on the Geology of the Neighbourhood of Nagasaki, and a few notes on the South Coast of Saghalin, by Mr. Anderson. The principal paper, occupying 180 pages, is on Annam and its Minor Currency, by M. Toda. Besides the portion devoted to numismatics, the author gives a short historical and geographical account of Annam, which should be valuable at the present time, when public attention is being strongly drawn by political events to these regions. Of the remaining papers, one, by Mr. Giles, discusses Chinese Composition; the other, by Dr. Hirth, describes a manuscript work written at the end of the last century, referring to the manner in which the Customs dues on foreign goods were then levied at Canton. It is called the "Hoppo" book, "Hoppo" being the title popularly given, even now, by foreigners to the principal native chief, or commissioner, of Customs at Canton.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus* ♀) from India, presented by Mr. W. Percy Laing; a Black-headed Lemur (*Lemur brunneus* ♂), a Black Lemur (*Lemur macaco* ♀) from Madagascar, presented by the I Company 3rd Battalion King's Royal Rifles; two Leopards (*Felis pardus* ♂ ♀) from India, presented by Lady Brassey; a North African Jackal (*Canis anthus*) from Tunis, presented by Capt. W. F. Wardroper; two Mexican Sousliks (*Spermophilus mexicanus* ♂ ♀) from Mexico, presented by Mrs. Simmonds; a Great Eagle Owl (*Bubo maximus*), European, presented by Mr. R. Leigh Pemberton; a Martinique Waterhen (*Porphyrio martinicus*) from Venezuela, presented by Mr. F. L. Davis; a Common Squirrel (*Sciurus vulgaris*), British, presented by the Hon. L. W. H. Powys; two Raccoon-like Dogs (*Nycterentes procynides*) from North-Eastern Asia, purchased.

OUR ASTRONOMICAL COLUMN

COMET 1882 *b*.—A number of very beautiful photographs of the great comet have been received from Mr. Gill during the past week. Several of them are remarkable for the amount of delicate detail that is brought out. Mr. Gill writes: "These photographs are interesting, not only as pictures of the comet, but they appear to me to show the possibility of making, with very little labour, a photographic *Durchmusterung* of the heavens." One of them taken on November 8 was exposed two hours, and shows all the 8th magnitude stars and the curious envelope extending 4° or 5° beyond the nucleus. This envelope was barely visible either to the naked eye or in the telescope.

Both Mr. Gill and Dr. Elkin had made a careful search for the cometary body seen within a few degrees from the nucleus of the great comet, by Prof. Julius Schmidt at Athens.

We have more than once pointed out that calculations based upon such observations as were available here at the time of writing, indicated sensible disturbance of the comet's motion at the perihelion passage. It is right, therefore, that we should state at once that this inference is hardly countenanced by calculations made by Mr. Finlay and Dr. Elkin at the Cape, who have had the advantage of more numerous, and probably in general more accurate and uniform series of observations. Mr. Gill writes: "The great comet is a puzzle. The whole question of its orbit now turns on which point of its nucleus should be observed. So long as the nucleus was single, *i.e.* from September 8 to September 28, Dr. Elkin has been able to represent its motion by parabolic elements within 3″ of observation. But after September 28 matters change; the head begins to break up. What we took for the principal nucleus is no longer the centre of gravity. Finlay and Elkin's original elements are now nearly 2′ out. Elkin's subsequent elements founded on observations September 8 to 28, give a place corresponding nearly with the end of the elongated nucleus (about 1½′ long) furthest from the head. Now (November 21) the nucleus is getting very ill-defined. We have done the best we can in the matter, and shall continue the best observations we can, as long as the comet is visible."

COMET 1882 *c* (Barnard, September 10).—From an approximate orbit calculated by Mr. Hind, and communicated to Mr. Gill at the Royal Observatory, Cape of Good Hope, which reached him on November 11, this comet was found the same evening, and was observed on the meridian on several days up to November 19. The first position from a lower transit is as follows:—

	R.A.	Decl.
Nov. 11 ...	12h. 53m. 21s.·74 ...	−65° 57′ 28″·3

Mr. Gill's observations will allow of a much better determination of the orbit of this comet, than could have been made from the European observations alone; the comet arrived at perihelion on November 13.

GEOGRAPHICAL NOTES

MR. JOSEPH THOMSON sailed yesterday for Zanzibar as leader of the Geographical Society's Expedition to Mount Kenia and the East Coast of the Victoria Nyanza. Mr. Thomson expects to be away for two years.

THE new number of the *Deutsche Geographische Blätter* continues the interesting account by Dr. Arthur Krause of the researches of himself and his brother in the Chukchi peninsula and Alaska; there is, besides, a separate catalogue of the ethnological collections, and a short paper by Dr. Kuntz of the plants collected. The number contains a useful paper on South New Guinea from the observations of D'Albertis, Moresby, Macfarlane, and others. In the *Zeitschrift* of the Berlin Geographical Society are several papers of interest. Major Lovemann gives the leading results of the new survey of Russia, which is being carried out; Dr. Hann examines the data of Dr. Rholl's for the altitudes in the oasis of Kufra; Herr G. A. Krause gives some account of the Saharan town of Chat, which is followed by an abstract of the census of Bulgaria; and a preliminary account of Prof. Haussnecht's Oriental travels. Dr. W. Götz contributes a valuable paper on a subject which is taking great prominence in Germany—commercial Geography, while Dr. Reiss contributes an analysis of recent researches in some tributaries of the Amazon. In the December number of the *Deutsche Rundschau* for geography and statistics (Vienna, Hartleben), we have the conclusion of Baron von Lehnest's paper on his Land Formations in the Lunda region, the first of a series of pictures from East Africa, by Karl Berghoff; a short paper on the distribution of islands, and a biography of Mr. A. R. Wallace, with a good portrait. The number contains many other short papers and notes.

THE new quarterly number of the *Bulletin* of the Paris Geographical Society reports at length several important papers: Commander Gallieni gives an account of his mission to the Upper Niger and Segou, with a map and several interesting illustrations, some of which show curious formations, suggesting the buttes of some of the North American rivers. M. A. d'Abbadie has a useful paper on the spelling of foreign words; M. Jules Garnier an account of his excursion to the country of the Don Cossacks; M. M. Biollay, a paper on Finland; M. Dutreuil de Rhins, on Père Creuse's journeys to Southern China; M. Romanet du Caillaud, notes on the Ting-King; and M. Theodore Ber the first part of an elaborate paper on the Titicacon valley of Tiahuanaco.

THE December number of *Petermann's Mittheilungen* contains some supplementary information by Dr. Junker on his Welle explorations, in addition to the letters already referred to. Herr R. A. Hehl contributes a geographico-geological sketch of the Brazilian coast-lands between 20° and 23° S. lat. Along with the chief results of the Hungarian Census is an excellent series of statistical maps showing the various aspects of the figures. Signor P. Gialussi contributes an interesting paper on the changes which have resulted from recent geological action in an Istrian valley, while Herr Hehl gives a detailed account of the German colonies in South Brazil.

