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THURSDAY, JANUARY 30, 1873

THE INTERNATIONAL METRIC COMMISSION *

IN continuation of the previous remarks upon the proceedings of the Commission, we may now notice some of the more important scientific details of its operations.

The material for constructing the new Standards, for which an alloy of pure platinum with 10 per cent. of iridium has been selected, is obviously a matter of primary importance. Before determining upon this metallic alloy, a series of experiments was made by the French section of the Commission. A material was needed, both for the metre and the kilogramme, that should as far as possible be unalterable in its composition and molecular structure, in its form and dimensions, from the ordinary action of air, water, fire, or other chemical agents, or from mechanical forces to which it might be subject; that would in fact possess physical properties rendering it invariable with time. It should be hard, elastic, and yet not difficult to work. It should at the same time be perfectly homogeneous, so that all the Standards should be as nearly as possible identical in their material. And in order to lessen the unavoidable influences of variations of temperature, it was obvious that a material was most desirable that would experience the least alteration in its dimensions from changes of temperature. Proceeding by an exhaustive process, the Commission decided against employing any of the materials which have been hitherto adopted. Brass and alloys of copper did not satisfy the requirements, and were rejected as liable to be injuriously affected by air and heat, and from being composed of different metals varying in their density and dilatation. Quartz, though satisfactory in many respects, was too fragile and bulky; besides which there existed no prospect of obtaining it of sufficiently large dimensions and of the requisite purity. In addition to the objections attaching to quartz, glass was inadmissible by reason of the disturbing influences of moist air on its surface, and from its molecular condition as a tempered and crystallised body rendering it liable to changes from variation of temperature which might affect the constancy of its density, expansion, and even length; for it was thought that a glass metre, like a steel metre, would thus become shorter in course of time. Even platinum, which was the best pure metal for the purpose, has the disadvantage of being too soft and too weak for a measuring bar. Combined, however, with a proper proportion of iridium, platinum satisfied all the conditions required either for a Standard metre or kilogramme. These two metals have the same system of regular crystallisation, the same density and rate of expansion, and when alloyed in proper proportions, they produce a perfectly homogeneous material. They are the two metals which of all others dilate the least by heat, and the proposed alloy of 10 per cent. of iridium has been proved to have as nearly as possible the same density and the same rate of expansion as the existing Metric Standards, the *Mètre* and the *Kilogramme des Archives*. This fact alone is important as greatly facilitating the identity of the length and weight of the new Standards with those of the original prototypes of the Metric System. Platinum-iridium has also been proved to be extremely hard and rigid, and to possess the greatest elasticity, as well as cohesion or resistance to fracture. At the same time, it is easily cut with a diamond, and it has been shown that lines $\frac{9}{1000}$ of a millimetre apart (or 0·00035 inch), so cut upon it, with the aid of a microscope, are perfectly regular, even when magnified from 300 to 600 times.

The experiments of M. Regnault have shown that platinum-iridium resists the penetration of absorbent gases, and further experiments made by the Commission prove that the influence of such gases can in no way cause any change, either in its volume or its weight. A more severe test had already been applied to platinum by M. Stas at Brussels. He subjected a platinum kilogramme successively to the action of alcohol, cold water, boiling water, drying in a vacuum, and heating in a red heat of from 250° to 300° C., whilst guarded from flame; and he ascertained by comparisons in moist air, at a temperature of 15° C., with a platinum kilogramme not subjected to any of these conditions, that no change whatever had occurred in the weight of the kilogramme so treated. It was only requisite to allow a certain number of days, at most a fortnight, to elapse for the platinum to recover itself.

Another important question was that of the form to be given to the new metre. The present *Mètre des Archives* is a bar of platinum with a rectangular section, 25 millimetres wide, and 4 millimetres deep (or about 1 inch by $\frac{1}{6}$ inch). It had been determined that the new metre, which was to be a standard *à traits*, or line-standard, should have its defining lines marked at mid-depth of the bar, on the same principle as our English standard of length, in order that the actual length of the measure should be as little as possible affected by any difference of temperature, and consequently of dilatation, between the upper and lower surfaces of the bar. But the Commission objected to the English mode of sinking cylindrical holes to the mid-depth of the bar, and tracing the defining lines on the plane surface of the bottom of these holes, as being not only inconvenient on many accounts, but also as interfering with the uniformity of structure of the bar during its whole length. The form of the new *mètre à traits* mentioned in the resolutions as having been proposed by M. Tresca, one of the secretaries of the commission, who had given much study to the question, and laid an elaborate note upon the subject before the Commission, is of a very ingenious and entirely novel character. Its transverse section may be described as taken from the form of the letter X, if divided down the middle into two halves, and then joined by a band equal in thickness to the other parts (3 millimetres). By lowering the upper surface of this band to the mid-depth of the bar, it gives a continuous plane, upon which not only the two defining lines of the metre can be cut, but also any intermediate lines that may be required as subdivisions of the metre. By a further slight reduction in the thickness of the lower half of the sectional figure, the defining lines will lie not only in the length of the neutral axis of the bar, but also in that of its centre of gravity. The dimensions of the bar itself when first constructed are to be 102 centimetres in length, and 2 centimetres square in section, and the bar is afterwards to be planed to the form decided upon. Its weight will thus be reduced to about 3¼ kilogrammes, and the

* Continued from p. 197.

defining lines of the metre will be cut at the distance of 1 centimetre from each end of the bar.

