meter column. You have only to imagine a sensitive plate moving at a uniformly rapid rate taking the place of the screen, and you have as the result the photograph (Fig. 10) which I show. Here are the electrical effects of several successive excitations recorded by light with unerring exactitude. In each, the diphasic character is distinct, and you see that the first or negative phase lasts less than a second, but that the positive, of which the extent is much less, is so prolonged that before it has had time to subside it is cut off by another excitation.

It would have been gratifying to me, had it been possible, to exhibit to you other interesting facts relating to the excitatory process in our leaf. It has, I trust, been made clear to you that the *mechanism* of plant motion is entirely different from that of animal motion. But obvious and well marked as this difference is, it is nevertheless not essential, for it depends not on difference of quality between the fundamental chemical processes of plant and animal protoplasm, but merely on difference of rate or intensity. Both in the plant and in the animal, work springs out of the chemical transformation of material, but in the plant the process is relatively so slow that it must necessarily store up energy, not in the form of chemical compounds capable of producing work by their disintegration, but in the mechanical tension of elastic membranes. The plant cell uses its material *continually* in tightening springs which it has the power of letting off at any required moment by virtue of that wonderful property of excitability which we have been studying this evening. Animal contractile protoplasm, and particularly that of muscle, does work only when required, and in doing so, uses its material directly. That this difference, great as it is, is not essential, we may learn further from the consideration that in those slow motions of the growing parts of plants which form the subject of Mr. Darwin's book, "On the Movements of Plants," there is no such storage of energy in tension of elastic membrane, there being plenty of time for the immediate transformation of chemical into mechanical work.

I have now concluded all that I have to say about the way in which plants and animals respond to external influences. In this evening's lecture you have seen exemplified the general fact, applicable alike to the physiology of plant and animal, that whatever knowledge we possess has been gained by experiment. In speaking of Mimosa, I might have entertained you with the ingenious conjectures which were formed as to its mechanism at a time when it was thought that we could arrive at knowledge by reasoning backwards—that is, by inferring from the structure of living mechanism what its function is likely to be. In certain branches of physiology something has been learnt by this plan, but as regards our present investigation, almost nothing, nor indeed could anything have been learnt. Everywhere we find that nature's means are adapted to her ends, and the more perfectly, the better we know them. But, with rare exceptions, knowledge is got only by actually seeing her at work, for which purpose, if, as constantly happens, she uses concealment, we must tear off the veil, as you have seen this evening, by force. Have we the right to assume this aggressive attitude? Ought we not rather to maintain one of reverent contemplation—waiting till the truth comes to us?

I will not attempt to answer this question, for no thoughtful person ever asked it in earnest. Another question lies behind it, which is a deeper and a much older one. Is it worth while? Is the knowledge we seek worth having when we have got it? Notwithstanding that so recently even those who are least conversant with our work have been compelled to acknowledge the beauty and completeness of a life devoted to biological studies, still the question is pressed upon us every hour—How can you think of spending days in striving to unravel the mechanism of a leaf, when you know all the time that if there were no such thing as Dionæa, the world would not be less virtuous or less happy? That is a question which I willingly leave to those who put it. From their point of view it does not admit of an answer; from mine it does not require one. They must go on seeking for and finding virtue and happiness after their fashion; we must go on after ours, striving by patient continuance in earnest work, to learn year by year some new truth of nature, or to understand some old one better. In so doing, we believe that we also have our reward.

THE BRITISH ASSOCIATION

REPORTS

Third Report of the Committee appointed for the Purpose of Reporting on Fossil Polyzoa (Jurassic Species—British Area only). Drawn up by Mr. Vine (Secretary).—A partial examination of the Jurassic Polyzoa was made by Goldfuss (*Petrifacta Germaniæ*, 1826-33), but the author is not aware whether he had any English examples of the types described and figured by him. With the exception of the *Aulopora*, all the types are foreign, and he does not find any reference to British species in his text. In the "Geological Manual" of De la Beche, published in 1832, a list of species is given, but only two are named as found within the British area—*Cellipora orbiculata*, Goldfuss (=*Berenicea*, Lamouroux), and *Millepora straminea*, Phill. In the "Geology of York," ed. 1835, Phillips gave three species only—*M. straminea*, *Cellarea Smithii* (*Hippothoa* (?), Morris's Catalogue), Scarborough, and an undescribed *Retepora* (?). When, in 1843, Prof. Morris published his "Catalogue of British Fossils," there was a large increase of species, but many of these had not been thoroughly worked. In 1854, Jules Haime examined critically the whole of the Jurassic Polyzoa then known, and many English naturalists furnished him with material from their own cabinets so as to enable him to correlate British and foreign types. Lamouroux, Defrance, Milne Edwards, Michelin, Blainville, and D'Orbigny have published descriptions of Jurassic species, and a list of these, so far as possible, will be given at the end of this report. Prof. D. Braun, by the publication of his paper on species found in the neighbourhood of Metz, added materially to our knowledge of French Jurassic types, and later foreign authors, Dumortier Waagen and others, have increased the number of described species. Since the publication of Haime's work, much valuable material has been accumulating in the cabinets of collectors, and Mr. Vine willingly draw up a monograph if desired to do so. In the meantime he offers, in the following report, a rather compact analysis of genera and species known by name or otherwise to the palæontologist.

Classification.—Haime's arrangements of the Jurassic Polyzoa is very simple; all his species, excepting two, are placed in one family, the *Tubuliporidæ*. In the "Crag Polyzoa," 1859, Prof. Busk gave a synopsis of the "Cyclostomata," arranged in eight family groups, which were made to include several Mesozoic types. This arrangement, with a slight alteration, was followed by Smitt, Busk to some extent accepting the modification for the arrangement of recent Cyclostomata in his later work ("Brit. Mus. Cat.," pt. iii., 1875). The Rev. Thomas Hincks ("Brit. Marine Polyzoa," 1880) disallows the family arrangement of Busk in so far as it relates to British species. The *Tubuliporidæ*, Hincks, include, in part, three of the families of Busk. In this report Mr. Vine follows Hincks as far as he is able to do so, as many of the Jurassic species may be included in the family *Tubuliporidæ* as now described. It will, however, in the present state of our knowledge at least, be impossible to arrange the species stratigraphically, as many, having the same type of cell, range from the Lias upwards. As far as the author is able to do so, he gives the range of the species, beginning, of course, with the lowest strata.

CLASS POLYZOA. Sub-order *Cyclostomata*, Busk. Fam. I. *Crisidæ*, Busk.—No fossils belonging to this family are at present known to have existed in the Jurassic epoch.

FAM. II. 1880. *Tubuliporidæ*, Hincks.—*Zoarium* entirely adherent, or more or less free and erect, multiform, often linear, or flabellate, or lobate, sometimes cylindrical. *Zoœcia* tubular, disposed in contiguous series or in single lines. *Oœcium*, an inflation of the surface of the zoarium at certain points, or a modified cell" (vol. i. p. 424).

1825. *Stomatopora*, Bronn. 1821. *Alecto*, Lamx.; 1826, *Aulopora* (pars), Goldf.—The Reporter has already done partial justice to the uniserial *Stomatopora*, found in the Palæozoic rocks of this and other countries. He has again studied the species described by James Hall, Prof. Nicholson, and himself, and he cannot, at present, detect any generic character in the species that may be used by the systematic palæontologist to separate the Palæozoic from the Mesozoic types. He must, therefore, regard the *Stomatoporæ* of the two epochs as one, though the sequence is broken in the Palæozoic—no species having as yet, he believes, been recorded from the Carboniferous series of this or any other country.

In our modern classification (Hincks) we have a sub-genus, *Proboscina*, which links together the genera *Stomatopora* and *Tubulipora*. Haime's second genus is also called *Proboscina*, but there seems to me to be a great difference between the recent and fossil species. The type of the recent sub-genus *Stomatopora incrassata*, Smitt, is a very peculiar species as regards the cells, and he knows of no Jurassic type that can compare with it.

Terebellaria. Lamouroux.—"A fossil, dendroid polypary, composed of cylindrical scattered branches, spirally twisted from left to right or from right to left indifferently; pores prominent, almost tubular, numerous, disposed quincuncially, and more or less inclined according to their position with the spires." Lamouroux says the genus should be placed after the *Millepores* and before the *Spiroporæ*, remarking "that the *Spiroporæ* have the cells or the pores projecting as in *Terebellaria*, but that this character is observable only in well-preserved specimens. When the prominent part of the spire has been worn by attrition, it looks like a narrow riband wound round the branch." The fossils which ordinarily pass for species of *Terebellaria* in the cabinets of collectors are a very curious group that may be more closely studied. Mr. Vine's studies are made from specimens from the Cornbrash, and Bradford Clay of Bradford and Stanton, Wilts, and it is from this locality that the School of Mines specimens were obtained. To properly master the details of colonial growth, it will be necessary to isolate a single colony. The one furnished by Haime as a specimen of a young colony on stone shows a tapering proximal point, gradually widening by the addition of cells, till a certain fan-like shape is arrived at. A similar growth to this is found in young colonies of *Diastopora*. If superficially examined, it will be seen that the cells are peculiarly arranged, beautifully punctured, with an orifice sometimes circular, at other times semi circular, and sometimes the cell characters of portions of the colony bear a resemblance to *Bidiastopora ramosissima* of D'Orbigny. A complete and critical examination of the type will show that any fragment of stone or shell is sufficient to form the nucleus of a colony. It begins with a primary cell and then enlarges in a spiral direction, but to what extent the riband-like growth would be carried without a check I am unable to say. In another direction a similar colony will be developed, the distal cells of which will ultimately meet and coalesce, both colonies striking out in fresh directions till met by another check, the growth not always being in an upward direction. The dendroid character of species is perfectly accidental.