THE Carpathian Club, which was formed at Hermannstadt (Transylvania) after the pattern of the Alpine Club in 1880, having for its object the study and minute investigation of the mountains of the country, as well as the endeavour to direct the attention of tourists to that region, already numbers no less than 1200 members. It is divided into nine sections. Quite recently the second year-book of the Club appeared, which contains a number of valuable scientific papers, as well as descriptions of tours in the Carpathian Mountains.

SCHWEIGER-LERCHENFELD'S interesting work "Die Adria," has just been completed in twenty-five parts, and published by Hertleben of Vienna. The fact that the eastern coasts of the Adriatic are so little known by the general traveller, renders the book valuable. In an appendix the commerce of the Adriatic, as well as the fisheries, are spoken of, and an excellent map is added to the work.

THE ROYAL SOCIETY[1]

II.

THE subject of the Circumpolar Observations mentioned in my address last year, was since that time brought more formally before our Government by that of Russia. At the request of the Treasury, the President and Council, after consultation with the Meteorological Office, advised as follows:—

"The object of the undertaking is to throw light on the influence of the great inaccessible region surrounding the pole on the meteorology and magnetism of the earth. With this view it is proposed to take simultaneous observations at a chain of circumpolar stations for a full year at least.

"A chain of not less than eight stations will be occupied independently of any co-operation by this country. This chain, however, leaves a gap of 90° in longitude in the northern part of America, the centre of which would be advantageously occupied by a station in the Dominion of Canada. The value of the results will be greatly enhanced by the addition of this link to the chain. Independently of this, such a station would be of great value as being of a continental character, in contrast with the other stations, which are in close proximity to the coast. By choosing for the station one of the forts of the Hudson's Bay Company, no great outlay need be involved in its occupation."

The point first proposed was Fort Good Hope, near the mouth of the Mackenzie River; but it was found too late to erect the necessary huts and to transport the party and its provisions there during the present season. Fort Simpson, on the same river, was next suggested. Guided by considerations of facilities of access and sustentation, the Committee came to the conclusion that either Fort Rae or Fort Providence, on Great Slave Lake, is to be preferred to Fort Simpson, with which the former forts nearly agree in latitude; and accordingly the President and Council recommended one of these.

"In framing an estimate, it was thought well to assume that the expedition might last a year and eight months, so as to allow a sufficient margin for travelling to and from the station, and for possible detention in waiting for the Hudson's Bay Company's brigade. It is calculated that the cost might be safely estimated at 3,000*l.*, which would include salaries of one officer and three men; journey of the party from England and back, including reasonable baggage; rations, allowances, and all other expenses."

To this communication the following reply was received:—

"My Lords have to thank you, and the Committee whom the Council appointed to advise them in the matter, for the valuable information contained in Dr. Michael Foster's letter of the 16th ultimo. Acting upon that information and upon the advice of the Royal Society, Her Majesty's Government have decided that this is an object on which public money may properly be employed and they are prepared to ask Parliament to provide a total sum not exceeding 2,500*l.* for the purpose. My Lords understand that there is good reason to hope that the balance required to make up the total estimated cost of 3,000*l.* will be forthcoming from other sources.

"I am to ask whether the Royal Society would be so good as to take charge of the Expedition under similar conditions to those under which the Transit of Venus Expedition is being conducted; accounts of the expenditure chargeable to the Parliamentary grant being rendered to this Department. The choice of stations, the appointment of observers, and the methods of procedure would be left entirely to the Society, subject to the condition that the total amount chargeable on public funds does not exceed 2,500*l.* My Lords understand that it is expected that not more than 1,500*l.* of this amount would come in course of payment during the present year, and they will present estimates to Parliament for 1,500*l.* and 1,000*l.* at the proper times."

The Canadian Government has since promised a contribution of 4,000 dollars towards the expenses of the expedition.

A committee, consisting of the President, Dr. Rae, Sir George Richards, Mr. R. H. Scott, and Prof. Stokes, was accordingly appointed to superintend the expedition, which, comprising Captain H. P. Dawson, R.A., in command, Sergeants J. English and F. Cookesley as observers, and W. Wedenby, as artificer, left England on May 11, for Quebec, was heard of at Fort Carlton on 27th June, and was about to proceed the next day for Green Lake, on the way to Portage Loche. It was still not quite certain whether it might not be necessary to push on to Fort Simpson, on account of insufficient accommodation, as well as lack of time and materials for building at Fort Rae.

Two parts of *Mittheilungen der Internationalen Polar Commission* have been published, containing full particulars and instructions relating to the whole circumpolar scheme.

The geological, mineralogical, and botanical collections, formerly in the Museum in Bloomsbury, have been properly arranged in the new building in Cromwell Road, and are on exhibition in their respective galleries. A commencement has

[1] Address of the President, William Spottiswoode, D.C.L., LL.D., delivered at the Anniversary Meeting, November 30, 1882. Continued from p. 137.

been made in the transfer of the zoological collections. The osteological specimens, hitherto packed out of sight in an obscure vault in the basement of the old Museum, have been safely removed to the new building, and are now exhibited in a large and well lighted gallery. The collection of shells, which occupied the floor space of the long eastern gallery in Bloomsbury, is now suitably exhibited at South Kensington. Some of the corals have been removed, in order to clear the way for the removal of other specimens; and many of the stuffed quadrupeds and mammalian skins which had been stowed away in the old Museum basement are now in the new repository.

The removal of the general collection of mammalia, of the birds, of the entomological specimens, and those of British zoology, will not be undertaken until after the coming winter. The fittings for the galleries prepared for them are not fully completed. The detached building designed for the specimens preserved in spirit cannot be made ready for their reception before the opening of next spring. It is, however, expected that the whole of the zoological collections will have been transferred to the new Museum by the end of June, 1883.