There appear to be many advantages in this new form of measuring bar, of a geometrical, mechanical, thermal, and economical character. Much importance is attached to the absolute uniformity of the bar throughout its whole length, as equalising its resistance and molecular action, and also to the adoption of a geometrical form as symmetrical as possible. The absence of any acute angle was also dwelt upon as facilitating the mechanical displacement of the surplus metal; and it has since been practically ascertained that the planing can be executed with the utmost regularity and precision. It will also prove an excellent test of the soundness of the metal throughout the whole length of the bar. The great rigidity of this form of bar, combined with the advantage of the high elasticity of the platinum-iridium, was fully shown; as compared with the rigidity of the *Mètre des Archives*, it will be as 25·9 to 1, although its sectional area is only half as much more. The new form will also be highly favourable for equalising the temperature throughout its whole length and thickness, and for taking the temperature of the surrounding medium; and it will afford a most convenient lodgement for mercurial thermometer tubes, thus enabling the actual temperature of the measuring axis of the bar to be readily and accurately determined. This measuring axis will be in one open and unbroken line, and quite unaffected in its dilatation by any contact with the support of the bar. Lastly, in an economical point of view, the form proposed will give the greatest possible strength with the least quantity of the costly material used.

This form for the *mètre à traits* can be employed with merely a slight modification for any *mètres à bouts*, or end-standards, that may be required. The form of the bars for the *mètres à bouts* will have a similar sectional figure, but symmetrical, the measure being defined by the spherical end of two small cylinders, 3 millimetres in diameter, and projecting 1 millimetre from the middle of the ends of the bar, the radius of curvature being 1 metre.

One other point may be noticed as to the mode of determining the temperature and dilatation of the standards. The temperature at which the new metre will have its true length has been decided to be the same as that of the *Mètre des Archives*, that is to say, 0° C. All the necessary arrangements have been already made for making comparisons at this temperature by constructing a cold chamber expressly for the purpose, and surrounding it with non-conducting materials. By a blast of cold air driven by a steam-engine in an adjoining room over a surface of ether and through pipes into the cold chamber, the temperature in it may be reduced in a few hours to the freezing point, and maintained constant there. From this adjoining room also the requisite light is conveyed into the cold chamber, and is thrown by reflection on the bars and apparatus. There is an inner part of the chamber in which the standard metres and the comparing apparatus are placed, whilst the observer is enabled to make the adjustments and the comparisons through the microscopes from an outer part, and thus the heat of his body is prevented from exerting any disturbing influence on the bars and apparatus.

Many comparisons of the metre will, however, be made at other temperatures, and in all such cases, as well as for ascertaining the rate of expansion of the bars, the accurate determination of the temperature by thermometers will be requisite. The question of the amount of dependence to be placed on the indication of the temperature by mercurial thermometers, which has recently been a good deal agitated in this country, was considered by the Commission to be one of great importance. They found that in all mercurial thermometers, the dilatation of the glass envelope, which, so far as it is known, is only about one-seventh that of the quicksilver, renders the reading of the best calibrated thermometers liable to errors amounting to some tenths of a centesimal degree. The best authorities are also of opinion that implicit dependence cannot be placed on the constancy of mercurial thermometers, so far as they indicate the temperature, nor on the constancy of the dilatation of the glass envelope. It was thought, therefore, that for ascertaining the temperature with a degree of precision exceeding 0°·1 C., recourse must be had to an air thermometer.

On the other hand, the air thermometer is an instrument complicated in construction and difficult to use. It requires the greatest precautions and practised skill in its manipulation; and the necessity of having recourse to an air thermometer on every occasion of making comparisons with the primary standards would create very serious embarrassments. On these grounds it was decided that every one of the new metres should be accompanied by two detached mercurial thermometers, carefully compared with an air thermometer, and which should be re-verified with it from time to time.

It was stated to the Commission by M. H. Saint-Claire Deville, as the result of twenty years' use of an air thermometer, that no instrument could be more precise and convenient in reading, more easy and expeditious in use. He estimated that by employing an air thermometer according to a method suggested by him, the mean temperature of a standard metre under comparison could be determined with precision to the $\frac{1}{210}$th of a degree of the centigrade scale.

On the subject of dilatation, we can only briefly allude to M. Fizeau's admirable method of accurately determining the rate of expansion of solid bodies by heat, by employing the length of a wave of monochromatic sodium light (a constant = 0·005888 millimetre, or 0·00002318 inch), as his standard of measure. By means of an ingenious apparatus constructed by M. Soleil, the yellow ray is made to fall vertically through a piece of plate glass on a horizontal plane of the solid body, and is reflected in the under-surface of the glass. By counting the number of Newton's rings passing a fixed point upon the glass, when they are set in motion from the expansion of the surface of the solid body by observed degrees of heat, its dilatation can be computed with the greatest precision. This method has been described in the proceedings of the Royal Society on November 30, 1866, when the Rumford gold medal was awarded to M. Fizeau for it. The Commission also hope to obtain a standard of dilatation by marking a measure of length of one or two decimetres upon the plane surface of a piece of Beryl in its axis of non-dilatation. M. Fizeau has shown that Beryl varies in its dimensions from heat less than almost any other body, and that it possesses this peculiarity, that whilst it expands by heat in the direction of its axis of crystallisation, it contracts by heat in the direction perpendicular to this axis; consequently in the line of the proper intermediate angle there is no dilatation or contraction whatever from heat. Endeavours will therefore be made thus to obtain an invariable standard measure of length, by comparison with which the rate of dilatation of measures variable with heat may be determined.