Genus *Diastopora*, Lamx. Sy. with *Berenicea* (pars), Lamx.—Mr. Vine accepts this genus, in its wider sense, as defined by Hincks; yet he hardly thinks that it will be possible to include the whole of the foliaceous forms of the Jurassic period in one group. In this report he adheres to the arrangement of Busk, as he has done in his two papers on the Diastoporidæ, keeping the foliaceous types for distinct study. At the same time he is willing to admit that in getting rid of one difficulty in our grouping we open the door to admit others. Haime admits both the encrusting and foliaceous types, accepting the genus *Berenicea* for the encrusting, and *Diastopora* for simple-foliaceous and retiform species. Prof. Braun, in his Jurassic studies, separates the species *Diastopora foliacea* from the group, and establishes another, which he calls *Elea*, claiming for his type certain peculiarities which have been entirely overlooked by authors. It is very certain that the more closely we examine Jurassic Polyzoa and compare them with modern species of the genus *Diastopora*, the more divergent the types appear; and although we would rather accept a simple than an elaborate classification, still there are limits beyond which it is not wise to go.

BISERIAL DIASTOPORA, Milne Ed. *Mesenteripora*, Blainville; *Bidiastapora*, D'Orb; *Ditaxia*, Hagenow.—It is well that the encrusting and biserial *Diastopora* should be separated, but not widely so. In the choice of the above names he has selected the simplest—*Diastopores biserialares* of Milne Edwards—because it has the precedence of the *Bidiastopora* of D'Orb. Busk—in the "Crag Polyzoa" and in the "Brit. Mus. Cat." pt. iii—has chosen Blainville's name for this division of the group. Mr. Vine's chief objection to Blainville's term for the biserial species may be found in the diagnosis as given by Busk: "Cells in two layers, parted by a calcareous septum," In all the specimens figured in "Crag Polyzoa" (Plates xvii. Fig. 2; xviii. Fig. 4; and pl. xx. Fig. 2, pp. 109, 110) of *Mesenteripora meandrina* the transverse sections of the foliaceous zoarium are shown to have this septum very distinct. In many of Haime's figures where cross sections are given, the septa are also shown to be present. It seems to him, judging from the foliaceous specimens in my own cabinet, that this "calcareous septum" is only an apparent, and not a real character. If sections are made in a line with the cells, the only axis visible is that made by sections of the cell walls. In a cross section of the foliations there is an apparent septal division, but the more closely this is examined the less real will it be. The septal divisions of *D. scobinula*, *D. Terquemi*, and *D. cervicornis*, as given by Haime, show one, two, and three sections of cells on either side of the septal line; and specimens of Inferior Oolite species found in the neighbourhood of Cheltenham are in many respects of a similar character. As Mr. Vine has been able to examine only a very limited number of species, he would be glad to have more detailed information if students of our Oolitic Polyzoa will address their attention to this point. Meanwhile, by selecting the divisional name of Milne Edwards, he does not commit himself to any generic name dependent upon a questionable structural character.

1822. *Intricaria*, Defranc. 1830. *Cricopora*, Blainville. 1840. *Meliceritites*, Roemer. 1850. *Entalophora*, D'Orbigny. 1853. *Cricopora*, *Spiropora*, *Tubigera*, *Meliceritites*, *Laterotubigera*, *Entalophora*, D'Orb. Palæontology.—He has already vindicated by use and preference the retention of this genus for species of Palæozoic Polyzoa. He still retains the name for species of the genus very common in the Mesozoic rocks. He has also given the synonyms with their dates of genera intended to supersede Lamouroux's original term. It may be as well to define and limit the genus as applicable for the reception of Palæozoic, Mesozoic, and Cainozoic species. He is not aware that any recent species of Polyzoa can be included in the group.

FAM. III. HORNERIDÆ, Hincks.—This family contains only one genus, *Hornera*. There is no representative of the family, in Brit. Jurassic Rocks at least, and he is not aware of any recorded species of the genus in foreign Oolites. As the Rev. Thomas Hincks says that "the genus HORNERA is connected with TUBULIPORIDÆ, through *Idmonea*," to which it bears in many points a very close resemblance, in all probability early types of the genus, as defined by him, may yet be found in either the Jurassic or Cretaceous rocks. The *Siphodictyum*, of Lonsdale, is given as one of the synonyms of Hornera.

FAM. IV. LICHENOPORIDÆ.—This is the last family given by Hincks in which Jurassic Polyzoa can be placed. The genus *Lichenopora* of Defranc has also a number of synonyms, but as species of the genus are rare in the Oolites, we find only one recorded. Haime says the genus has not been represented until now, other than by Tertiary or Cretaceous fossils. In *Lichenopora Phillippsii*, derived from the Great Oolite of Hampton Cliff, the *zoarium* is disciform, very slightly elevated, and adherent only by the middle of its inferior face. The upper surface resembles a fungus, with unequally developed rays formed of a series of long zoœcia, ordinarily doubled. The peristomes are polygonal, regular, and closely connected.

1835. *Neuropora*, Bronn.; *Chrysaora*, Lamx; *Filicaria*, D'Orb.—Species belonging to this genus are present in our British Oolites, in the Bradford Clay, and Cornbrash, but he has not been able to secure specimens to operate upon so as to study the internal characters. Dumortier describes several species from the Middle Lias, Haime describes three from the Great Oolite of Ranville and Hampton Cliffs, and Prof. Brann says that it extends from the Lower Lias onward into the White Jura and also into the Great Oolite of Ranville. It is also found about Metz. Through the kindness of Prof. Roemer of Breslau Mr. Vine had supplied to him the species of *Ceripora*, Goldfuss, which are referable to this genus, but the types differ in many particulars from our own species.

1834. *Heteropora*, Blainville.—We have now left one group of Oolitic Fossils which within the last few years have been more closely studied than any of the others, because of their supposed relationship with the Palæozoic *Monticulipora*. In his "Pertifactions of Germany," Goldfuss placed in the genus *Ceriopora* three species, which he describes and figures as containing large and small openings on the surface of the branches. These were *Ceriopora anomalopora*, *C. cryptopora*, and *C. dichotoma*, all of which were from the Mastricht beds of Astrupp or Nantes. In 1834 M. de Blainville separated these from the *Ceriopora* of Goldfuss, and established another one for their reception which he called *Heteropora*, assigning as essential structures the two sorts of openings, but giving very few details respecting the genus. After this Milne Edwards added to them *Millepora dumitosa* and *corigera*, Lamouroux. In his "Miocene Fossils of North America," Mr. Lonsdale complained of the inadequate description of Blainville as not having in it sufficient details "to enable an opinion to be formed of its complete characters, or of the nature of the minor openings." This error was to some extent rectified by Lonsdale, and we owe to him the merit of being the first author who clearly indicated upon sufficient grounds the real zoological position of the genus.

Report of the Committee on Electrical Standards.—Mr. Taylor had been engaged during the past year in determining the effect of the annealing of wires on the temperature co-efficient of their resistance. The experiments were not yet concluded, but so far they had shown that the effect of annealing was enormous, in some cases altering the temperature co-efficient by as much as 50 per cent. The Committee hoped that Lord Rayleigh would arrange a system for testing resistances at the Cavendish Laboratory. In connection with this report Lord Rayleigh made some remarks *On making Standard Resistance Coils equal to Multiples of an Original Unit Coil*. The usual method is to make a copy of the unit coil; by combining these, a coil of two units can be made, then of four, five, and so on. By this means the errors would accumulate. The method he proposed was simpler than this. Three coils each of three units resistance, placed in multiple arc, are equivalent to one unit, whilst in series the resistance amounts to nine units. This, with the addition of the original unit, makes a resistance of ten units. The observations should be made quickly after one another, and he explained an arrangement of mercury cups by which this was effected with rapidity.

Report of the Committee on Meteoric Dust, by Prof. Schuster.—The report referred to the work of M. Tissandier, who has found magnetic particles of iron in the dust gradually settling down in dry weather, or precipitated by rain or snow. These particles are of various shapes, but the most remarkable form is a spherical one, which conveys the obvious information that the particles at one time must have been in a state of fusion. These have been found in the snows on the slopes of Mont Blanc, at a height of nearly 9000 feet, in the sediment of rain collected at the observatory of Sainte Marie du Mont, and in the dust collected at different elevated positions. For an explanation of these magnetic spherules we are reduced to three alternatives. The particles may be of volcanic origin, they may have been fused in our terrestrial fires, or they may be meteoric. All the volcanic dust which the author has had at his disposal was carefully examined under the microscope, but its appearance was found to be altogether different from the supposed meteoric dust. Such also seems to be the conclusion arrived at by Tissandier. No iron spherules to the author's knowledge have been found in volcanic dust. The smoke issuing from the chimneys of our manufacturing towns contains iron particles similar in appearance to those to which Tissandier ascribes a meteoric origin. That some of these particles are found very far from any terrestrial sources which can produce them, would not perhaps tell conclusively against their terrestrial origin, but chemical analysis seems to settle the point. The iron particles issuing from our chimneys contain neither nickel nor cobalt, while these metals were found by Tissandier to exist in the microscopic magnetic particles found in rain-water collected at the observatory of Sainte Marie du Mont. We are, therefore, driven to ascribe a cosmic origin of these particles. During the last year the author has examined microscopically small iron particles from the sand near the great pyramids, from the desert of Rajpootana, and from the Nile mud near the village of Sohag. The sand from the pyramids contains an appreciable quantity of magnetic particles. The great part of these particles are angular, and doubtless are due to the *débris* of magnetic rocks; but here and there spheres are found exactly like those described by Tissandier, and about the same diameter, that is 0·2 to 0·1 mm. The Rajpootana sands are not yet completely investigated, but as yet there has been no appearance of metallic iron. The author then passes on to consider the *débris* left behind in our atmosphere by the passage through it of shooting-stars. Tissandier has examined the dust found on meteors, and has found that it resembles in appearance the magnetic particles found in other places. The question arises, how is it that the red hot sparks from the meteors do not get oxidised, and the author pointed out that at high elevations the proprotion of oxygen in the atmosphere is very small, at a height of 100 kilometres being about 4 per cent. of the whole, supposing the temperature the same throughout the atmosphere. He also drew attention to the fact that a line in the spectrum of the aurora has not been recognised as belonging to any known substance, and from his experience in observing the spectra of oxygen and nitrogen under very various conditions, he felt convinced that it was not due to oxygen or nitrogen, but to some unknown gas of very small density. He pointed out that at a great height the density of this would only very slightly be diminished, and although of extremely small density, would nevertheless form by far the largest part of the atmosphere there. Consequently the meteoric sparks would only meet a very small proportion of oxygen. He mentioned that the spherules might be easily produced artificially by moving a file over a copper wire conveying a current of electricity. Collecting the sparks which fly off, these were found to contain a large proportion of spherules similar to those referred to meteoric origin, together with angular specimens such as had been found in some of the sands.