The subject of Technical Education has continued to be prominently under the notice of the country during the past year. The appointment of a Royal Commission on Technical Instruction, to which I have previously referred, has done much towards awakening the interest of manufacturers, and exciting curiosity in regard to the efforts that are being made abroad to improve the education of artizans. The Commissioners issued in March last their first Report, which dealt exclusively with primary education and apprenticeship schools. The Commissioners expressed an opinion adverse to the establishment of apprenticeship schools in this country; and in this view they are supported by nearly all our large manufacturers, and by the action of the City and Guilds of London Institute for the Advancement of Technical Education. At the request of the Executive Committee, I myself gave evidence before the Commission, explaining generally the objects of the City Guilds and Institute, and describing the progress already made towards their attainment. As a member of the Executive Committee of this Institute, I have watched its progress with interest, and have observed with satisfaction that its scheme of Technical Instruction is being gradually matured. The general Examinations in Technology undertaken by this Institute, were held in May last at 147 centres in 37 subjects. Of the 1,972 candidates who presented themselves for examination, 235 passed in Honours, and 987 in the Ordinary Grade. In 1881, 895 candidates passed, showing an increase of 307. The Examinations were held this year for the first time under the revised Regulations, which appear to have worked very satisfactorily. Two points deserve notice with respect to these Examinations. In the first place, the Institute experiences very great difficulty in obtaining properly qualified teachers. The applicants are either practical men working in the factory, or at their trade with no scientific knowledge whatever, or men possessing a very elementary science knowledge, and little or no practical acquaintance with the details of the industry, the technology of which they profess to understand. In order to indicate the kind of qualifications required in an ordinary technical teacher, the Institute has inserted in its programme a paragraph to the effect that persons who are engaged in teaching science under the Science and Art Department, and who at the same time have acquired a practical knowledge of their subject in the factory or workshop, may be registered as teachers of the Institute. The second point calling for consideration is the fact referred to in the Report of the Directors,—that of the 1,220 candidates who, this year, passed the examinations, most of whom are workmen or foremen in various branches of industry, not more than 450 are qualified to receive the full Technological Certificate, by having previously passed the examinations of the Science and Art Department in certain science subjects. This fact clearly indicates that widely beneficial as has been the action of this Department of State, there is still a large field for its influence among the population who are engaged in manufacturing processes, and desire to receive Technical Instruction.

One of the most satisfactory results of the Examinations of the City and Guilds of London Institute is the impulse they have given to the establishment, in different parts of the country, of properly equipped technical schools. At Manchester, Preston, Dewsbury, Hawick, Sheffield, Leicester, and other places, efforts have been made during this year towards organising schools for the technical instruction of artizans and others in the application of science and art to specific industries. At Nottingham, a grant of 500*l.* has been made by the Institute, to be followed by an annual contribution for a limited period of 300*l.*, towards the establishment of technical classes in connection with the University College; and at Manchester a subscription of 200*l.* a year has been promised to assist the funds now being raised for the conversion of the Mechanics' Institution into a Technical School. The attention of the Council has been greatly occupied of late with arrangements for the opening of the Finsbury College. Classes in Electrical Engineering and in Technical Chemistry, have been carried on for nearly three years in temporary rooms belonging to the Cowper Street Schools. The attendance at these classes has been eminently satisfactory, much more so than could have been anticipated. During the past session 960 class tickets were sold at fees varying from 5*s.* to 12*s.* The staff of the College has recently been doubled by the appointment of a Professor of Mechanical Engineering, and a Head Master to the new Department of Applied Art, the establishment of which, as I stated last year, was then under the consideration of the Committee. In January next, it is anticipated that the new building in Tabernacle Row, which is already nearly completed, will be opened for the reception of students. The programme of instruction, prepared by the Director and the Professors of the College, has been for some time under the consideration of the Committee, and it is hoped that in the instruction given in this College will be found the realization of a very important part of the Institute's Scheme of Technical Education.

Grants to the Technical Science Classes at University College and King's College, London, to the Horological Institute, to the School of Art Wood Carving, and other institutions, have been continued during the past year.

The Technical Art School in Kennington Park Road, established and maintained by the Institute, has been satisfactorily attended; and a proposition is to be brought before the Committee for supplementing the teaching of this school by technical science classes, with a view of establishing in the south of London a Technical College for Artizans, similar to the one about to be opened in Finsbury.

The building of the Central Institution or Technical High School in Exhibition Road, the foundation stone of which was laid by H.R.H. the Prince of Wales, President of the Institute, in July, 1882, is rapidly advancing and promises to be completed within a year. It is not expected, however, that this school will be ready for the reception of the students before the commencement of the session 1884-5. Meanwhile, the Council and Committee are fully occupied with the development of other parts of their scheme.

In forwarding the Report of the Meteorological Council to the Treasury in December last, the President and Council took occasion to remind their Lordships that the arrangement for the organisation of the Meteorological Office generally, in May, 1877, would terminate with the then financial year. The Treasury, in reply, asked the advice of the Royal Society. After consultation with the Meteorological Council on various points connected with the subject, the President and Council reported fully to the Treasury, and concluded with the following general recommendation: "The President and Council beg leave to express a hope that the constitution of the Meteorological Council may remain unchanged, and that the same gentlemen who have hitherto performed its duties and administered its funds with such intelligence and judgment may be disposed to continue their labours." To this recommendation the Treasury cordially assented; deciding at the same time that no period should be fixed to the Meteorological Council for their tenure of office, but that it might be terminated by either party at any time on twelve months' notice.

The Meteorological Office has completed during the past year a series of charts of sea-surface temperature, for the three great oceans of the globe, and for the representative months of February, May, August and November. The work, which is now in the course of publication, will consist of twelve large charts, for the Indian, Atlantic, and Pacific Oceans respectively; and of four on a reduced scale, showing, for the four months, the isothermal lines of sea-surface temperature over the entire globe. In the preparation of these charts, all the observations existing in the Log Books of the Meteorological Office, and in the Remark Books of the ships of Her Majesty's Navy, have been employed, as well as the information which has been already rendered accessible in scientific memoirs, and in the narratives of the great scientific voyages. The isotherms agree

substantially with those which have been already given for the months of February and August, in the wind and current charts published by the Hydrographic Department of the Admiralty; but as the present series is founded on a much larger number of observations than have ever before been available for a similar purpose, it may fairly be regarded as a valuable contribution to a not unimportant part of terrestrial physics. Between the limits of 50° north and 50° south latitude, the mean annual surface temperature, so far as it can be deduced from the data now available, appears to be 74°·9 F. for the Indian, 69°·5 F. for the Atlantic, and 68°·6 F. for the Pacific Ocean. The North Atlantic is 4°·6 F. warmer than the South Atlantic Ocean; the corresponding difference in the case of the Pacific Ocean is only 1°·8 F.

Among other contributions to Ocean Meteorology, which the past year has produced, I may mention (1) the Physical Charts of the Atlantic Ocean, published by the Deutsche Seewarte, at Hamburg; (2) the second volume of the narrative of the voyage of H.M.S. *Challenger*, containing the magnetical and meteorological observations; and (3) a report by Captain Toynbee, F.R.A.S., on the Gales of the Ocean District adjacent to the Cape of Good Hope, which completes the discussion by the Meteorological Council of the meteorology of that tempestuous part of the sea.

The meteorology of our own country has been actively studied during the year. The Scottish Meteorological Society have given in their Journal a series of monthly pressure charts for the British Isles, together with a revised edition of the temperature charts already published by them in 1871. The charts now embody the results of observations extending over a period of twenty-four years; the revised edition, as well as the original publication, are due to the indefatigable activity of Mr. Alexander Buchan, F.R.S.E., the Secretary of the Scottish Meteorological Society. An atlas of convenient size, intended for the use of observers in the United Kingdom, and conveying similar information derived from data partly different, and quite independently discussed, has been already prepared by the Meteorological Office, and will immediately appear.