There are other subjects of the investigations of the committee which might be noticed, but we have probably stated enough to enable some idea to be formed of the magnitude of the work undertaken by the International Metric Commission, and of the value and importance of the anticipated results of their labours; as well as the advantages expected to be obtained from the proposed establishment of the permanent International Metric Institution. H. W. CHISHOLM

DE MORGAN'S BUDGET OF PARADOXES

A Budget of Paradoxes. By A. De Morgan. (Longmans, 1872.)

THIS work is absolutely unique. Nothing in the slightest degree approaching it in its wonderful combinations has ever, to our knowledge, been produced. True and false science, theological, logical, metaphysical, physical, mathematical, &c., are interwoven in its pages in the most fantastic manner: and the author himself mingles with his puppets, showing off their peculiarities, posing them, helping them when diffident, restraining them when noisy, and even occasionally presenting himself as one of their number. All is done in the most perfect good-humour, so that the only incongruities we are sensible of are the sometimes savage remarks which several of his pet bears make about their dancing-master.

De Morgan was a man of extraordinary information. We use the word advisedly as including all that is meant by the several terms knowledge, science, erudition, &c. Everywhere he was thoroughly at home. An old edition and its value-giving peculiarities or defects, a complex mathematical formula with its proof and its congeners, a debated point in theology or logic, a quotation from some almost-unheard-of author, all came naturally to him, and from him. With a lively and ready wit, a singularly happy style, and admirable temper, he was exactly fitted to write a work like this. And every page of it shows that he thoroughly enjoyed his task. Witness, for instance, the following extract:—

"I will not, from henceforward, talk to any squarer of the circle, trisector of the angle, duplicator of the cube, constructor of perpetual motion, subverter of gravitation, stagnator of the earth, builder of the universe, &c. I will receive any writings or books which require no answer, and read them when I please: I will certainly preserve them—this list may be enlarged at some future time. There are three subjects which I have hardly anything upon: astrology, mechanism, and the infallible way of winning at play. I have never cared to preserve astrology. The mechanists make models, and not books. The infallible winners—though I have seen a few—think their secret too valuable, and prefer *mutare quadrata rotundis*—to turn dice into coin—at the gaming-house: verily they have their reward."

He was not, let it be at once said, a great original mathematician—not, that is, of the order of men like Boole or Rowan Hamilton—but extraordinarily great mathematicians like these are very rare, and there were not in Britain a dozen who were his superiors. We are told in the Preface to this work that it was his intention to have composed a companion volume on "the contradictions and inconsistencies of orthodox learning." What a loss we have here sustained—how narrow an escape several of our most popularly idolised men of science, &c., have made—must be known to many, perhaps even dimly suspected (at least we hope so) by those who would assuredly have been the earliest and most prominent sufferers.

A great part of the volume consists of reprints from a series of almost weekly papers in the *Athenæum*; but much new matter has been added, and several modifications and corrections have been made. The task of editing has been undertaken by the author's widow, and appears to have been exceedingly well done throughout. The volume is not one which can be read through at a sitting—nor even at three or four: the multiplicity of subjects renders it bewildering if more than a dozen or two of pages be read at a time—but we do not envy the man who cannot, at a spare moment, find both pleasure and profit in the perusal of a moderate portion of it, taken *ad aperturam*.

De Morgan was a very dangerous antagonist. Ever ready, almost always thoroughly well informed, gifted with admirable powers of sarcasm which varied their method according to the temperament of his adversary, he was ready for all comers, gaily tilted against many so-called celebrities; and—upset them. It is unfortunate that the issue of his grand contest with Sir William Hamilton (the great Scottish Oxford Philosopher) is but in part indicated in this volume—it is softened down, in fact, till one can hardly recognise the features of the extraordinary *Athenæum* correspondence of 1847. There the ungovernable rage of the philosopher contrasts most strongly with the calm sarcasm of the mathematician, who was at every point his master, and who "played" him with the dexterity and the tenderness of old Isaak himself! But it is characteristic of De Morgan that, though he was grievously insulted throughout the greater part of this discussion, no trace of annoyance seems to have remained with him after the death of his antagonist; for none would gather from the "Budget" more than the faintest inkling of the amount of provocation he received.

Yet De Morgan had his weak points, and in an unguarded moment he made a first, and last, attack—one of the few assaults in which he was unsuccessful—on Faraday. At least he gets the credit of having reviewed a lecture of Faraday's in the *Athenæum* of 1857, and of having for once wholly missed the main point at issue.

To return to the "Budget." The tenderness displayed for trisectors, duplicators of the cube, circle squarers, perpetual motionists, *et hoc genus omne*—from J. Reddie through J. Symons, to J. Smith—is most touching. The real human interest evidently taken in the careers of those hopelessly ignorant writers, does credit to De Morgan's heart. He does not hang up his Paradoxer on high as a warning, nor does he dissect him for purposes of psychological study; he carefully spreads him out, under sufficient but not extravagant pressure, on the white page of his herbarium, and fondly preserves him as a specimen for his future lectures. Thus the specimens may be said to *live* in his pages, with all their bright motley of colour and their extraordinary odours—only *flattened* a little by the supreme necessities of the case.

Mingled with the paradoxes, and generally more or less directly suggested by them, we have many valuable pieces of information—as, for instance, about the calendar (pp. 219, &c.), the names of the "beast" (p. 403), the "Macclesfield Letters" (p. 448), &c.—and we have anecdotes, verses more or less confessedly doggrel, and paradoxes full-blown, from the author's own pen.

One extract must suffice, though there are hundreds equally good, for which we must refer the reader to this most thoroughly enjoyable book itself. Our choice is determined by the present aspect of the education question: and conveys a much-needed lesson to all who are capable of comprehending.