In *the Report of the Committee on Wind Pressure* it was stated that the maximum pressure on small plane surfaces had been ascertained to exceed 80 lbs. and even 90 lbs. per square foot. The pressure over any large area was still a matter of considerable uncertainty, but it was possible that the maximum pressure of 56 lbs. allowed by the Board of Trade might take effect over the whole of very exposed structures. The cases of wind and water pressure were somewhat analogous, at any rate with regard to the proper method of determining the relative exposure in various positions. In the latter case this might be done by a comparison of the readings of anenometers differently located.—Prof. W. C. Unwin remarked that some form of pressure guage of considerable delicacy was needed which could be applied to all parts of a roof. Mr. Barlow said that the Board of Trade rule was capable of being amended, and this no doubt would be done as soon as further knowledge was forthcoming; in the proposed Forth Bridge 3000 tons of steel would be employed for resisting wind pressure.

In the *Report of the Committee on Screw Guages* it was stated that there is at present no universally recognised form of screw-thread and no specified number of threads to the inch. For telegraphic and electrical apparatus some coherent and uniform system is much wanted. The report gave an account of the efforts made in Switzerland towards this end, and explained the screw guage finally adopted by that country. Much credit is due to Sir Joseph Whitworth for his important work in connection with the improvement of the system in England. The Committee asked to be re-appointed.

SECTION A—MATHEMATICAL AND PHYSICAL

On a Similarity between Magnetical and Meteorological Weather, by Balfour Stewart, M.A., L.L.D., F.R.S., Professor of Physics at the Owens College, Manchester.—It has been hitherto supposed that there is no traceable likeness between the magnetical and meteorological changes of the globe. The former have been imagined to be of a cosmical nature affecting all parts of the earth at the same moment of time, while the latter are well known to be of a local and progressive nature. As a matter of fact, all attempts to trace a likeness between simultaneous magnetical and meteorological phenomena have been without success.

There is however one class of magnetical phenomena that are of a progressive nature. I allude to the diurnal variations of the magnetic elements caused by the sun. Of these the solar-diurnal variation of the magnetic declination—that is to say the variation of the position of a freely suspended magnetic needle is that which has been most observed and best understood.

It has been noticed that the diurnal progress of this variation is not unlike that of atmospheric temperature; the hourly turning points in both being pretty nearly the same. Both phenomena too are regulated by the local time at the place of observation, and hence are of a progressive nature, travelling with the sun in his apparent course from east to west. Both phenomena too are subject to a well-marked annual fluctuation, the diurnal temperature range, for instance, or the difference between the indications of the maximum and the minimum thermometers being greater in summer than in winter; and in like manner the diurnal declination range or the difference between the east and the west positions of a suspended magnet being greater in summer than in winter. Finally both phenomena appear to be subject to the influence of something which may be called *weather*. Sometimes we have very hot days and cold dry nights in which the diurnal temperature range is very great, succeeded by close rainy weather in which the diurnal temperature oscillation is very small. In like manner we have sometimes a very large and at other times a comparatively small diurnal oscillation of the magnetic needle, so that it too is affected by the influence of magnetic weather. The question which I now wish to put is the following: Is there any connexion between these two weathers? between the temperature-range weather, and between declination-range weather, both defined as above?

Now there is I think preliminary evidence to show that both kinds of weather are due very greatly, if not altogether, to changes in the sun, a large declination-range, and a large temperature-range denoting an increase of solar power. There is also evidence that temperature-range weather once produced travels from west to east, taking probably on an average eight or nine days to cross the Atlantic.

There is also, I think, preliminary evidence that declination-range weather travels likewise from west to east, but quicker than temperature range weather, taking about two days to cross the Atlantic.

Now if this be true it might be expected that the declination-range weather of to-day should be found similar to the temperature-range weather six or seven days afterwards, so that by a study of the declination-range weather of to-day, we should be able with a certain measure of success to predict the temperature-range weather six or seven days afterwards.

I have here given the train of thought which led to this investigation, but, I ought to say that the results obtained do not depend upon the exact truth of every step of this train of reasoning.

This is in reality a matter of fact investigation undertaken with the view of ascertaining whether or not there is any recognisable connexion between these two weathers in Great Britain. The result obtained I may add was reported to the Solar Physics Committee, and by them communicated to the Royal Society.

In order to avoid as much as possible the influence of locality, I obtained through the kindness of the Meteorological Council the diurnal temperature ranges at Stonyhurst, Kew, and Falmouth for the years 1871 and 1872. I obtained likewise through the kindness of the Kew Committee, the diurnal ranges of magnetic declination at the Kew Observatory for the same two years, excluding disturbed observations. The temperature ranges discussed are therefore the means of those at the three observatories above mentioned, and still further to tone down or equalize individual fluctuations, the daily numbers exhibited are each the sum of four daily ranges the two before and the two after. Finally the object being to represent fluctuations of range rather than their absolute values, a daily series representing the mean of twenty-five daily numbers has been obtained. Each daily number is thus compared with the mean of twenty-five daily numbers both columns being symmetrically placed with regard to time and the differences whether positive or negative between the two columns is taken to represent temperature-range fluctuations.

A precisely similar course has been taken with respect to the Kew declination ranges.

By this means two years of daily numbers, sometimes positive and sometimes negative, representing temperature range weather, and two years of daily numbers sometimes positive and sometimes negative representing declination range weather, have been obtained. The next object is to compare the two series with one another.

Now when two series of waves representing elevations and depressions come together it is well known that we shall have the greatest result when the crests of the one series coincide with the crests of the other, and the smallest result, perhaps even none at all, when the crests of the one series coincide with the hollows of the other. This indeed is the well known explanation of musical beats.

Now if there be any marked likeness between the two weathers and if it be true that declination-range weather precedes temperature weather by six or seven days, the algebraic sum of the two sets of fluctuations representing these weathers will be greatest when the declination is pushed forward in point of time so that the declination fluctuations of to-day shall be summed up with the temperature fluctuation six or seven days after.

For suppose that the declination fluctuation of to-day is represented by a very large positive number; if the above theory be true, the temperature fluctuation six or seven days afterwards will be represented by a large positive number also, so that we shall have the addition of two large positive numbers, whereas, if we add the declination weather of to-day to the temperature weather of to-day it may chance that we are really adding a large positive to a large negative quantity in which case the result will be very small. It may also happen that this amount of precedence of declination-weather is greater at one season of the year than at another.

We have therefore to pursue a plan somewhat of the following nature. Take a month's temperature-weather say for the month of August and add to it a month's declination-weather, extending say from July 21st to August 21st, let the sum be 262. Here the declination month has been pushed forward 11 days. Next push it forward 12 days and let the sum be 273, then 13 days and let the sum be 276, next 14 days and let the sum be 270. It thus appears that the greatest sum is got by pushing the declination forward 13 days, and we may therefore presume that at this season of the year 13 days denotes the precedence of the declination weather.

On this principle the following table has been constructed.

Table showing by how many days the declination-range fluctuation precedes the corresponding temperature-range fluctuation.

Corresponding to middle of month.	Precedence of Declination. First year.	Second year.	Mean.
January	—	8	8
February ...	6	4	5
March	6	5	5·5
April	5	5	5
May	9	9	9
June	9	9	9
July	12	11	11·5
August	13	13	13
September ...	9	10	9·5
October ...	7	5	6
November ...	10	7	8·5
December ...	12	—	12

It thus appears from each year that the precedence of declination is smallest about the equinoxes, and greatest about the solstices, and it seems probable that were a considerable number of years so treated, more exact values would be obtained. Having thus determined the amount of precedence of the declination from month to month, the next point is to ascertain to what extent the two fluctuations when brought together in a manner regulated by this precedence show any distinct resemblance to each other. This has been done in a graphical representation which accompanies the report above-mentioned and I think I may say that there is a considerable likeness between the two curves, the one exhibiting temperature-range weather and the other declination-range weather so pushed forward.

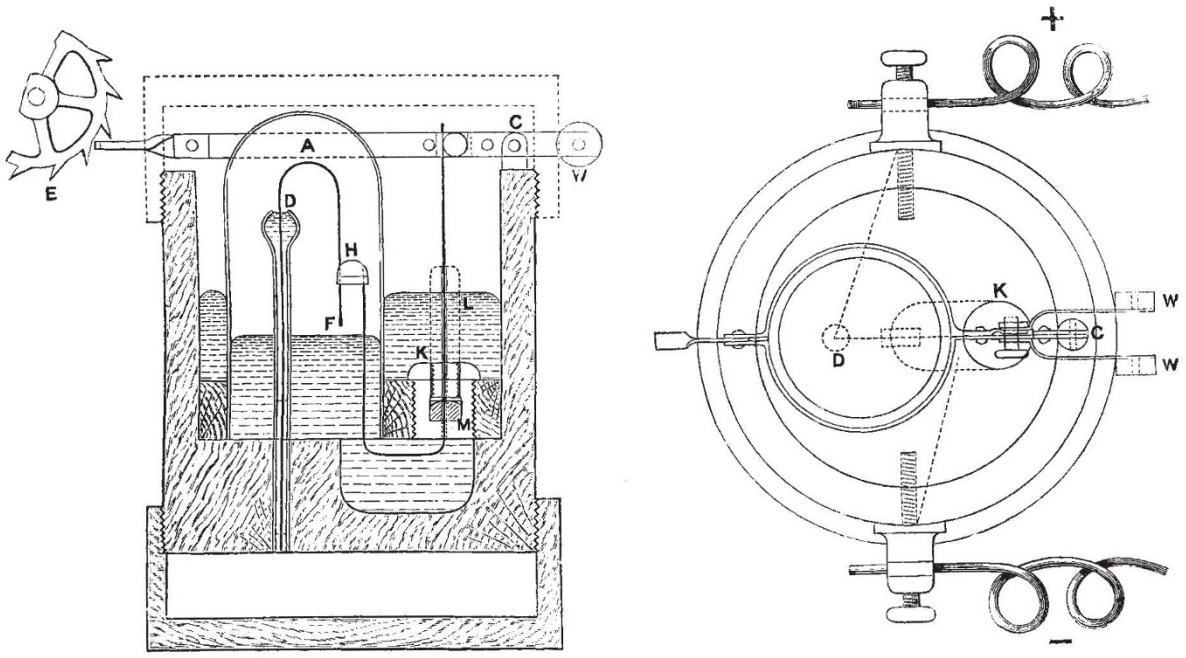
It would thus seem as if a comparison of magnetical and meteorological weather might be made a promising subject of inquiry besides being one which may perhaps lead to results of practical importance.