It is a fact now universally recognised that the greater part of the changes of weather which are experienced in the British Isles are occasioned by travelling areas of excessive or defective atmospheric pressure, which arrive at our shores from the Atlantic Ocean. The importance of a systematic study of the weather of the North Atlantic being thus indicated, the Meteorological Council have resolved to undertake the preparation of synoptic weather charts for the thirteen months beginning 1st August, 1882, and ending 31st August, 1883, and have issued a special appeal to the British shipping interest for active co-operation during that period. It is satisfactory to know that this appeal has not been fruitless, and that there is every prospect that the number of observations available for the discussion will exceed 200 per day.

This is, perhaps, the proper place to make mention of some results having an important bearing on meteorology, obtained by Prof. Tyndall in the course of a larger research on the action of radiant heat on gases.

By methods which he has applied to gases and vapours generally, Tyndall has established anew the action of aqueous vapour upon radiant heat, and the sensibly perfect diathermancy of dry atmospheric air. The phenomena of solar and terrestrial radiation are profoundly modified by the presence of aqueous vapour in the earth's atmosphere, the temperature of our planet being thereby rendered very different from what it would otherwise be.

The celebrated experiments of Patrick Wilson, wherein were observed a rapidity of radiation and a refrigeration of the earth's surface previously unknown, are explained by the fact that when they were made, the amount of aqueous vapour in the air was infinitesimal, the unhindered outflow of heat towards space being correspondingly great. The sagacious observation of Six and Wells, that the difference between the surface temperature and that of the air a few feet above the surface, on equally serene nights, is greatest in cold weather, is explained by the fact that, when the temperature is low, the agent which arrests the surface radiation is diminished in quantity. Wells, moreover, found that the heaviest dews were deposited on nights when the difference between air temperature and surface temperature was small; while the greatest difference between the two temperatures was observed on nights when the deposition of dew was scanty. The explanation offered by Tyndall is this:—copious dew indicates abundant vapour; and abundant vapour, by arresting the terrestrial rays, prevents the refrigeration observed in drier air. Strachey's able discussion of observations made at Madras, point distinctly to the action of aqueous vapour on the radiation both of the sun and of the earth; while the experiments of Leslie, Hennessey, Hill, and other distinguished men, which were long considered enigmatical, are readily explained by a reference to the varying quantities of vapour with which the atmosphere is charged, on days of equal optical transparency. The interesting observations of Desains and Branley, made simultaneously on the Rigi and at Lucerne, are well worthy of mention here. The difference of level between the two stations is 4,756 feet, and within this stratum 17·1 per cent. of solar heat was proved to be absorbed. This absorption being due to aqueous vapour, is tantamount to the transmission of the sun's rays through a layer of water of a definite thickness. A sifting of the rays would be the consequence, and on *a priori* grounds we should infer that the percentage transmission through water at Lucerne must be greater than on the summit of the Rigi. This was the exact result established experimentally by Desains and Branley. H. Wild, the distinguished Imperial Astronomer of St. Petersburg, basing his statement on experiments made by himself according to Tyndall's method, has expressed the opinion "that meteorologists may, without hesitation, accept this new fact in their endeavours to explain phenomena which hitherto have remained more or less enigmatical." The correctness of this statement is illustrated by the foregoing examples, to which, if necessary, many more might be added.

At the recommendation of the Committee on Solar Physics of the Science and Art Department, a grant of 350*l*. was made from the Society's Donation Fund to Captain Abney and Mr. Lockyer in aid of their proposed observations of the total eclipse of the sun at Thebes in May last. Unfortunately the state of Captain Abney's health precluded his taking part in the expedition; but Dr. Schuster generously undertook the conduct of his observations, and, notwithstanding the short time remaining for preparation, he carried them out in the most satisfactory manner.

Three photographs of the corona itself were obtained during the eclipse. They show that the corona had the characteristic features observed during the time of the maxima of sun-spots. The long streamers in the plane of the ecliptic seen during sun-spot minima were absent, and the corona showed much disturbance. A bright comet appeared in all the photographs at a distance slightly less than a solar diameter.

A complete photograph of the spectrum of the prominences and the corona was for the first time obtained. The prominences give a spectrum in which the lines of calcium bear a conspicuous part by their intensity. The ultra-violet hydrogen lines, photographed in star spectra by Dr. Huggins, were seen, as well as a number of unknown lines.

The corona gives a very complicated spectrum. Close to the limb of the sun the spectrum was so nearly continuous and so strong as to hide any lines which might have been present. Further away the continuous spectrum fades off, the solar group G appears as an absorption line, and a large number of coronal lines hitherto unobserved appear in the ultra-violet.

In addition to these photographs one was obtained in a camera, in front of whose lens a prism was placed without a collimator. This photograph allows us to study the spectra of different prominences. As the picture was produced on one of Captain Abney's infra-red plates, all the tints of the prominences ranging from the ultra-red to the ultra-violet made their impressions, and some interesting differences in the spectra of different prominences can be noticed.

But, beside taking part in this expedition, Mr. Lockyer has continued with unwearied perseverance his observations on the spectra of solar prominences and spots, and has recently combined with these the results obtained by him during the late eclipse. During this eclipse he made naked eye observations, which he considers to be of a crucial character between the two rival hypotheses regarding the nature of the sun's atmosphere. The results of this investigation have in his opinion considerably strengthened the views which he first put forward in 1873 on the constitution of the solar atmosphere. A statement of these views will be found in a paper by him recently read before the Society.

In the present state of the questions there raised, it must I think be admitted that, after giving all due weight to the facts and reasonings adduced by Mr. Lockyer, additional and varied observations are greatly to be desired; and that no opportunity

reasonably available, for adding to our knowledge of the subject, should be neglected. And, therefore, without committing myself or the Society to the support of any particular proposal or expedition, I think it may be fairly claimed as a *primâ facie* duty on the part of the present generation to obtain as many faithful records of the various phenomena occurring during solar eclipses as possible.

From a discussion of the meridian observations of Mars made during the favourable opposition of 1877, at Washington, Leiden, Melbourne, Sydney, and the Cape, Prof. Eastman has deduced the value 8″·953 for the solar parallax—a value which, though considerably larger than any of those found by other methods, agrees closely with that obtained by Mr. Downing, in 1879, from the meridian observations of Mars at Leiden and Melbourne, as well as with the values found from similar observations in 1862. In this investigation, Prof. Eastman rejects the observations at Cambridge, United States, as they were made in a slightly different manner, and gives (in combination with Melbourne) a very large value for the solar parallax, viz., 9″·138.

The detailed account of the British Observations of the Transit of Venus, 1874, was published at the beginning of the year, and the observations of the transit made at colonial observatories have been recently printed in the Memoirs of the Royal Astronomical Society.