"It was somewhat more than twenty years after I had thus heard a Cambridge tutor show sense of the true place of Horner's method, that a pupil of mine who had passed on to Cambridge was desired by his College tutor to solve a certain cubic equation—one of an integer root of two figures. In a minute the work and answer were presented by Horner's method. 'How!' said the tutor, 'this can't be, you know.' 'There is the answer, sir,' said my pupil, greatly amused, for my pupils learnt not only Horner's method, but the estimation it held at Cambridge. 'Yes,' said the tutor, 'there is the answer, certainly; but it *stands to reason* that a cubic equation cannot be solved in this space.' He then sat down, went through a process about ten times as long, and then said with triumph, 'There! that is the way to solve a cubic equation!' I think the tutor in this case was never matched, except by the country organist. A master of the instrument went into the organ-loft during service, and asked the organist to let him *play the congregation out*; consent was given. The stranger, when the time came, began a voluntary, which made the people open their ears, and wonder who had got into the loft; they kept their places to enjoy the treat. When the organist saw this, he pushed the interloper off the stool, with 'You'll never play 'em out this side Christmas.' He then began his own drone, and the congregation began to move quietly away. 'There!' said he, 'that's the way to play 'em out!'"

BURMEISTER'S ANNALS OF THE PUBLIC MUSEUM OF BUENOS AYRES

Anales del Museo Publico de Buenos Ayres, para dar a conocer los objetos de Historia Natural nuevos o poco conocidos conservados en este establecimento. Por German Burmeister, M.D. Vol. ii., parts 1—4. (Buenos Ayres and London: Taylor and Francis.)

In a previous number of NATURE (vol. iii. p. 282), Prof. Flower has given our readers an account of the first volume of this most meritorious work, and of the objects of its distinguished author in undertaking it. Since Prof. Flowers's article was published, four parts of the second volume of the "Anales" have been issued, containing a series of articles and illustrations of quite as great zoological interest as those in the first volume. The wonders of the extinct Mammalian Fauna of the Argentine Republic are well known, and in the present volume Prof. Burmeister devotes himself to their exposition. In the first part he commences a complete monograph of the Glyptodonts, or extinct gigantic Armadillos, represented by specimens in the museum under his charges and carries it on to the end of Part IV. In the first volume of the "Annals" Prof. Burmeister, in the course of a general article on the fossil mammals of the diluvium of Buenos Ayres, had given a preliminary exposition of his views as to the arrangement of these wonderful animals. He now enters at length upon the description of the species known to him, and gives a series of splendid lithographs to illustrate their remains. Not only are the bones of the Glyptodonts so perfectly preserved as to enable many of the skeletons to be completely restored, but great portions of the extraordinary suits of armour with which they were clad above and below have likewise been discovered, so that their external appearance can likewise be portrayed. Those who interest themselves in palæontology will do well to secure copies of these beautiful illustrations, a few of which are on sale at Messrs. Taylor and Francis, of Red Lion Court, at 10*s.* a number.

We should add that, attached to each number of the "Anales" is a "Boletin del Museo Publico de Buenos Ayres," in which is given an account of the additions made to the establishment during the year. An important acquisition in 1871 was the series of remains of the *Machrauchenia patachonica*, an extinct animal allied to the horses and tapirs, formerly belonging to a naturalist named Bravard, who was killed in the earthquake of Mendoza. These specimens formed the basis of Prof. Burmeister's complete restoration of this animal, published in the first volume of the "Anales."

OUR BOOK SHELF

Notes on the Post-pliocene Geology of Canada, &c. By J. W. Dawson, LL.D., F.R.S., F.G.S. (Montreal: Mitchell and Wilson, 1872.)

THESE "Notes," which are reprinted from the *Canadian Naturalist*, cannot fail to interest European glacialists. Especially valuable for purposes of comparison are the detailed notes on the fossils obtained from the glacial beds. The lists include in all about 205 species, distributed as follows:—Radiata, 24; Mollusca, 140; Articulata, 26; Vertebrata, 5. All these, with three or four exceptions, may be affirmed, says the author, to be living northern or southern species. Moreover, the fauna of the older part of the Canadian glacial deposits is more Arctic in character than that of the modern part. It would thus appear that since the accumulation of the boulder-clay a gradual amelioration of climate has taken place: but the change from Arctic conditions has evidently been less decided on the west than on the east side of the Atlantic. Dr. Dawson's conclusions regarding what we may term the physics of the glacial epoch will probably meet with less acceptance than his palæontological results. He considers the Erie-clay described by Whittlesey, Newberry, and others to be of marine, and not of fresh-water origin, as these authors believe. But his reasons for this opinion can hardly be considered satisfactory. When an extensive deposit of fine clay, after having been examined over a wide area, is found not only to be totally destitute of marine organisms, but to contain quantities of drift-wood, and to have associated with it beds of peat and an old soil containing tree roots, the probabilities are that the clay-beds are of fresh-water origin. Besides, if we are not mistaken, fresh-water shells have been got in the Erie clay. That much-vexed question, the origin of boulder-clay comes in for some discussion in these "Notes," the author inclining to think the deposit is marine. It is somewhat significant, however, that the boulder-clay is only fossiliferous in the lower part of the St. Lawrence river; further inland it has not been observed to contain fossils. From the author's description of the boulder-clay as seen at low levels in Canada, we think that deposit more closely resembles some of the maritime fossiliferous stony clays of Britain than our Till or lower boulder-clay. Dr. Dawson seems to have satisfied himself that the "real cause" of the excavation of the American lakes "was obviously the flowing of cold currents over the American land during its submergence." He also thinks that "the fiords on coasts, like the deep lateral valleys of mountains, are evidences of the action of waves, rather than that of ice." No glacialist, as far as we know, holds the extravagant belief that fiords have been cut out by ice. They are undoubtedly submerged valleys, and were hollowed out by streams and other atmospheric influences in ages long anterior to the glacial epoch. But however much we may differ from Dr. Dawson in some of his conclusions, there can be no doubt that he has added very considerably to our knowledge of American glacial deposits, and we cordially recommend the perusal of his "Notes" to our geological readers.