On a Supposed Connection between the Heights of Rivers and the number of Sunspots on the Sun, by Prof. Balfour Stewart, M.A., LL.D., F.R.S.—While a connection between the state of the sun's surface as regards spots, and the magnetic state of the earth, may be considered as well established, the fact of a connection between sunspots and terrestrial meteorology is still *sub judice*, and without attempting to assert the truth of such a connection, the following may perhaps be regarded as a slight contribution tending to throw light upon the subject. The heights of the rivers Elbe and Seine have already been examined by Fritz, who reported in favour of such a connection as would make a great height correspond to a large number of sunspots, and all that I have done has been to treat the evidence in a somewhat different manner. I divide each sun period without regard to its exact length into twelve portions, and put together the recorded river heights, corresponding in time to similar portions of consecutive sun-periods. I find by this means residual differences from the average, representing the same law whether we take the whole, or either half of all the recorded observations, and whether we take the Elbe or the Seine. This law is that there is a maximum of river height about the time of maximum sunspots, and another subsidiary maximum about the time of minimum sunspots. It is of interest to know whether the same behaviour is followed by the River Nile. Through the kindness of General Stone Pacha, and through the Science and Art Department, South Kensington, information has been obtained about this river. This information shows us that the Nile agrees with the European rivers in exhibiting a maximum about the times of maximum sunspots and a subsidiary maximum about the time of minimum sunspots, only the subsidiary maximum is greater than for the European rivers already named. It also appears that the date of maximum height of the Nile is latest on these years for which the yearly height is greatest. Now the present year is, perhaps, not very far removed from a solar maximum, and I am thus induced to think that the Nile may this year be somewhat late in attaining its maximum rise.

Contact Makers of Delicate Action, by Prof. H. S. Hele Shaw.—The author has been engaged in designing a speed indicator in which it is essential to have the uniform motion of a revolving disk. This disk is subject to varying resistance, so that for driving it, clockwork, even though powerful and expensive, could scarcely be depended upon. It therefore seemed best to employ an electro-magnet acting on a ratchet wheel and controlled by a clock. This clock for the purpose might then be a common one, with lever escapement. Upon enquiry there appeared to be no contact maker at once, absolutely reliable, suitable for continuous use, and at the same time sufficiently delicate in its action.

In an instrument of this kind for completing circuit it is necessary to ensure such a close approach of the surfaces forming the opposite poles as practically amounts to absolute contact. With small differences of potential and without previous contact, the exact distances across which the current will flow appears to be at present unknown. According to Prof. Guthrie the terminals of 50 or 60 grove cells may be brought to within 1-1000th of an inch without any indication of the passage of a current. Prof. Tyndall says that a battery of more than 1000 cells is required to cause a spark at 1-1000th of an inch, and Prof. Sylvanus Thompson mentions 1-10,000th of an inch as the distance. To ascertain the quantity exactly, appears impossible without the use of an instrument of such refinement as Whitworth's millionth measuring machine, a modification of which might be very appropriately employed for the purpose. The distance no doubt is extremely small, and the consequent difficulty in the way of ensuring electrical contact when the opposite poles are the surfaces of two solids, seems to merit a brief consideration.

The ways in which two such surfaces are brought together may for convenience be divided into (1) a relative motion of the two terminal surfaces, normal to both; (2) a motion tangential to both; (3) a motion compounded of these two. The first mode is very common with rapid contact makers, such for instance of those with electric bells and telegraphic transmitters, but these require an appreciable amount of force to work them. That contact makers of this kind are not suitable with delicate clocks is the testimony of every clockmaker to whom the author has spoken One of these instruments of very delicate construction required the weight of nearly one gram to ensure electrical contact, and then could not be entirely relied upon. There is no doubt that when two surfaces of solids touch only lightly the area of contact is exceedingly small. This area may be made



Sectional Elevation. Plan.

Electrical Contact Maker (full size).

to increase by increasing the pressure with which they are brought into contact. The conditions of the problem under consideration do not admit of this being done to any appreciable extent. Thus, even when chemical compounds are prevented from forming on the surfaces, dust and particles floating in the air are liable to become deposited between them, and render contact uncertain.

For these reasons contact of the second kind which is known as rubbing or sliding contact has been largely adopted. This action may be made perfectly reliable, and is suitable where the motion is not rapid as for instance with switches and commutators. But considerable energy may be absorbed in overcoming friction. Those clockmakers who employ it, appear to do so only for large clocks. The third method has, as far as the author is aware, been adopted in only one way, though in that way with eminent success. A contact maker of this kind is used by Mr. Hargreaves of Leeds, who has had it at work for fifteen years. A metal roller with rounded edge runs upon and between two metal rails of circular section, thus making contact between them. Contact is broken when the roller passes over a gap or joint to another pair of rails. When the roller is moving along the rails, there is a slight rubbing action, by reason of its resting between them. This is almost certain to produce electrical contact, which is even found to occur without failure when the whole is covered with dust. The metal employed is gold, which with a weak current, is found to last much better than even platinum. With a strong current the metal oxidises, and moreover, though working admirably with a heavy pendulum, the resistance is too great for a delicate escapement to overcome.

The use of a liquid terminal with which the the other terminal (being solid) is brought into contact obviates most of the foregoing difficulties. Of all liquids mercury is the only one which can be practically employed. There are two objections to its use which have hitherto prevented its being used for more than temporary and experimental purposes:—

1. The fact that it readily combines with oxygen on the passage of an electric spark.

2. The difficulty of rendering a contact maker of this kind portable.

The author has endeavoured to overcome the first of these by causing contact to be made in a gas which has no action on the mercury. The way in which this is done is as follows: A short glass tube closed at its upper end (such as an inverted test tube) is filled with mercury, and inverted in a vessel of mercury. The mercury is then partially displaced by hydrogen gas. A very light bent lever working on a pivot is connected with a platinum

wire, which passes through the mercury into the gaseous space. It there makes contact between the mercury below, and a smaller quantity in an insulated capsule within the tube. The lever is worked from the outside by mere contact with the escapement wheel of an ordinary clock, which owing to its extreme sensitiveness is quite sufficient to do this. The positive and negative poles of the terminals are connected respectively with the mercury in the capsule and that in the vessel. It is evident that although the lever is always in electrical contact with the mercury in the vessel, the circuit is only completed when it is brought into contact with that in the capsule.

Various experiments have been made with this instrument, and the result has been completely satisfactory. With a battery of fifteen Grove cells the surface of the mercury was brighter at the end of half an hour than at the beginning of the experiment, although a much more brilliant spark was visible than when contact was made in air. After three weeks of intermittent working for periods of sometimes as much as twelve hours but with weaker batteries, the mercury remained quite clean.

The present form of the instrument is shown in the annexed figure. The general action is similar to the one already described A, being the gaseous space, D, the capsule of mercury, E, the escapement wheel. The chief improvements to be noted are:—

1. Contact is made and broken at F instead of at D, thus preventing sensible loss by volatilization from the small quantity of mercury in the capsule. The wire D F is insulated from the bent lever by the glass junction at H.

2. Portability is secured by having a plug, K, shown in dotted lines, which can be screwed down and a gland L, by means of which the wire can be packed by an india rubber washer, M. The lever and balance weights, W W, are made to go within the lid which can be taken off the bottom and screwed on to the top (as shown by the dotted lines). This keeps in any loose mercury above the plug.

3. The lever is so arranged that contact is only of momentary duration, a point of no little importance in connection with the constancy of the battery.

SECTION C—GEOLOGY

On the Geology of the Channel Tunnel, by Prof. W. Boyd Dawkins, F.R.S.—He laid special stress on the fact that the line of faults both on the English and French coast are small, neither of them have throws of more than 38 feet, and even this magnitude is rare, he therefore considers the chances of the older porous rocks being thrown by them is well nigh impossible. He considers, however, that in some cases this fault acts as ducts conveying water downwards, and he ascribes to one of these faults the well-known springs on Abbot's Cliff, known as the "Lydden Spout." 1. The lower beds of the chalk marl and the lower part of the grey chalk, are the only strata in the chalk sufficiently impervious to allow of the construction of a tunnel in the dry. 2. That the outcrop of the chalk marl between Folkestone and the Shakespeare Cliff, is the best position for a tunnel, which could strike the lower part of the chalk marl, and remain in it throughout, so as to join the workings of the French Channel Company, which are being carried on in the same horizon. 3. That the faults in the lower part of the chalk would not now allow of free percolation of water, and are not likely to become a serious obstacle to the work. 4. That the strata above the chalk marl are so porous and traversed by open fissures that they allow of free access to water both sub-aërial and marine. He considers that on the French side the rocks are far more shattered and faulted, and more open to be traversed by water, which is now, however, being successfully contended with by the French Company. The author refers to analyses made of samples of cretaceous rocks. Insoluble material in gault was 45 per cent.; chalk marl (No. 1), 75 per cent.; and only 6 per cent. in the more soluble part of the grey chalk; over the yellow chalk 18 per cent.; while above this it is only 2 per cent. in the lower white chalk without flints. He described the work done by Sir John Hawkshaw in having soundings taken in the English Channel to ascertain the character of the Channel bottom.

On the Proposed Channel Tunnel in its Geological Aspects, by C. E. De Rance, F.G.S., described the sub-divisions found in 1874 in the chalk of Abbott's Cliff, by Mr. Hilton Price and himself, and the impermeable nature of the lower beds, which support a sheet of water met with in springs at the outcrop, and in wells at various points. He regards these underground waters as circulating in the porous white chalk under the sea, and he considers that the artificial abstraction of water by pumping, in making the proposed tunnel in St. Margaret's Bay, will allow the percolation of sea-water to the extent of a million gallons of water in each mile driven daily, and therefore offers great difficulties in the way of the construction of a sub-marine tunnel which are not presented by the lower beds of the chalk marl.