The Transit of Mercury last November was well observed in Australia and other places, and the results are of special interest in connection with the late Transit of Venus. The discordances in the times of internal contact recorded by different observers seem to show that such observations are subject to much uncertainty.

An important memoir on astronomical refraction has been lately published by M. Radau, who, after a discussion and comparison of previous theories, gives formulæ and tables for refraction, in which allowance may be made for difference in the rate of decrease of temperature with the height above the earth's surface at different seasons of the year. M. Radau also discusses the case in which the surfaces of equal temperature in the atmosphere are inclined to the earth's surface.

A new map of the solar spectrum, containing a much larger number of lines than are shown in Angström's classical normal spectrum, has been published by Prof. Vogel in the publications of the new Astrophysical Observatory at Potsdam. In this work Prof. Vogel has bestowed great care on estimates of the breadth and intensity of each line. In the same volumes are given the results of Prof. Spörer's sun-spot observations at Auclam from 1871 to 1879, in continuation of those for the years 1861 to 1870, previously published. From a comparison of the rotation-angles for 78 spots with the formula, Prof. Spörer finds that the larger deviations are always towards the west, indicating that a descending current has brought down with it the larger velocity of the higher regions of the sun's atmosphere. The law previously deduced by Prof. Spörer, that, about the time of minimum, spots commence to break out in high latitudes, and that the zone of disturbance gradually approaches the equator till at the minimum it coincides with it and dies away, to be replaced by a new zone in high latitudes, is confirmed by the recently published Auclam results, comprising (with Carrington's series) two complete spot-cycles.

In astronomical photography an important advance has been made by the successful application of the new processes to the nebulæ as well as to the comets. Prof. Henry Draper and Mr. Common have obtained photographs of the great nebula in Orion, showing considerable detail, and Mr. Huggins and Prof. Henry Draper have succeeded in photographing its spectrum. Mr. Huggins finds in his photograph a very strong bright line in the ultra-violet at wave-length 3730, in addition to the four nebular lines previously discovered by him in the visible portion. Prof. H. Draper's photographs do not show this bright line, though they have faint traces of other lines in the violet, and he thinks that this may be due either to the circumstance that he had placed himself on a different part of the nebula or to his use of a refractor with glass prism, while Mr. Huggins used a reflector and Iceland spar prism. The most striking feature of Prof. Draper's photographs is perhaps the discovery of two condensed portions of the nebula (just preceding the Trapezium) which give a continuous spectrum.

Prof. Schiaparelli has recently called attention to a peculiar feature on the planet Mars. In 1877 he remarked a number of narrow dark lines, which he called "canals," connecting the dark spots or so-called "seas" of the southern and northern hemispheres. He now finds that these lines are each doubled, so that according to his view the equatorial regions of Mars are covered by a network of pairs of parallel straight lines. It is to be remarked that though the appearance of Mars as depicted by Prof. Schiaparelli differs greatly from previous representations, indications of these double "canals" are to be found in the sketches of other observers.

The two bright comets of this year possess more than usual interest. The bright comet discovered at Boston by Wells, on March 18th, was the first comet since the spectroscope was applied to these objects, which presented a spectrum unlike the hydrocarbon type common to all other comets which appeared since 1864. The eye observations, as well as its photographic spectrum (taken by Mr. Huggins), showed an absence of the hydrocarbon spectrum, which was replaced by a brilliant continuous spectrum and bright lines, including those of sodium.

In September, a very brilliant comet appeared near the sun. It seems to have been discovered independently by Ellery, at Melbourne, Finlay at the Cape. Mr. Common in this country, and also by Thollon and Cruls. This great comet has been a brilliant object in the early mornings during the past two months. On September 17th, an observation, apparently unique in the history of astronomy, was made by Mr. Gill at the Cape, who watched the comet right up to the sun's limb. It could not, however, be detected in the sun, and this circumstance of appearing neither bright nor dark when in front of the sun, appears to suggest a very small substantiality, or great separation of the cometary matter. After perihelion it presented a magnificent appearance, having a tail 30° long, and even on October 30th the tail covered a space greater than the mean distance of the earth from the sun.

On October 9th, Prof. Schmidt discovered a nebulous object not far from the great comet, the orbit of which strongly suggests a connection in the past with the great comet. This fact is of more interest when the orbits of the great comet of this year, of Comet I, 1880, and of the well-known comet of 1843 are compared. The very near approach of the great comet to the sun will lead astronomers to watch with great interest for its return to our system, whatever may be its destiny, to fall ultimately into the sun, or to disappear through a process of gradual disintegration. In the *Astronomische Nachrichten*, just published, Prof. Pickering, who has computed the elements of the orbit of this comet, states, "I believe the deviation from a parabola to be real, although the corresponding period may be very long. These differences seem to indicate that the disturbance suffered by the comet in passing through the coronal region could not have been great."

This comet presented a spectrum similar to that of Comet Wells, but while receding from the sun, the bright lines of its spectrum became fainter, and then the usual hydrocarbon spectrum made its appearance. This observation, taken in connection with those of the previous comet, suggests a modified condition of an essentially similar chemical constitution. The phenomena would admit more easily of explanation if the cometary light is supposed to be due to electric discharge as it is well known how preferential is the electric discharge when several substances are present together in the gaseous form.

Before leaving this subject, I venture to quote the following passage from the *Observatory*, which puts in a very clear form the speculations now current, on the relation of the present great comet to that of 1880, 1843, and possibly 1668.

"The physical appearance of the comet, which like that of 1843, and unlike that of 1880, showed at first a decided nucleus, together with the intimation of a period very considerably greater than that of the interval from 1880, January 27, the date of perihelion of the 1880 comet, suggest that perhaps the 1843 comet suffered disintegration when at its nearest approach, and that the 1880 comet was a portion of its less condensed material, whilst the body of the comet with the principal nucleus, suffering less retardation than the separated part, has taken two and a-half years longer to perform a revolution. The remarkable discovery made by Prof. Schmidt, of Athens, on October 8, of a second comet only 4° S. W. of the great comet, and having the same motion, would seem to confirm this view."

The scientific year now concluded has not been so fertile as its predecessor in the initiation of great national and international undertakings, neither have any of those larger enterprises which I took occasion to mention last year, such as the circumpolar observations, or the Transit of Venus Expeditions, as yet been brought to their final issue. Nevertheless, in some of them we

have evidence that good work is already being done, and in the others, of which we have as yet no information, there is no reason to doubt that the same is the case. Nor again, in the border-land betweeen science proper and its applications, have I to record anything so important as the Paris Electrical Exhibition. That Exhibition, however, bore legitimate fruit in the Electric Lighting Exhibition at the Crystal Palace, and in the technical experiments lately carried out on a large scale at Munich. Perhaps the most prominent feature of the Crystal Palace Show was the incandescent light. At Paris that mode of illumination appeared to be little more than a possibility, in London it had become an accomplished fact. The importance attaching to this advance in electric lighting may be measured both by the rapid extension of its use, and also by the fact that not a few of our leading minds consider that the incandescent lamp is the lamp of the future, not merely for domestic, but even for many other public purposes.