LETTERS TO THE EDITOR

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

The Invention of the Water-Air-Pump

STATEMENT BY PROF. BUNSEN*

"A letter addressed to me by Dr. Sprengel, under date of November 1, 1872, in which he says: 'Perhaps it will not have escaped your observation, that the invention of the water-air-pump, which you have constructed after the principle of my mercury air-pump, according to your paper published in 1868 on the washing of precipitates, is almost everywhere attributed to you,' induces me to make the following statement:

"The interesting discovery, that by means of columns of liquids flowing downwards a more perfect vacuum can be produced, than was possible by the air-pumps hitherto in use, belongs solely and only to Dr. Sprengel. He in his researches on the vacuum (*Journal of the Chemical Society*, January 1865) brings prominently forward, that water is from a practical point of view the only liquid which could come into consideration as a substitute for mercury used in the instrument described by him; and that it is not unlikely that such an instrument, adapted for water, might possess advantages which air-pumps of other constructions have not, particularly in hilly countries, where the large volume of a natural waterfall might be rendered available. In the theoretical considerations on the action of his instrument, which immediately follows the above, it is noticed, that it is simply the reverse of the Trompe, with this addition, that the supply of air is limited, while that in the Trompe is unlimited.

"If in the face of these facts, which are open to all, anyone attributes to me, as I must conclude from Dr. Sprengel's letter, a share in his discovery, I can regret this only all the more keenly, as in my treatise on the new method of filtration I could not possibly have expressed myself with regard to Dr. Sprengel's claims more loyally and precisely than I have done. There, I have stated expressly, that I have constructed the pump used for filtrations and described by me in detail, after the principle of Sprengel's mercury-air-pump. It was the only apparatus of the kind which Dr. Sprengel described, consequently the one to which alone I could refer. "R. BUNSEN

"Heidelberg, Nov. 5, 1872"

Expressing my best thanks to Prof. Bunsen for the above statement, I beg to add, that since 1860 I have been using for laboratory purposes a water-trompe, as described by me in *Poggendorff's Annalen* for 1861, vol. cxii., which (by reversing the action) led me in 1863 to the new method of air-rarefaction. Water was the first liquid, which I used in my first pump, constructed during the summer of 1863. But the fallacies arising from the tension of aqueous vapour and from the air absorbed in water, as well as the inconvenience of having to provide for the requisite fall, caused me to discontinue the use of water, and to substitute in its stead mercury as the most suitable liquid for establishing *the* truth, which I had recognised by means of a water-air-pump with an insufficient fall. My paper of 1865 was written with reference to *all* liquids; in fact, on p. 15 (rendered prominent by italics) I summed up thus:—

"The main fact which I have established in this paper may be shortly stated to be that, *if a liquid be allowed to run down a tube, to the upper part of which a receiver is attached by means of a lateral tube, and if the height at which the receiver is attached be not less than that of the column of the liquid which can be supported by the atmospheric pressure, a vacuum will be formed in the receiver* minus *the tension of the liquid employed.*"

I regret that the obviousness of the matter led me to refrain from expressing myself in a more detailed manner, believing, as I still believe, that what I wrote sufficiently described the construction of the water-air-pump.

In conclusion Mr. Johnson's aspirator* for establishing a current of air ought to be mentioned here. It was recognised by Prof. Hofmann† to act on the principle of the trompe, and of course might have served as an air-pump, had it been noticed at the time that the instrument would furnish the means of creating a vacuum. And I may also draw attention to the tube‡ of a vacuum-pan, through which the water is made to escape, which has served to condense the steam of the boiling liquid. This no doubt would in like manner have served as a complete water-air-pump, but it does not appear that its use as such was discovered. H. SPRENGEL

London, Jan. 22, 1873

Kant on the Retarded Rotation of Planets and Satellites

IT is now recognised that the tides are necessarily lengthening the day; but the history of this recognition seems to be incomplete. "It appears," says Mr. Tait in his "Thermodynamics," p. 86, "that the first suggestion of such an effect is due to Kant." Mr. Stewart speaks more positively ("On Heat," p. 356), but adds that Mayer "was the first to give his conclusions general publicity."

The following are the facts with respect to Kant, as they are to be found in Rosenkranz and Schubert's edition of his works, part vi. pp. vii. 3-12. The Berlin Academy of Sciences had proposed, as the subject of a prize essay for 1754, the questions whether the length of day and night had changed, and if so, what the cause could be and how this was to be ascertained. Kant did not compete; apparently he was dissatisfied, as well he might be, with his attempt to estimate the possible amount of retardation; but he published his views in a Königsberg weekly paper.

It is of some interest to compare Kant's position with our own. In the first place, he expresses himself with almost entire generality. He does not speak merely of the tides, but says that the rotation of any planet is necessarily retarded if it contains a considerable amount of fluid. Kant knew as well as we do that the *considerableness* (that is the magnitude) of the cause affected only the magnitude (and not the bare reality) of the effect; so there is nothing to be added to his statement of the condition of retardation but what our own writers do not seem to think worth adding, namely the energy dissipated in consequence of the imperfect rigidity and elasticity of the solid parts of the planet.