Evidence of Wave Action at a Depth of 40 *Fathoms in the English Channel*, by A. R. Hunt, B.A., describes 16 localities in which pebble have been dredged off the Start Point in 34 fathoms of water, and the discovery of a soda water bottle covered with Serpulæ, and containing 36 species of shells which have been washed in, at a depth of 40 fathoms, by a Brixham trawling fishing boat.

List of Works on the Geology and Palæontology of Oxfordshire, Berkshire, and Buckinghamshire, by W. Whitaker, B.A.—This is a continuation of the County or District Lists, of which a catalogue was given at the head of the Welsh List in the Report for 1880; the present list contains nearly 300 references.

On the Equivalents in England of the "Sables de Bracheux," and of the Southern Limits of the Thanet Sands, by J. Prestwich, M.A., F.R.S.—The author dwells on the importance of establishing in adjacent separate basins, a certain number of well-defined horizons. The lignitic and freshwater beds of the Paris Basin, and of the Woolwich and Reading series, form one such, but he considers the correlation of the beds beneath to be not yet satisfactorily established. The author correlates the Mancheux sands with the lower ends of the Woolwich series, and he is confirmed in this view by M. Desharges, and he further is of opinion that the Thames sands are absent in the Paris Basin.

On the Formation of Flints, by Prof. W. J. Sollas, M.A.—Flints are siliceous pseudomorphs after chalk. Three different stages in their formation are to be distinguished: (1) the silicification of the foraminifera, coccoliths, and calcareous granules of the chalk gives rise to *siliceous chalk;* (2) a deposition of silica follows and produces white or *grey flint;* (3) as the deposition of silica continues it fills up and obliterates the pores of the opaque grey flint, rendering it black and translucent, thus the common *black flint* results. Flint nodules are sometimes found in which all three stages are still represented, but more frequently only the last two: thus grey spots and blotches are seldom absent from black flint, whilst in many cases the two kinds regularly alternate and thus produce the phenomenon of banded flint, which has up to this time remained without any satisfactory explanation.

On some Fossils from the Inferior Oolite, by the Rev. G. F. Whidborne, M.A., and Prof. W. J. Sollas, M.A.—Describes bivalve shells of mollusca chiefly in the Jermyn Street Museum, and 8 new species of sponges, of which 4 belong to 4 new genera.

Mention of an Example of an Early Stage of Metamorphic Changes in an Old Red Sandstone Conglomerate near Aberfoil, by Prof. James Thomson, LL.D., F.R.S., describes fractured quartzite pebbles which he regards as originally a plastic body, which first bent, and then broke, and that the present brittle appearance has been induced at a late era, and he refers their origin to metamorphic action.

On Features in the Glacial Workings noticed on Sandstone Conglomerate at Skelmorlie and Aberfoil, by Prof. James Thomson, LL.D., F.R.S., describes a railway cutting half a mile from Aberfoil. At 150 to 200 feet above the sea occurs striated sandstone, on which were glaciated pebbles, behind which occurred tails of fine material, 5 or 6 feet in length, in the direction in which the ice travelled. Examples have been found by the author showing distinct traces of the ice moving up hill.

Problems in the Geology of the Channel Islands, by the Rev. E. Hill, M.A., states the work done by the late Prof. Ansted leaves much to complete, and is of opinion that there is here a fine field for detailed investigation.

Notes on the Geology and Mining of the United States of Columbia, S.A., by R. B. White.—This paper gives an exhaustive report of the range of metals in time and space in this region, and the application of facts observed, to other districts.

Suggestion for a Revised Classification of the British Eocene, by J. S. Gardner.—Some modification in the classification of the Eocene has become desirable, through the transfer of the Upper Eocene group of Edward Forbes to the Oligocene formation. The discovery of several distinct floras seems also to necessitate certain alterations in order to bring periods founded originally

on changes in mollusca into harmony with the more striking changes indicated by the plants. A grouping is suggested which separates the London Clay from the Lower Eocene, and brackets it with the Lower Bagshot Beds as a Middle Eocene. The Middle Bagshot series forms the Upper Eocene, while the Upper Bagshot may remain a member of the same formation, or find a place in the Lower Oligocene. Refers to the changes of climate in the Tertiary epoch.

On the Classification of the Oligocene Strata in the Hampshire Basin, by J. W. Elwes, describes results of investigations in Hampshire and the Isle of Wight. In the latter district he considers that Prof. Edward Forbes was correct in stating that there is only one marine series in the Headon and Brockenhurst group, but he considers, with Prof. Judd, that there are at least two marine zones, the Brockenhurst zone, lying at the base of the series, instead of above the Middle Headon *Venus* bed. The author found the southerly dip at Totland Bay, as described by Prof. Judd, but found no evidence of the local flexure described by that author, by which the latter explains this section, in opposition to the view of the late Edward Forbes.

On the Outcrop of the Brockenhurst Beds near Lyndhurst, by E. Tawney, M.A.—Fossils characteristic of the rich beds which he had been lately working in the railway cutting near Brockenhurst, were found by Mr. H. Keeping, at Cut Walk Hill, Lyndhurst, in 1858. The well at Emery Down, closely adjacent also, yielded the same fossils in 1863. The excavations which the author had lately carried out with the assistance of the Rev. J. Compton, of Minstead, on several sides of this hill, show the succession of the beds to be on the base of the hill. Upper Bagshot sands, next in ascending order, freshwater Lower Heaton, Marine Brockenhurst bed, *Voluta geminata* zone, followed by beds not explored, concluding with the freshwater Osborne marls on the top of the hill. The succession is therefore that of Whitecliff Bay. The thickness of beds between the freshwater Lower Heaton and the Osborne marls is about 100 feet. The discovery of freshwater Upper Heaton beds at Roydon brick-yard was announced.

SECTION D—Biology

Department of Zoology and Botany

On a New Principle affecting the Systematic Distribution of the Family of the Torpedinidæ; and on the Probable Occurrence of the T. Occidentalis (Storer) on the British Coast, by Prof. Du Bois Reymond, F.R.S.—The author referred to the researches of Prof. Babuchin, of Moscow, on the development of the electrical organs of Torpedo, who has established that these organs are formed by the metamorphosis of striated muscle, and that as they grow they increase in size, not by the addition of new columns and septa, but by the growth of the columns and septa, so that the number is the same in adult and young specimens. He then passed on to the consideration of the part which this fact—known as "delle Chian's and Babuchin's Law—plays in the distribution of the Torpedinidæ. He thought that the average number of columns ought henceforward to form a part of the diagnosis of the species of Torpedinidæ—a matter which has hitherto been entirely overlooked by zoologists. He referred to the species of Torpedo of John Hunter, and showed how Hunter's conclusion that the columns increase in number as well as size was erroneous, and described fully the *T. occidentalis* on the British coasts.

On Cephaliscus, a New Form allied to Rhabdopleura (Allman), by Prof. McIntosh, F.R.S.—This new form was very fully described, and its relation to Rhabdopleura of Allman, which we know as a somewhat abnormal Polyzoön, was discussed. It differs from *Rhabdopleura* in regard to the *cœnœcium*, in the much greater size of the buccal shield, in the remarkable branchial or textacular plumes, in the structure of the pedicle, and the perfectly free condition of the polypides. Cephaliscus and Rhabdopleura agree in the absence of the calyciform membranes connecting the bases of the tentacles, in the position of the mouth, which opens behind the buccal shield, in the general structure of the alimentary canal, and in the position of the anus. The development of the young buds is similar. Both forms connect the ordinary Polyzoa with *Phoronis*.

On an Instructional System of Arrangement in Provincial Museums, by F. T. Mott.—The author suggests a combination of a typical collection of the entire fauna of the globe with that of the local species, the latter being on the ground row, both scientific and vernacular names being given on labels corresponding with a cheap popular guide-book.

Injurious Parasites of Egypt, by Dr. Cobbold, F.R.S.—Egypt is a grand field for the helminthologist, since not only is that country the headquarters, so to say, of one of the most dangerous of human parasites, but it swarms with others possessing scarcely less practical importance, whilst it likewise enjoys the distinction of having made us acquainted with parasitic rarities not known to occur in any other part of the world.

The most dangerous parasite is *Bilharzia hæmatobia*. This was so named by me in honour of Dr. Bilharz, who first discovered it at Cairo in 1851. A few years later I detected the same species of parasite in a monkey; and since the year 1856 confirmatory discoveries and observations, made both at home and abroad, have very greatly extended, though they have by no means completed, our necessary knowledge of the natural history of the creature. In this connection it is fitting that we should signalise the labours of Dr. Prospero Sonsino, whose residence in Egypt has enabled him to contribute facts of great interest. It is to Sonsino that we owe our knowledge of the fact that cattle and sheep are also liable to be infested by *Bilharzia*, but the species is not the same as that which invades man and monkeys.

The *Bilharzia* is a genuine fluke parasite of the digenetic kind, and therefore requiring a change of hosts. It differs from the ordinary sheep-fluke and its allies in being unisexual. In other words we have male and female *Bilharziæ*, the male being the stouter of the two sexes. This is an unusual circumstance amongst parasites. Again, these *Bilharziæ* differ in respect of habitat, for, instead of occupying the liver-ducts and intestinal tract, as most flukes do, they take up their abode within the blood-vessels of the victim.

Although the parasites are individually small, the slender females being less than an inch in length, the presence of any considerable number of them gives rise to a formidable malady, which, in some cases, proves fatal. The disorder thus occasioned has received various names, but it is sufficient to speak of it as the *endemic hæmaturia* of warm climates. Dismissing the purely professional aspect of the affection, and viewing the matter as a question of public health specially affecting European residents in Egypt, I may state that I have recently seen six officers of the Eastern Telegraphic Company, who contracted the disorder in the neighbourhood of Suez, and also another gentleman who obtained the parasite in Natal. In all of these instances the immediate cause of the parasitic invasion was due to their having carelessly drank unfiltered water. In all the Egyptian cases this took place during shooting expeditions along the banks of the Cairo-Suez Canal.

Thus, all the evidence of a practical sort that we have obtained as to the cause of the endemic is in perfect harmony with that which has been derived from scientific inquiry. So far as our investigations have been pushed, it is clear that in respect of *Bilharzia hæmatobia*, the natural history phenomena do not differ in any very essential particular from those that occur in the case of ordinary flukes. We have a similar mode of origination, the same rapid growth and development attended with metamorphosis, and likewise a change of hosts.