But in another way the present year has witnessed the most important step which could have been taken for the promotion of electric lighting in this country. The Legislature has passed the Electric Lighting Bill, and, so far as legislation can effect the object, it has brought electricity to our doors. Up to this time installations of greater or less magnitude had sprung up sporadically in many parts of country, in railway stations, manufacturing works, and occasionally in private houses. But, compared with the lighting of a whole town, or even of separate districts of a large city, even the most important of these must be confessed still to partake of the nature of experiments; experiments, it is true, on a large scale, and, as I believe, conclusive as to the ultimate issue. Indeed, by multiplication of machines it is certainly, even now, possible to increase the lighting power to any required extent; but this can hardly be regarded as the final form of solution of the problem, inasmuch as such a method would be as uneconomical as it would be to use a number of small steam-engines instead of a large one. And when we consider that at the time of the passing of the Act in question, there was but one machine actually constructed which was capable of illuminating even one thousand incandescent lamps (I mean that of Edison), we cannot but feel that much remained to be done before the requirements of the public could be fully met. I do not mean thereby to imply that the Act was passed at all too soon; on the contrary, it has already given just that impetus which was necessary for producing installations on a larger scale. In illustration of this, I cannot help mentioning, as the first fruit of the impetus, a remarkable machine, by our countryman Mr. J. E. H. Gordon, which appears capable of feeding from five to six thousand lamps.

But beside the impulse above described, the Bill will have a scientific influence perhaps not contemplated by its original promoters. Under this Act, for the first time in the history of the world, energy will come under the grasp of the law, will become the subject of commercial contracts, and be bought and sold as a commodity of everyday use. It is, in fact, far from improbable that the public supply of electricity will be reckoned and charged for in terms of energy itself. But whether this be literally the case or not, a measurement of energy must lie at the root of every scale of charge.

And, further, since the Act allows no restriction to be placed upon the use of the electricity so supplied, it follows that it may be used, and undoubtedly will be used, at the pleasure and convenience of the customer, either for lighting, or for heating, or for mechanical, or for chemical purposes. This being so, it is clear that the public must by this process become, practically at least, familiar with the various modes of the transformation of force; and the Act in question might, from this point of view, have been entitled An Act for the better Appreciation of the Transformation of Force.

While offering to the public this new commodity, electricians may, in one respect, especially congratulate themselves, namely, that their article is incapable of adulteration. An electric current of a given strength and given electro-motive force is perfectly defined, and is identically the same whether it comes from a Siemens or a Gramme, from a magneto- or from a dynamo-machine, or as suggested by an eminent counsel before the Select Committee of the House of Commons, from one machine painted red or from another painted blue.

It has been said, and perhaps with truth, that the electric light will be the light of the rich rather than that of the poor. But in more ways than one electricity may now become the poor man's friend. The advantages in avoidance of heat and of vitiated atmosphere in workshops and factories have often been pointed out, and may ultimately become an important factor in the physical growth and prosperity of our population. But besides this, when electricity is literally brought to our doors, it will become possible, by converting it into motive power of limited extent, to revive some of the small industries which during the last half century have been crushed by the great manufacturing establishments of the country. There are operations which are capable of being carried out by the wives and families of workmen; there are works of small extent which can be performed more advantageously in a small establishment than in a large one, and it can hardly fail to be a gain to the community if this new departure should give fresh opportunities for the development of our industry in these directions.

The Copley Medal has been awarded to Prof. Arthur Cayley, F.R.S., for his numerous profound and comprehensive researches in Pure Mathematics.

One Royal Medal has been awarded to Prof. William Henry Flower, F.R.S. During the last thirty years Prof. Flower has been actively engaged in extending our knowledge of Comparative Anatomy and Zoology in general and of the Mammalia in particular.

His Memoirs on the Brain and Dentition of the Marsupialia published in the *Phil. Trans.* for 1865 and 1867, established several very important points in morphology, and finally disposed of sundry long-accepted errors.

His paper "On the Value of the Characters of the Base of the Cranium in the Carnivora" (1869), and numerous memoirs on the Cetacea, are hardly less valuable additions to zoological literature.

Prof. Flower has been for more than twenty years Curator of the Museum of the Royal College of Surgeons, and it is very largely due to his incessant and well-directed labours that the museum at present contains the most complete, the best ordered, and the most accessible collection of materials for the study of vertebrate structure extant.

The publication of the first volume of the new Osteological Catalogue in 1879, affords an opportunity for the recognition of Prof. Flower's services in this direction. It contains carefully verified measurements of between 1300 and 1400 human skulls, and renders accessible to every anthropologist a rich mine of craniological data.

The other Royal Medal has been awarded to Lord Rayleigh, M.A., F.R.S.

The researches of Lord Rayleigh have been numerous, and extend over many different subjects; and they are all characterised by a rare combination of experimental skill with mathematical attainments of the highest order.

One class of investigations to which Lord Rayleigh has paid much attention is that of vibrations, both of gases and of elastic solids. The results of most of these researches are now embodied in Lord Rayleigh's important work on the "Theory of Sound," a work which not only presents the labours of others up to the time of writing in a digested and accessible form, but is full of original matter.

The subject of vibration naturally leads on to a mention of other hydro-dynamical researches. Lord Rayleigh has investigated the motion of waves of finite height, and in particular has shown that the "great solitary wave" of our late Fellow, Mr. Scott Russell, has a determinate character; and he has investigated the circumstances of its motion to an order of approximation sufficient to apply to waves of considerable height.

Lord Rayleigh has examined more fully than had previously been done the theory of diffraction gratings, and the effects of irregularities; and also investigated the defining power of optical combinations, and its limitation by diffraction and spherical aberration.

He has lately been engaged in the elaborate re-determination of the B.A. unit of electrical resistance.

The Rumford Medal has been awarded to Capt. W. de W. Abney, R.E., F.R.S. Capt. Abney has contributed largely to the advancement of the theory and practice of photography by numerous investigations. In the Bakerian Lecture for 1880 he has given an account of a method by which photography can be extended to the invisible region below A, which had been hitherto but very imperfectly examined by means of the thermopile.

Making use of plates prepared with silver bromide in a particular molecular condition, Capt. Abney, by means of a diffraction grating containing 17,600 lines to the inch, constructed a detailed map of the infra-red region of the solar spectrum extending from A down to λ 10,650 (Plate XXXI. *Phil. Trans.*,

1880). The lowest limit of this map was fixed by conditions of the diffraction-apparatus, and not by a falling-off of the sensitiveness of the plates at this low point; for, when a prismatic apparatus was used, photographs were obtained which show a continuous spectrum down as far as λ 12,000.