Again, with respect to the final result, Kant makes two statements, which, if literally contradictory, yet taken together go to show the fulness of his knowledge. First he says the rotation must ultimately cease; further on that it must diminish till it is equal to the revolution of the moon, so that the earth will constantly face the moon, as the moon now constantly faces the earth. The essay bears marks of hasty writing; and it seems clear that the latter statement is only intended for that part of the effect which is due to the moon. The former may be intended to affirm the ultimate abolition of the solar day; if it means much more (as it ought) I presume it is inconsistent with Kant's express rejection of the hypothesis of an interplanetary resisting medium.

On the other hand, Kant betrays no suspicion of the reaction upon the disturbing bodies, and the consequent lengthening of the month and year. And in speculating on the possibility of

* Translated from *Ann. Chem. Pharm.* vol. clxv. p. 159, by H. Sprengel, authorised by Prof. Bunsen.

* *Quarterly Journal of the Chemical Society*, vol. iv. p 180. 1852.
† Ibid.
‡ "Elements of Physics," by Neil Arnott, M.D. (Longmans.) 3rd edit. London, 1828.

historical verification, he thinks only of an apparent shortening of the year, forgetting the month, which, as it has turned out, has proved the tell-tale. Least of all can he have imagined that the question could be answered, or even asked—What becomes of the lost velocity?

But he says expressly that it is probably the tidal influence of the earth that has brought the moon to face the earth constantly as it does. Mr. Tait, in the passage from which I have quoted, treats this suggestion as originally Helmholtz's, though, speaking under correction, I should have said it formed part of Laplace's explanation. Be this as it may, Kant published it when Laplace was five years old.

The essay was reprinted by Nicolovius in his collection of Kant's minor pieces. I do not know the date of this publication, but 1839 is the date of Rosenkranz and Schubert. Yet we have Arago in his latest work, and Herschel at least as late as 1851, affirming the invariable length of the day, not merely as approximately established by history, but (internal disturbance apart) as a direct result of dynamical principles. It is not "general publicity" that was wanting in Kant's case, but special publicity, the publicity of Transactions and Jahrbücher. It is to be hoped that those who work in the several departments of knowledge are now learning to know better what their neighbours are about.

Hadley, Middlesex, Jan. 21 C. J. MONRO

Pollen-eaters

I AM sorry that I am unable to give Mr. Bennett all the information that he desires, as I have never studied the classification of the Diptera, and do not know the species of the flies in question; nor do I like to trust my memory as to those of the flowers. The common dandelion is, however, I think, an especial favourite; and it is evident that in this and other Compositæ the movements of any insect among the flowrets must scatter some of the pollen upon the stigmas, and some may even be carried on its legs and body in its wanderings from flower to flower, though the smooth body and cleanly habits of the fly must be rather an obstacle to this. But to some other species of flowers, on the pollen of which I have sometimes seen them feeding, and paid particular attention to this point, I think it very doubtful whether their visits can be anything but injurious.

W. E. HART

P.S.—Allow me to correct a misprint in my former note. By the substitution of an "N" for the initial "h," the expressive popular name of "hoverers," which I used in writing of the *Syrphidæ*, has been rendered quite meaningless. I should also be glad to know whether I am correct in the use of the word "mandibula," in the same note.

Meteors in South Pacific

WHILE some natives of these islands were preparing my boat for a journey during the night of October 27-28, they were considerably alarmed by the appearance of a very large meteor. As far as I could ascertain from them it became visible near to ζ Ceti, and rushed towards the south-east, leaving a bright train in its wake. One of the natives described it as being as large as a man's head; the others thought it was larger than that. These statements about size must be taken with caution, but from the excitement it caused I believe the meteor was a very large one. It was seen a little before local midnight.

I was travelling the same night from midnight to 3 A.M., and during that time I observed eleven meteors: two of which appeared near to Pollux, and disappeared near to α Hydræ. The other nine all appeared near to η Canis majoris and proceeded through the constellation Argo Navis. The last I saw, at 3 A.M., reached nearly to the Southern Cross, which was then just above the horizon.

Only one of the eleven meteors I saw was at all remarkable for size, and that was about as bright as Sirius, with which I compared it. This was the only one which left any perceptible train.

I should add that, although Samoa is in the Western hemisphere, our local time is that of the Eastern hemisphere; hence the dates given are twenty-four hours ahead of the true time of our geographical position. S. J. WHITMEE

Samoa, South Pacific, Oct. 30, 1872

Aurora Spectra.

MR. CAPRON's notice of my observations with regard to the auroral spectra compels me to say a few words with regard to them which I should rather have deferred till I could confirm my suspicions by fresh experiments. The spectrum which appears to coincide with the aurora, is not the ordinary spectrum of oxygen obtained by the disruptive discharge, but is, I have little doubt, that described by Wällner (Phil. Mag. p. 420, vol. xxxvii.) It is not uncommon in ordinary *lumière* tubes, but I obtained it with a feeble discharge in tubes filled with electrolytic oxygen, and therefore put it down to that gas. It is now two years since I made these experiments. Circumstances compelled me to leave the research incomplete, and I have hitherto been unable to return to it; but greater experience in the difficulties of spectrum work has suggested sources of error which I did not then suspect, and I should not feel any surprise if the spectrum in question turned out to be that of some carbon compound from the india rubber connections. It certainly has a strong family likeness to these, and if it were so, would confirm Prof. Piazzi Smyth's coincidence with citron acetylene. I will endeavour shortly to decide this.