Practically it is of little moment what water snail or other aquatic organism holds the cercaria of Bilharzia. Infection follows as well from the ingestion of the free-swimming cercaria as from the ingestion of the intermediate hosts. It comes to the same thing in the end. Canal water-drinking in Egypt is the direct cause of the Bilharzia infection, and of the consequent endemic hæmaturia. This being so, simple filtration is in most cases a sufficient protection. To European residents, therefore, the drying up or damming up of the fresh-water canals is not an unmixed evil, because it insures greater freedom from parasitic dangers; moreover, it induces efforts to remedy the evil. Of course these efforts will correspond in magnitude with the necessities of the case.

Unfortunately, there are other parasites whose entrance into the human body by means of water-drinking is of constant occurrence, and they are often found associated together in one and the same person. The other specially obnoxious endemic worms are *Anchylostoma duodenale* and *Filaria sanguinis hominis*. Speaking of the collective *rôle* of the three parasites, Dr. Sonsino says that "they concur in the production of a large mortality of the natives," and the mischief they thus occasion "is not sufficiently appreciated."

How fatal the *Anchylostoma* may prove in other countries

than Egypt was recently seen in the endemic outbreak which carried off some of the labourers during the formation of the St. Gothard Tunnel. Many disputes and misunderstandings at first prevailed respecting the *rôle* of this Entozoon. Having been called "tunnel trichinosis," this disorder got sadly mixed up with affections having a totally different character and history. Similarly, the blood-letting habits of *Bilharzia* and *Anchylostoma* having produced analogous symptoms, the two disorders were called Egyptian chlorosis, intertropical anæmia, and so forth. Recently our knowledge of the geographical distribution of the Anchylostoma has been extended by the discovery of Prof. McConnell, who finds that the parasite is more or less prevalent in India. Wherever it is to be found, its power for mischief is the same, and its mode of entrance into the human frame can only occur through the medium of water.

As regards dangers arising from external attacks by water parasites, little need be said. Troops invading foreign lands are now better furnished than formerly in the matter of clothing and other protective aids; still there are points worth mentioning, especially as in the heat of a campaign the distress from thirst often compels the soldier to drink the filthiest of waters. One quotation will suffice During the invasion of Egypt by Napoleon, the French soldiers were much distressed, and often laid themselves flat on the ground to drink. Their mouths and nostrils were thus attacked by leeches. The species responsible for these assaults is the *Hæmopis sanguisorba* of Savigny. These free parasites not only attacked the men, but also their horses, camels, and cattle.

On the Brown Coloration of the Southampton Water, by Arthur Angell, Ph.D.—The author has found that this coloration is very irregular, and even occurs in isolated patches; he showed that the coloration is due to a brown organism (*Pendinium fuscum*); he has been able to obtain from it brown and green solutions, which both give the spectroscopic appearances characteristic of chlorophyll. He discussed its probable animal or vegetable nature, but favoured the latter view.

Department of Anatomy and Physiology.

Dr. Fraser proceeded to the description of his results on the early development of certain rodents, illustrating his remark by drawing on the board. He showed that the guinea-pig, instead of standing isolated among mammalia by its peculiar form of development, shared this isolation among rodents with the rat and the mouse. He traced the history of the ovum from the sixth day after union of the sexes, up to the formation of the allantoic circulation. Dr. Fraser, whose work is still incomplete, but who is at present busy with the earliest condition of the ovum, offered no explanation of this important result. He insisted, however, upon the hypoblastic layer being external from the close of segmentation, and that the inversion of the layer therefore existed in these three animals from the earliest segmentation phenomena.

Prof. Allen Thompson made some remarks upon the general excellency and result of the work as changing our ideas on the mammalian development, and stated that as Kölliker had just found the hypoblastic layer in the amnion of the rabbit, we must be prepared for great changes in our received opinion on this subject.

On the Homologies of the long Flexor Muscles of the Feet of Mammalia, by G. E. Dobson, M.A., M.B.—Dr. Dobson dealt with the homologies of the following muscles:—Flexor Digitorum fibularis = Flexor hallucis longus; 2. Flexor Digitorum tibialis = Flexor Digitorum longus; 3. Tibitalis positicus. He explained by means of drawings how these muscles partially or totally supplanted one another in different animals. From the examination of a large number of animals he fonnd the *flexor fibularis* existing in all and exhibiting but few modifications, while the other two were subject to much variation, or might be absent. He deduced from his dissections that the variation of the *flexor tibialis* had not been properly understood, its real homologues having been named *tibialis porticus accessorius secundus*, or *internus*, while it was supposed the muscle had undergone fusion with the *flexor fibularis*.

On the Nature of the "Telson" and "Caudal fusca of the Crustacea," by M. M. Hartog, M.A., D.Sc.—Dr. Hartog sent a short paper to explain that the telson in the higher crustacea is equivalent to the last segment of the Nauplius body, together with an immensely developed postanal portion composed in varying proportions of the supra-anal plate and the adnate fuscal processes. The fuscal processes he regards as outgrowths of this telson not strictly comparable to limbs, but rather to the primitive-paired outgrowths of the body-segments which have become limbs elsewhere by the development of basal articulations and a proper musculature.

Considerations arising from Koch's Discovery of the Bacillus of Tuberculosis, by F. J. Faraday, F.L.S.—Two great discoveries, Pasteur's discovery of the decreasing virulence of specific disease germs when kept in the presence of oxygen, and Koch's discovery of the bacillus of tuberculosis, have been made within the past two years. The author suggests a possibly useful relation between these discoveries. Referring to the suggestion of Dr. William Roberts, F.R.S., of Manchester, in his address to the Medical Association in 1877, that disease germs may be "sports" from harmless saprophytes which have acquired a parasitic habit, he asks whether deprivation of oxygen, or cultivation in gaseous mixtures from which the normal supply of free oxygen present in good air is absent, may not have an influence in converting harmless germs present in the atmosphere into the bacilli of tuberculosis. He refers to Carl Semper's researches on the influence of the environment on animal modification, and to the fact that many larvæ of insects live in situations where the air is undoubtedly mixed with gases which the higher vertebrata could not breathe without injury, and suggests that the adaptability of organisms, and their impressionability by surrounding conditions, may increase as the scale of life is descended. He also refers to a paper by Mr. Frank Hilton, F.C.S., read before the Chemical Society, on experiments with bacteria in various gases. Mr. Halton gave the chemical results, but it would be interesting to know the influence of cultivation in such media on the character of the bacteria themselves. Dr. Angus Smith has argued that the putrefying process, when carried on in confined places, such as sewers, may develop disease germs which are not developed when the same process goes on in unconfined places; typhoid fever seems to be developed by processes in sewers, which, carried on in the Clyde, for instance, do not originate any well-marked disease. Analogous conditions may be presented in the lungs of persons engaged in dusty trades, breathing vitiated atmosphere in ill-ventilated rooms, or engaged in sedentary occupations, and not taking healthy exercise; and also in the lungs of persons who are hereditarily narrow-chested, weakly, and of feeble inspiratory habit. Innoxious germs present in the atmosphere may be inhaled and retained in the lungs of such persons, and there by successive culture and deficient aëration acquire a parasitic or deadly character. The author refers to Pasteur's method of restoring the virulence of "attenuated" germs by successive culture in the bodies of different animals, as possibly explaining the communication of tuberculosis to persons of sound constitution, the parasitic habit of the tubercle "sport" being so strengthened and confirmed by successive culture under the assumed favourable conditions as to enable it eventually to establish itself under certain conditions in a *milieu* which would not be suitable for the origination of the culture. He refers to a new treatise by Dr. Ferdinand Kroczak, of Brünn, entitled "Die Heilung der Tuberculose," and shows that Dr. Kroczak's arguments in support of the special treatment recommended by him are in harmony with the hypothesis advanced.

The decrease of mortality from consumption in the army since the improvement of barrack ventilation, and the relief afforded to patients by sea-voyages, the air of pine-woods, carbolic acid inhalations, and other suggested remedies, is also referred to as giving support to the hypothesis.

On the Kidneys of Teleostei, by W. Newton Parker. In following the investigations of Prof. Balfour, who showed that in certain adult Teleostei, as well as in Lepidosteus and Accipenser, the so-called "head kidney" contained no urniferous tubules, but was composed entirely of highly vascular lymphatic tissue, the author finds that in some Teleostei the so-called "head-kidney" has precisely the same structure as the rest of the kidney in mesonephros. He nevertheless holds that Prof. Balfour's view is correct, and explains the circumstance by supposing that the mesonephros has grown forwards so as to take the place of the larval pronephros.

On the Perception of Colour in Man and Animals, by Dr. S. D. Macdonald, R.N.—Dr. Macdonald read a paper, in which he endeavoured to show the near relationship of perception of sound and light, comparing different colours to different notes.

On the Structure of the Muscular Tissue of the Leech, by T. W. Shore.—The author described his research, summing up as follows:—1. The muscle of leech consist of elongated tubes

with two coats—a sarcolemma and contractile layer—the inner surface of which is irregular, and gives rise to an apparently granular contents. 2. In living condition it is unstriped. 3. There are no nuclei. 4. Transverse striation may be produced post-mortem, the result of three changes :—α. Regular arrangement of the papillæ on the inner surface of the contractile layer. β. Folding of the surface of the sarcolemma. γ. Splitting into segments of the contractile substances which subsequently contract. 5. The contractile substance coagulates, forming myosin, which subsequently contracts. 6. The rapidity of contraction gives rise to varying appearances of fissures, striations, &c.

An Improved Method of Direct Determining of the Contraction Wave in Curarised Muscle, by E. A. Shaafer, F.R.S.—In this method, instead of using levers which write directly on a blackened surface, the levers are caused to successively break galvanic circuits connected with a Ruhmkorff induction apparatus, the ends of the secondary coil being so arranged that the sparks are transmitted through a sheet of smoked paper, turned rapidly by means of a spring myograph. A time tracing is at the same time recorded on the paper.

On the Presence of a Tympanum in the Genus Raca, by G. B. Howes.—The author regards a fenestra (long known to exist) in the roof of the auditory capsule of the genus and its adjacent parts, to be a modification of what is seen in other species, which is correlative of the compression from above downwards undergone by it, resulting in the formation of a tympanum physiologically foreshadowing the essential process involved in the elaboration of the auditory organ of the higher forms.