In a subsequent paper (*Phil. Trans.*, 1881, p. 887), Capt. Abney, working with Lieut.-Col. Festing, R.E., applied this new extension of photography to a research on the influence of the atomic grouping in the molecules of the organic bodies on their absorption in the infra-red region of the spectrum. The authors believe that their results indicate, without much doubt, that the complex substances they examined can be grouped according to their absorption spectra, and that such grouping, as far as their experiments go, agrees on the whole with that adopted by chemists. They have more confidence in their results, as they were careful to select such bodies as might be regarded as typical; but, of course, much patient labour of many, for a long period, will be necessary before this new branch of physico-chemical research can be regarded as fully established in any complete form.

Capt. Abney has since carried on his work in this new region of the spectrum at different elevations during a recent visit to Switzerland.

The Davy Medal has been awarded to D. Mendeleeff and Lothar Meyer.

The attention of chemists had for many years past been directed to the relations between the atomic weights of the elements and their respective physical and chemical properties; and a considerable number of remarkable facts had been established by previous workers in this field of inquiry.

The labours of Mendeleeff and Lothar Meyer have generalised and extended our knowledge of those relations, and have laid the foundation of a general system of classification of the elements. They arrange the elements in the empirical order of their atomic weights, beginning with the lightest and proceeding step by step to the heaviest known elementary atom. After hydrogen the first fifteen terms of the series are the following, viz. :—

Lithium	7	Sodium	23
Beryllium	9·4	Magnesium ...	24
Boron	11	Aluminium ...	27·4
Carbon	12	Silicon	28
Nitrogen	14	Phosphorus ...	31
Oxygen	16	Sulphur	32
Fluorine	19	Chlorine	35
		Potassium	32

No one who is acquainted with the most fundamental properties of these elements can fail to recognise the marvellous regularity with which the differences of property, distinguishing each of the first seven terms of this series from the next term, are reproduced in the next seven terms.

Such periodic reappearance of analogous properties in the series of elements has been graphically illustrated in a very striking manner with respect to their physical properties, such as melting-points and atomic volumes. In the curve which represents the relations of atomic volumes and atomic weights analogous elements occupy very similar positions, and the same thing holds good in a striking manner with respect to the curve representing the relations of melting-points and atomic weights.

Like every great step in our knowledge of the order of nature, this periodic series not only enables us to see clearly much that we could not see before, it also raises new difficulties, and points to many problems which need investigation. It is certainly a most important extension of the science of chemistry.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The examiners for the Natural Science Tripos in 1883 are Lord Rayleigh, Mr. Vernon Harcourt (Oxford), Dr. A. M. Marshall (Owens College), Dr. R. D. Roberts, Mr. J. N. Langley, Mr. L. Fletcher (Oxford) of the British Museum, Mr. A. Hill, and Dr. Vines.

The time for the presentation of the report of the Syndicate appointed to frame regulations for the Doctorates of Science and of Letters is extended to the end of next term.

The increased work of the museums and the larger number of departments has caused an excess of expenditure over the ordinary income 3000*l.* allowed by the University, during the past year. The expenditure has included a provision of microscopes for the morphological and physiological laboratories at a cost of nearly 150*l.*, and a Bianchi air-pump for the chemical laboratory, costing 83*l.* The balance which has accrued is 804*l.* which is asked for as a special grant from the chest.

Mr. A. S. Shipley, of Christ's College, has been nominated to study at the Zoological Station at Naples for the first six months of 1883.

A Clothworkers' Exhibition of 52*l.* 10s., tenable for three years, will be awarded by means of the examination of the Oxford and Cambridge Schools Examination Board in July next. The successful candidate must be or become a non-collegiate student at Oxford or Cambridge.

There will be an examination at Gonville and Caius College, beginning on March 9, 1883, for one Shuttleworth Scholarship, value 60*l.* per annum, tenable for three years, open to medical students of the University, who are of at least eight terms' standing. The subjects are Botany and Comparative Anatomy; practical work will be given as part of the examination. The scholarship may be held with any other scholarship at the College, and a candidate may be recommended at the same time for a foundation scholarship. Particulars may be obtained from the Rev. A. W. W. Steel, Tutor of the College.

The following nominations have been made to the Electoral Board of the under-mentioned professorships, with varying tenure of office to secure due rotation :—Plumian of Astronomy: Prof. Stephen Smith (Oxford), the Astronomer Royal, Prof. Adams, Mr. Spottiswoode, P.R.S., Prof. Stokes, the Master of Caius (Dr. Ferrers), Prof. Cayley, and Mr. Todhunter. Mechanism and Applied Mechanics: Sir John Hawkshaw, Lord Rayleigh, Messrs. R. F. Martin, W. Airy, and Coutts Trotter (Trinity), the Master of Emmanuel (Dr. Phear), Mr. W. H. Besant, and Prof. Cayley. Physiology: Prof. Humphry, Prof. Huxley, Mr. J. N. Langley, Prof. Burdon-Sanderson, Dr. Vines, Dr. Pye-Smith, Prof. Paget, Prof. Stokes. Knightbridge of Moral Philosophy, Prof. Caird (Glasgow), Mr. Leslie Stephen, Mr. J. Venn, Prof. Fowler (Oxford), Prof. Hort, Prof. Seeley, Mr. Todhunter, and Dr. Campion. The Boards of Physics and Chemistry and of Biology and Geology hape concurred in recommending that students who have passed in the Mathematical Tripos may be permitted to enter the second part of the Natural Science Tripos without passing in the first part. It is thought desirable to encourage mathematical students thus to take up the practical and experimental work in physics required of the Natural Science students; at present they have not time for studying the elementary parts subjects required of the latter.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, December 7.—Sir J. Lubbock, Bart., president, in the chair.—The following gentlemen were elected Fellows of the Society:—The Rev. R. Baron, F. O. Bower, T. H. Corry, O. L. Fraser, D. Houston, A. W. Howitt, H. McCallum, E. A. Petherick, S. Rous, and H. C. Stone.—The Rev. R. T. Murray showed specimens of *Althæa hirsuta*, *Vicia Orobus*, and *Phlomis fruticosa*, obtained by him last summer in Somerset.—Mr. W. T. Thiselton Dyer exhibited and explained maps illustrative of the rapid spread of Phylloxera in Spain and Portugal, observing that within the last year quite a wide area of the wine-growing districts therein were affected. He also exhibited photographs and made remarks on the Cinchona cultivation in Ceylon.—Mr. W. B. Espeut drew attention to some Kola nuts, and mentioned their remarkable sobering effects after intoxication by spirituous liquors.—Mr. G. Brook read notes on some little known Collembola and the British species of the genus Tomocerus. Tullberg refers to their occurrence in Sweden, but the four species in question have not hitherto been accorded a British habitat.—A paper by J. G. Otto Tepper was read on the discovery of above ninety species of Tasmanian plants near Adelaide, South Australia.—A contribution by Dr. W. Nylander and the Rev. J. M. Crombie was read, viz. on a collection of exotic lichens made in Eastern Asia by the late Dr. A. C. Maingay. Those enumerated were from British Burmah, China, and Japan; some are interesting as illustrative of lichen distribution, and others as new species and varieties.—Remarks on the genera of sub-family Chalcidinæ with synonymic notes and descriptions of new species of Leucospidinæ and Chalcidinæ was a paper by Mr. F. Kirby.—The Rev. R. P. Murray afterwards

made some remarks on cleistogamic flowers of *Hoya carnosa*, producing fertile seed.