As to instrumental power, the greatest I have used on the aurora has been that of a 60° bisulphide prism; but this is sufficient to show in both lines a breadth distinctly greater than the slit. Unfortunately, however, as I think I have before stated, the auroral line appears equally nebulous on both sides, while that in the tube spectrum is shaded mainly towards the red. On the other hand it is fair to note that this ceases to be visible when the light is faint and the dispersive power not greater than that employed on the aurora.

North Shields, Jan. 18 HENRY R. PROCTER

On the Words "Diathermanous," "Diathermancy," etc.

IN reply to the question of Mr. W. M. Williams in the postscript to his letter (NATURE, vol. vii. p. 202) I beg leave to make a few observations. I presume that the author of the above terms thought that the idea of the permeability of a medium by radiant heat could be better expressed by derivatives of the verb θερμαίνω (I heat) than by those of the more elementary words θέρμος (hot) or θέρμη (heat). To the former of these classes "diathermanous," "diathermancy" (from θερμανσις), and "diathermacy" (from θερμασία), all belong, though they are not very regularly formed, as our English termination "cy" corresponds to the Latin *tia*, as "clemency" from *clementia*, or the Greek "τεια," as "policy," from πολιτεία. "Diathermous" belongs to the latter class.

According to precedents the substantive corresponding to "diathermous" might be "diathermy," as bigamous, bigamy, or "diathermeity," as diaphanous, diaphaneity, or "diathermosity," as porous, porosity, but not "diatherm*a*cy," in which the second letter "a" clearly points out its derivation from the verb.

In point of form the words of Latin origin, "transcalent," "transcalency," which have been used in the same sense, are quite unobjectionable, and have the great advantage of corresponding in form with "transparent," "transparency," "translucent," "translucency," so that the words expressing permeability by the rays of light and heat are of similar form, though perhaps the derivation of "calescence" from a neuter verb, when an active sense is wanted, may be an objection to their use.

Seeing, therefore, that "diathermous" has no very eligible substantive corresponding to it, I submit that the original words "diathermanous" and "diathermancy" are most eligible in sense and least objectionable in form of the words of Greek derivation. Some perhaps, in spite of the above objection, may prefer the Latin words. W. D. L. L.

Dr. Sanderson's Experiments

MAY I ask Dr. Burdon Sanderson to kindly state in your columns one or two matters relating to the cheese employed by Dr. Bastian in the experiments at which he assisted. He justly remarks on the value of a knowledge of methods of demonstrating important facts—and I would therefore ask for the advantage of other readers as well as my own—some further information. I have already to thank Dr. Bastian for stating the specific gravity of his turnip-solution, in reply to my request.

In Dr. Sanderson's letter additional particulars are given, which also do not form part of the statement of those conditions under which Dr. Bastian tells us in his book on the "Beginnings of Life," that he has in the proportion of 999 cases out of 1,000 obtained a development of Bacteria from turnip-solution—boiled and sealed boiling. It appears that Dr. Bastian considers it a condition favourable to success—that the rind of the turnip be excluded from the preparation of the infusion. This is for the first time announced in Dr. Sanderson's letter. Also it is there for the first time that an accurate description of the flasks (not tubes) used, and of the quantity of infusion enclosed in each flask is given.

I now merely desire to know the quality of the small quantity of pounded cheese added to each flask. Let me say that another condition of the experiment—not given by Dr. Bastian, but now for the first time by Dr. Sanderson, is the addition of the cheese after the infusion is in the flask—so that no straining or filtration is made use of, subsequently to its addition. In the absence of so distinct a statement on this point as that of Dr. Sanderson, it was natural to suppose that the turnip and cheese infusion would be strained in some way, to get rid of coarse particles. It seems important that it should be known (1) what kind of cheese was used, (2) about how much to each fluid ounce of turnip infusion, (3) to what extent the cheese was "pounded" before addition, and whether particles of cheese visible to the naked eye, and of what approximate size, were present in the infusion during its boiling? (4) whether the turnip solution was strained before the addition of the cheese, and whether it contained obvious solid particles, and of what size?

I trust that Dr. Sanderson having placed your readers, and those interested in the natural history of Bacteria, under so great an obligation by his careful statement of the conditions of the experiments of which he was witness, will kindly add to our debt by furnishing this additional information.

In numerous experiments with turnip solution made by Dr. Pode and myself recently in the laboratory of the Regius Professor of Medicine of this University, we found that under the conditions given in Dr. Bastian's book, no life was developed—a result contrary to that obtained by him in 999 cases out of 1,000. It will be necessary to make further experiments by aid of the light furnished by Dr. Sanderson's letter, in order to explain this discrepancy.

It is desirable to call to mind that Pasteur himself and others have recorded experiments regarded by them as demonstrating the survival of the Butyric form of Bacterium or its germs, after exposure to temperatures of 100° or even 105° C.

Exeter College, Oxford — E. RAY LANKESTER

THE NATIONAL HERBARIA MEMORIAL

WE are glad to be able to lay before our readers the reply to the memorial to Mr. Gladstone, signed by so many eminent botanists, which appeared in NATURE for January 16. The answer is in every respect satisfactory :—

"Treasury Chambers, January 23, 1873

"Sir,—The Lords Commissioners of Her Majesty's Treasury have had before them your letter of the 3rd instant, and the Memorial enclosed in it from various gentlemen engaged in the pursuit of botany or in instruction therein, with respect to the transfer to the branch of the British Museum about to be constructed at South Kensington, of the scientific collections and library now existing at the Royal Gardens at Kew.