Prof. H. N. Martin, D.Sc., explained briefly his method of isolating the mamalian heart for experimental purposes.

Dogs were used : these being etherised, were then kept alive by artificial respiration ; all systemic vessels, with the exception of the thoracic aorta and the superior cava were then ligatured. The heart is now supplied by defibrinated dog's or calf's blood by means of a Marriot's flask, the whole animal being kept in a moist and warmed chamber. Dr. Martin by these means has found that either the venous or aortic pressure may be varied in very great limits without the rate of the beat being altered, but by increasing the venous pressure very slightly, the work done by the organ was vastly increased. These researches are, however, only preliminary.

On some Toxic Conditions of the Blood illustrated by the Action of Hydrocyanic Acid, by T. S. Ralph.—Having found some apparently amyloid matter in the blood-corpuscles of patients taking hydrocyanic acid, Mr. Ralph has examined the subject, and brought forward some observations which tended to show that this may occur in recent paralysis, and the exhibition of various remedies.

Department of Anthropology

Evidence as to the Scene of Man's Evolution and the Prospects of Proving the same by Palæontological Discovery, by W. S. Duncan, M.A.I.—Mr. Duncan urged that a Committee should be appointed to investigate fossil forms proving the evolution of man. The author advanced a series of arguments in favour of the region of the South of Europe and Asia as the probable scene of man's evolution as a likely field of successful exploration.

Ebb and Flow in Mental Endowment, by G. Harris, F.S.A.—The theory propounded by Mr. Clarke was that an ebb and flow in mental capacity and moral quatities may often be discovered in the successive generations of particular families. The writer referred to the supposed transmission of endowments acquired by cultivation, and started the inquiry whether the condition of the parent at the time of procreation of the child is that from which the transmission of such qualities is derived.

On some Customs of the Aborigines of the River Darling, New South Wales, by F. Bonney.—Mr. Bonney gave the result of his own observations, during many years' residence, on the customs of the race, and especially on the rites and ceremonies relating to marriage, coming of age, burial, mourning, &c., and an account of the many superstitions relating to the healing art, detection of murderers, &c. The paper was illustrated by a large number of valuable photographs.

The Light thrown by the Explorations of Caves on the Conquest of Britain, by Prof. Boyd Dawkins, F.R.S.—The lecturer brought forward much important evidence drawn from the exploration of caves in Ayrshire and other localities as to the places to which the Britons retreated as the advancing Anglians spread westward.

SECTION G—Mechanical Science.

Mr. B. Baker read a paper on *The Forth Bridge*, of which we recently gave an account, (*Nature*, vol. xxv. p. 246). The author gave an amusing illustration of the size of this new bridge. The stature of a new born infant being 19·34 inches, the average height of a guardsman 5 feet 10½, the ratio of these two is as 1 : 3·65, and this is exactly the ratio of the span of the Forth bridge to that of the largest bridge at present in this country, viz. the Britannia bridge. The account above alluded to dealt principally with the questions of size and strength ; the paper in addition to these points dealt with the history of negotiations and Parliamentary proceedings, and then with mode of construction, weight of materials to be used, and probable cost. No less than 42,000 tons of steel will be used in the superstructure of the main spans and 3000 tons of wrought iron in that of the viaduct approach. The total quantity of masonry in the piers and foundations would be about 150,000 cubic yards, and the estimated cost of the entire work was about £1,500,000 though from the magnitude and novelty of the undertaking this must be regarded as only an approximate figure. A very fine model of the proposed bridge was placed in the room.

On the Treatment of Steel for the Construction of Ordnance, by Sir W. Armstrong.—The author alluded to the want of a proper definition of steel. The term was formerly confined to iron containing a much greater proportion of combined carbon than was to be found in the so-called mild steels of the present day. The chief distinction between iron and steel now seemed to be in the process of manufacture, steel being operated upon in the state of fusion, while iron was dealt with in a state of agglutination. But even mild steel contained more carbon than was generally to be found in wrought iron and that excess small as it was, appeared to exercise a very important influence upon its qualities. These qualities had been brought out in a marked way in some investigations he had occasion to make in welding, tempering, drawing, and annealing. The experiments were then detailed and the specimen of steel shown to the meeting. One important conclusion was that there was much less sacrifice of ductility and toughness in obtaining strength by tempering, than by increase of carbon. The saving in weight of steel for a given purpose would thus in the case of bridges and similar structures, amply repay the cost of tempering.

Mr. T. R. Wrighton read a paper on *The Increased Tenacity in Perforated Test Bars of Iron and Steel* which together with the former paper elicited a very interesting discussion, particularly with reference to the curious phenomenon dealt with in the latter. Several explanations of the result have been given, but it appears tolerably certain that the section of the test bar under tension is not decreased to the same proportial extent when perforated as when solid, and this the author appeared to think was due to the cutting through of the diagonal lines of stress by the drilled holes.

On the Channel Tunnel, by Mr. J. Clarke Hawkshaw.—The author commenced by giving an account of the steps which had hitherto been taken in the matter, stating that there were two schemes for carrying out the work. That by the South Eastern Company was the one of which the public had hitherto chiefly heard, while the Channel Tunnel Company had been silent, waiting for the promised Parliamentary enquiry. He then proceeded to discuss the geological aspect of the question in a most able and explicit manner. The plan he advocated may be briefly described as one to bore a tunnel which should approach the coast of this country east of Dover so as to enable the line to rise by the necessary gradient to the town. He proposed to take the shortest possible route and instead of deviating from the straight line to avoid the chance of coming upon water bearing fissures, to aim rather at dealing with the water from this cause by powerful pumping apparatus. He argued to show that the amount of water so met with would probably be quite within the power of pumps to deal with. The advantages to be gained from making a tunnel direct from Fainhole to Sandgatte were :—The shortest sea tunnel ; as short a land tunnel, as by any line ; a greater thickness of chalk through which to tunnel ; the best termination for effecting junctions with the existing English railways ; and a termination affording facilities for defence at a less cost than elsewhere. He criticised at length other proposed routes, and finally dealt with the proposed system of ventilation.

On the system of Excavating the Channel Tunnel by Hydraulic Machinery, by Mr. T. R. Crampton.—The principal

feature in this proposal is that of driving the chalk cutting machinery by hydraulic power, the waste water being discharged into a vessel with the chalk *débris*. Chalk "cream," is then formed by the revolution of a drum in this vessel, and this cream is pumped to the head of the working and discharged.

Three papers were read by Major Allen Cunningham R.E., whose recently published work in connection wi h the Hydraulic Experiments at Roorkee, gives this country a position with regard to the subject, which it certainly could not previously claim. The following are brief extracts:—*On unsteady Motion in Open Channels:* The motion of water in open channels is essentially an *unsteady motion with interlacing stream lines;* the hypothesis of steady parallel motion is at variance with nature. Single velocity measurements are of little practical use, being only accidental values; the average of a large number is pretty constant, so that the *average velocity* should always be sought. The time needed to obtain these involves a chance of change of the external conditions. In practical hydraulics the forward velocity is the only velocity considered or required. Floats measure this directly; no other instruments yield this quantity readily in large streams. These principles are of great importance, and show that hydraulic experiments must always be tedious and expensive.—*Convexity of the Surface of Streams:* The figure of the transverse section of the free surface of a stream, usually supposed to be convex, is here considered. The evidence is shown to be very small. Some new special experiments are cited. The conclusion is that the surface is probably level across.—*Depression of Maximum Velocity:* The line of maximum velocity in an open channel is usually below the surface. The cause of the depression is obscure. The wind and disturbances from the banks and bed are usually supposed to be the causes. The wind is probably too inconstant. The disturbances from the banks and bed seem an inadequate explanation. The general depression of the maximum velocity on all verticals at all parts of a channel indicates some resistance from above. The motion in open channels and in rivers flowing full shows some similarity with differences in detail fairly accounted for by supposing the air to be an ever present efficient drag or source of resistance to forward surface-flow, less intense than the banks or bed. If this be admitted the hydraulic term "wet border" must be modified so as to include *all parts* of the wet border, each with its own specific resistance.

On Compressed Air as applied to Locomotion, by Sir F. J. Bramwell.—The author dwelt upon the cases in which compressed air might be advantageously employed for this purpose, as for instance in the proposed Channel Tunnel and on tramways. For the latter, some altered means of traction seems for several reasons inevitable. One of these reasons is the undoubted cruelty to horses which is the result of the present system. The fact that compressed air can be satisfactorily used for this purpose is proved by the tramways of Nantes, which for three years and a quarter have been worked by this means. The various difficulties to be expected on any tram-line, such as those from curves and gradients, are to be found on that one which, running beside the River Loire, connects Doulon and Chantonay. The cars run every ten minutes from both ends of the line for fifteen hours each day in summer, and fourteen hours in winter, and during the time above mentioned there has been no hitch whatever. An arrangement called the "Hot Pot" is used to obviate the loss of energy and the inconvenience arising from the well-known fact that air becomes heated when being compressed, and cools upon expansion. The apparatus consists of a vessel of water into which steam is forced at the conclusion of each journey. Through this heated water the compressed air is passed, and is thus at the same time heated and lubricated. An ingenious form of regulating-valve was also described, by means of which a uniform working pressure is maintained, whatever may be the pressure in the air reservoirs. The two contrivances are combined, and together effect: (1) a great saving of power, and (2) a trustworthy mode of regulating the pressure. Details of the engines and pumps at the stations were given, these together working with the high efficiency of 82 per cent., that is, with a loss of only 18 per cent. of the total energy. The expenditure of fuel per day, under the conditions already given, is only 4½ tons of coal, or a little more than 12½ lbs. per mile run.