Institution of Civil Engineers, December 5.—Sir W. G. Armstrong, C.B., F.R.S., president, in the chair.—The paper read was "On the Sinking of two Shafts at Marsden, for the Whitburn Coal Company," by Mr. John Daglish, M.Inst. C.E.

EDINBURGH

Royal Society, December 4.—The Right Hon. Lord Moncrieff, president, in the chair.—The President, in opening the 100th session of the Society, gave a brief historical statement of its origin.—Obituary notices were read of Mr. Darwin, Prof. Emile Plantamour of Geneva, Mr. Charles D. Bell, Dr. Wm. Robertson, Sir Daniel Macnee, Mr. David Anderson of Morton, Mr. John M'Cull ch, Mr. Samuel Rayleigh, and Prof. Spence. —The Rev. Dr. W. R. Smith exhibited specimens of Dr. A. Guébhardt's electro-chemical method of figuring equipotential lines, which had been sent him by the author.—The Astronomer Royal for Scotland communicated a telegram from J. R. Hind, of the *Nautical Almanac*, correcting the time of ingress of Venus upon the sun's disc.

PARIS

Academy of Sciences, December 4.—M. Jamin in the chair.—The President presented to M. Dumas the medal struck in honour of the fiftieth anniversary of his election to the Academy, and M. Dumas spoke in acknowledgment.—Presentation of tome iii. of the third part of the "Recueil des Memoires, Rapports et Documents relatifs à l'Observation du Passage de Venus sur le Soleil, en 1874," by M. Dumas.—*Résumé* of measurements of the Daguerrian photographs of the Venus transit in 1874 by the French Commission, by MM. Fizeau and Cornu. About fifty selectep photographs from the four stations were measured by two observers or controlled by an equivalent operation. The 94 results represent 33,840 independent points. In a table are shown the values of the ratio of the distance between the centres to the sum and the radii for all the photographs measured.—Memoir on the vision of material colours in motion of rotation, and on the respective velocities, estimated in figures, of circles, one diametrical half of which is coloured and the other half white; velocities corresponding to three periods of their motion, from the extreme velocity to rest, by M. Chevreul. —On a letter of M. Spœrers relative to a peculiarity of solar mechanics, by M. Faye. If there were surface currents from the solar poles to the equator (as Dr. Siemens' theory requires), the spots should be carried in the same direction. But M. Spœrer's observations for twenty years, and those of Laugier, Carrington, and others, agree in showing displacement of spots in latitudes to be either *nil* or insignificant; and if there is any such tendency in spots far from the equator, it is rather towards than from the poles. The retardation observed in surface rotation towards the poles, M. Faye attributes to ascending and descending movements in the internal mass.—Notice on a new optical apparatus for the study of flexure, by MM. Lœwy and Tresca. It consists of three parts (1) at the observer's end a reticule of horizontal wires viewed by a lens, before which is a total reflection prism throwing lateral light along the optic axis; the eyepiece has also movable wires for measurement; (2) at the opposite end, an object holder, with stretched horizontal wires, illuminated; (3) in the middle, a lens with silvered surface, but transparent at the centre, and of such a focus that it reproduces in the plane of the reticule before the eyepiece, either the image of one set of wires by reflection, or that of the other by transparence.—On *rouget* or *mal rouge* of pigs, by M. Pasteur. This disease, called by Dr. Klein (London, 1878) *pneumo-enteritis* of the pig, has destroyed more than 20,000 pigs this year in the Rhone Valley. M. Pasteur considers Dr. Klein quite mistaken as to the nature and properties of the parasite, which is of figure 8 form, and like the microbe of chicken cholera, but finer, less visible, and quite different physiologically. He has found a method of protective inoculation.—Researches on the presence of nitric acid and ammonia in water and snow obtained in Alpine glaciers by M. Civiale, by M. Boussingault.—Order of appearance of first vessels in the leaves of Cruciferæ; demonstration of the distinctly basipetal ramification in these leaves, by M. Trécul.—On the connections (*enchaînements*) of the animal world in primæval times, by M. Gaudry. He gives a sketch of the first part of a projected work on this subject.—Chemical studies on maize (continued), by M. Leplay. This relates to potash and lime-bases in organic combination with vegetal acids or tissues of maize —On the gallicolar Phylloxera, by M. Henneguy.—On the pendulum, by M. Lipschitz.—Formula for determining how many prime numbers there are not exceeding a given number, by M. de Jonquières.—On a mode of transformation of figures in space (continued), by M. Vanecek.—On the transmission of an oblique pressure, from surface to interior, in an isotropic and homogeneous solid in equilibrium, by M. Boussinesq.—On the effect of oil calming the agitation of the sea, by M. Bourgois. Oil affects the breaking of the waves, but not sensibly the undulations themselves.—Method for determination of the ohm, based on the induction by displacement of a magnet, by M. Lippmann.—On the terrestrial induction of planets, and particularly on that of Jupiter, by M. Quet. The planets probably contain iron. With equality of magnetic powers, Jupiter would (next to the sun) exercise the greatest induction on the earth, because of its great volume and rapid rotation; but if its magnetic power were, *e.g.*, ten times that of the sun, variations of the compass might reveal some of the principal periods of that planet. The compass might, within certain limits, show to what point a planet is rich in iron or magnetic substances.—On the currents produced by nitrates in igneous fusion, &c. (second note), by M. Brard. He describes an electrogenerative fuel, which, in any hearth, yields both heat and electricity; and an electrogenerative hearth in which these agents may be generated with any fuel.—On a method of transformation of tricalcic phosphate into chlorinated compounds of phosphorus, by M. Riban.—On a new hydrocarbon, by M. Louise. This is named *benzyleme sitylene*, $C_6H_2(C_7H_7)(C.H_3)_3$. It is got by making benzyl act on mesitylene in presence of anhydrous chloride of aluminium.—On an unalterable linseed powder prepared for poultices, by M. Lailles. The oil is eliminated.—On cerebro-spinal ganglions, by M. Ranvier. —On the microsporidia or porospermida of Articulata, by M. Balbiani.—The migrations of the puceron of red galls of the country elm, by M. Lichtenstein.—Researches on digestion in cephalepod molluscs, by M. Bourquelot.—Geological history of the syssidere of Lodran, by M. Meunier.—Reply to a note of M. Musset, concerning the simultaneous existence of flowers and insects on the mountains of Dauphiné, by M. Heckel.

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