Three papers were read by Dr. Fleming. The first upon *Recent Progress in Electric Railways* was practically a description of an experimental railway laid down by Mr. Edison in Menlo Park. The plan there adopted is to connect one rail at regular distances with one of the terminals of a dynamo in a central station, the other rail being similarly connected with the opposite terminal. The motor has externally the appearance of an ordinary locomotive without a funnel, containing, however, a dynamo, by means of which short circuiting between the rails is prevented, and the motive power obtained. The percentage of useful effect claimed by the authot was exceedingly high, only 5 lbs. of coal per hour per H.P. being used, as against 6 lbs. with an ordinary locomotive. A speed of 40 miles an hour, over 8 or 10 miles, was stated to have been attained. These statements of the author concerning the efficiency of the system described by him, were called in question by the President, Prof. Forbes, and others, who complained of the meagre supply of facts upon which to form an opinion on such an important question. Dr. Werner Siemens, at the request of the President, made some remarks with reference to his own experience in electric railways, stating the loss of power to be one-fifth in winter, and one-eighth in summer. Amongst other things he advocated overhead connection of wires to convey the current. The other papers by Dr. Fleming were upon electric lighting and the efficiency of the Edison dynamo.

Prof. Forbes described a very simple and ingenious form of electric lamp, and then read a paper giving results of experiments on wires conveying currents, which he had embodied in two laws. These laws define the strength of current which can be sent through wires of different diameters without raising the external temperature above a certain limit. Law I. When the wire is bare and exposed to the air, the strength of current is proportional to the diameter of the wire. Law II. When the wire is wound in coils of the same size and weight, the strength of current is proportional to the diameter of the wire. To discover the first law, a thin coating of wax was put upon each wire, and a current gradually increasing in strength was passed through it until the wax melted. The strength of the current was then read off on a galvanometer. To discover the second law, two equal tubes were wound with many layers of wire until they were of equal weight; these were filled with water and a thermometer bulb inserted. The currents required to raise the temperature in each equally were measured.

Mr. Barlow read a paper *On the Mechanical Properties of Aluminium*. This metal is used chiefly as a substitute for silver, but the author had found it to be exceedingly strong in proportion to its weight. Experiments had been carefully made for him by Prof. Kennedy, from which its valuable properties of ductility, tensile strength, and elasticity were fully demonstrated. This was well illustrated by the comparative length of rods of uniform section, but of different metals, which could be suspended without rupture, the lengths in the case of steel and aluminium being equal and exceeding all others. Unfortunately it is an expensive metal, and the process by which it is at present extracted leaves little hope of its use being greatly extended. Sir H. Bessemer said he did not think any metal could be depended on like the one in question, from the small part its weight took in producing its rupture. He exhibited a key of the material (about the size of a large latch key), and it was stated that 45 of these would only weigh one pound.

Mr. A. Giles read a paper on *The Southampton Docks*. This paper was listened to with considerable interest, from the fact of proposed local changes, which, if carried out, would considerably affect the port. The paper not only gave a history of the present works, and dealt with the future improvements, but also gave statistics of the trade of the docks as a commercial undertaking.

Mr. Price Edwards read a paper *On Sound Signals*, discussing the various signals used on railways, ships, and the coast. He stated that a change was about to be introduced in connection with the Trinity House signals, in which a combination of high and low notes was to be used. A trial of explosive signals was also shortly to be undertaken. Allusion was made to the unnecessary shrillness of railway whistles.

Prof. W. C. Unwin read a paper on *Current Meter Observations in the Thames*. The author described and exhibited the instrument which he had used. This meter differs from most other meters in its mode of suspension, being lowered into the water by a stout wire from a boat, proper orientatian being secured by a tail or vane. The instrument is very convenient to use, observations being taken by one observer at an average rate of one in three minutes. The results obtained were exhibited by curves.

Sir F. J. Bramwell exhibited and explained the action of a speed indicator. This instrument had been designed and employed by him in connection with experiments upon railway

trains. It consists of a drum turned by clockwork, over which a continuous slip of paper passes. This paper is marked by two pencils which can at any time be brought into contact with it. One of these gives a straight line which shows the beginning, ending, and line of duration of an experiment. The other receives a reciprocating motion from one of the wheels of the locomotive, und so gives a continuous series of curves, the relative closeness of which to each other measures the speed of the train. From results given by this instrument a very instructive curve was drawn, showing the manner in which a train comes to rest. Experiments were made on a piece of level line on the Midland Railway, between Nottingham and Newark. On a calm day a train weighing 125 tons, and moving at the rate of 45 miles an hour, ran 5 miles and 5 yards after the steam was shut off.

SOCIETIES AND ACADEMIES

LONDON

Entomological Society, August 2.—Mr. F. D. Godman, M.A., F.R.S., vice-president, in the chair.—One new Member was elected.—Exhibitions: *Macropis labiata*, by Mr. F. Enock; *Paragus tibialis* and *Discomyza incurva*, by Mr. T. R. Billups; *Cicindela*, sp. from Babylon, by Miss E. A. Ormerod; *Xyleborus saxesenii* (destructive to ale-casks sent out to Rangoon), by Mr. W. L. Distant.—Papers read: Notes on the life-history of *Sitones lineatus*, by Mr. T. H. Hart, read by Miss Ormerod.—On a visit to Ceylon, and the relation of Ceylonese beetles to the vegetation there, by Mr. G. Lewis, who had captured about 1200 species of beetles in Ceylon in five months.—On certain temperature forms of Japanese butterflies, by Mr. H. Pryer.

PARIS

Academy of Sciences, August 21.—M. Boussingault in the chair.—The following papers were read:—On longitudinal shock of a free elastic bar against an elastic bar of other matter or of another size, fixed at the end not struck; consideration of the extreme case in which the striking bar is very rigid and very short, by M. de Saint-Venant.—On the vaso-motor effects produced by excitation of the peripheric segment of the lingual nerve, by M. Vulpian. This nerve seems to have a certain degree of recurrent sensibility, manifested on stimulating the peripheric segment of the cut nerve, by contraction of the vessels in the opposite half of the tongue.—On the appearance of manganese on the surface of rocks (continued), by M. Boussingault. This relates chiefly to the *Challenger* observations. The sea and rivers contain carbonic acid favouring the dissolution of insoluble carbonates. When, from any cause, the acid gas is expelled, the salts are precipitated; the carbonates of protoxide of iron and protoxide of manganese, once in contact either with the oxygen of the air, or with that dissolved in the water, are modified by sur-oxidation of their bases; the carbonate of iron produces a red sesquinoxide, the carbonate of manganese a black oxide.—Some observations on the phylloxeras of Savoy, by M. Lichtenstein. The multiplication is very much less in Savoy and other regions, where the temperature is below 20° to 25° in summer. Seven species of phylloxera are now distinguished in France.—Observations at Marseilles Observatory, by M. Borrelly.—On the solar metallic eruptions observed at Rome during the first half of 1882, by P. Tacchini. Forty-three were observed, twenty-four north of the solar equator, and nineteen south. A maximum occurred in March. The number of lines was always small, and the solar activity was far from that of the preceding epoch of maximum. The line B*c* was the most frequent. The only splendid eruption was on June 21; its maximum height was about 167″. The maxima of the eruptions were between ± 10° and ± 20°, nearly as with the spots; but they extended to greater latitudes.—Broadening of the spectral lines of hydrogen, by M. Van Monckhoven. He concludes from experiments that the broadening is quite independent of temperature, and solely due to pressure.—On the longitudinal shock of an elastic rod fixed by one of its extremities, by MM. Sébert and Hugoniot.—On approximate quadratures and cubatures, by M. Mansion.—Hydrodynamic experiments; imitation by liquid or gaseous currents of stratifications of the electric light in rarefied gases and of various forms of the electric spark (seventh note), by M. Decharme. He moves horizontally and quickly over a plate covered with minium, a tube with issuing current of liquid or air.—Remarks on the subject of M. Tommasi's communication on the numerical relations between thermal data, by M. Le Blanc.—On a synthetic type of Annelid (*Anoplonereis Hermanni*) commensal of *Balanoglossus*, by M. Giard.—The quaternary formation of Billancourt, by M. Riviere.—Chemical composition of the banana at different degrees of maturation, by M. Ricciardi. The green banana contains about half of its weight of starch, which disappears in the ripe fruit, and the sugar in the fruits ripened on the plant is almost entirely cane sugar; that of the fruits ripened after gathering, four-fifths inverted sugar, the rest cane sugar. The tannic substances and organic acids of the green fruits disappear in the ripe fruits. M. Ricciardi considers the CO_2 produced by the banana in the third period of its maturation is not due to alcoholic fermentation.—On modifications of the epidermic structure of leaves under various influences, by M. Mer.—Observations on an earthquake at Couchey (Côte d'Or), by M. Guillemot. This occurred at 4.25 a.m., on August 14; a single dull shock was followed by an oscillation south-south-east to north-north-west, lasting half a second. The shock was felt over at least 14 kilometres.

August 28.—M. Wurtz in the chair.—M. Mouchez communicated an address he had given at the inauguration of a statue to Fermat at Beaumont-de-Lomagne.—Meridian observations of small planets and of the comet Wells, at Paris Observatory, during the second quarter of 1882, by M. Mouchez.—On the inclination of the magnetic needle, by M. d'Abbadie. His observations with an inclination-needle of MM. Brunner, only 0·063m. long, prove its accuracy.—Communication on black phosphorus, by M. Thenard. As against doubts of the existence of black phosphorus, he states that lately, when moulding phosphorus in the usual way, and after getting a dozen rods, all of the ordinary colour, the thirteenth blackened suddenly throughout at the moment of cooling. The phenomenon was afterwards reproduced in a partial way.—Separation of gallium (continued), by M. Lecoq de Boisbaudran.—A communication by M. Chevreul affords evidence that Joseph Hubert, the friend and successor of Poivre in the island of Reunion, recognised, as early as 1788 (some ten years before English and German *savants*), the gyratory character of cyclones. In 1818 Hubert got the complete and correct formula expressing their double motion of gyration and translation (several years before Dove).—Observations of planets 227 and 229 with the western equatorial of the garden of Paris Observatory, by MM. Henry.—Solution of the problem of Kepler for considerable eccentricities, by M. Zenger.—On the formation of secondary couples with plates of lead, by M. Planté. He accelerates the formation of the couples, by first keeping them immersed twenty-four hours in nitric acid diluted one-half of its volume with water. The porosity produced extends the chemical action, which occurs on alternation of the primary current. These couples, in eight days, and after three or four changes of direction of the primary, yield results which were formerly obtainable only after several months' treatment.—M. Larroque presented a note on the transport, by lightning, of ferruginous particles contained in dust of the air. To this he attributes the persistence of the magnetic property observed in certain trees.

CONTENTS