"Their lordships desire me to request that you will inform the memorialists that Her Majesty's Government have not formed the intention of removing the collection to South Kensington, and that should anything lead them hereafter to entertain the idea, they will take care that ample notice shall be given, and that the judgment of the persons most accomplished in botany shall be fairly weighed in the first instance.

"I am, Sir, your obedient servant,

"WILLIAM LAW

"The Rev. M. J. Berkeley, Sibbertoft,
"Market Harborough"

THE METEOROLOGICAL OBSERVATORY AT MAURITIUS

THE Meteorological Society of Mauritius have recently presented to the Governor of that colony a memorial (contained in a copy of the *Commercial Gazette* sent to us) requesting him immediately to place on the estimates a sum sufficient to complete the new meteorological observatory there before the end of the present year. One of the objects for which this excellent society was formed in 1851, was to aim at the establishment of a permanent meteorological and magnetical observatory; and since 1860 the members have been doing their best to urge the Colonial Government to help them to accomplish their object; but one untoward event after another has occurred to postpone its consummation. The old observatory, a very inconvenient one, was sold in 1866 for 10,843*l.* and about half this sum was made available by the Government for the new observatory and instruments; besides this, another sum of 4,500*l.* is available, though the Government hesitate to make use of it. In 1870 a small portion of the new building was erected, and the foundation stone of the main building laid by H.R.H. the Duke of Edinburgh, but nothing more has been done since; and the staff, owing to the scanty allowance for the purpose, has been utterly inadequate. The memorial then asks the governor to grant at once the funds necessary to complete the building and to maintain an adequate staff; and urges, as a reason for haste, among other more enduring and general reasons, the approaching transit of Venus. The people of Mauritius, both for their own sakes and for the sake of science, the Society believe will be glad to lend a helping hand. We cannot but think that if the Government of Mauritius give the matter their serious consideration, they will at once accede to the prayer of the society's memorial. The benefit which such an observatory, in the heart of the Indian Ocean, would confer on science and humanity would be immense: and to cripple such an institution would be anything but economy. The vast importance in agricultural, nautical, and sanitary points of view, of having an observatory in Mauritius, is generally acknowledged; indeed, it is well known to those who have resided in Mauritius, as well as in other tropical countries, that timely warning of a single hurricane (which experience shows can be given), might save as much money as would suffice to build an observatory, and to maintain it for years. The Society does not seek any help from the Imperial Government; and we sincerely hope that no narrow and short-sighted notions of economy will prevent the Governor of Mauritius from at once granting the means of fulfilling the so frequently frustrated hopes of the Meteorological Society.

The Society concludes its memorial by "strongly recommending that no deviation should be made from the plan proposed by the President and Council of the Royal Society of London; that is, that meteorological, magnetical, and solar spot observations should be carried on simultaneously by photography. To endeavour to carry out a half-measure, liable to change and interruption, would be almost a waste of time and money. It is probable that meteorology, terrestrial magnetism, and sunspots, are intimately connected by some law or laws not yet determined; and nothing short of long-continued photographic records of the several phenomena concerned, would meet the present requirements of Science."

THE NATIONAL HERBARIA

THE Memorial printed in NATURE for January 16 will probably be held to be a sufficient indication of the estimation in which Kew is held as a scientific establishment by the botanists of the country as well as of the undesirableness in their opinion of its being in any way dismembered.

It will not I hope be considered improper if I venture (entirely, of course, on my own responsibility), to make some remarks with the view of aiding those who are not botanists to form an opinion upon the matter.

In the first place it may be well to give some notion of the nature of a public herbarium and the purposes it serves. Most persons are aware that with a little care specimens of almost any plant can be dried under pressure, so as to give, even to those who are not accustomed to study such specimens, some notion of what the plant is like in the fresh state. To a professed botanist they yield of course a great deal more information.

A herbarium then consists of a collection of dried plants. Whatever may be the plan adopted by private individuals, it is absolutely necessary in a public herbarium that the specimens should be securely stuck down upon sheets of paper, in order that they may bear frequent handling without injury. This does not, however, prevent the detachment under proper supervision of such fragments as can be spared and are requisite for scientific investigation. The sheets on which the specimens are fastened are placed in loose covers, and these are arranged in proper classificatory order on the shelves of cabinets which are made to hold them.

Any botanist interested in any particular group of plants, and visiting a well-worked herbarium, has only to go to the proper place to find everything that the herbarium contains belonging to that group ready to his hand, and in a state suitable for study. Such a result is not, however, attained without immense labour on the part of those who have charge of the herbarium. Fresh accessions of plants have continually to be examined in detail before the proper positions for their intercalation in the arranged collection can be determined.

A public herbarium derives its additions from three sources:—gifts, exchange, and purchase. The first includes, besides collections given by the government departments, at whose instance they have been made, supplies coming from private individuals. At Kew the Garden and the Herbarium benefit in common by the extensive correspondence carried on in every part of the globe with persons of every grade. Contributions, both large and small, are constantly arriving of living and dried plants, seeds, and specimens unsuitable for herbarium purposes but which find their place in the Museums. This correspondence it has required a long period to organise, and it needs no small exertion to continue and extend it. I conceive that it is, putting aside all others, a very strong argument for the maintenance of a herbarium at Kew, that it participates, as no other herbarium in this country could do, in the results of a correspondence which must necessarily be kept up for the purposes of the Garden, and which indeed could hardly be carried on elsewhere for the advantage of a herbarium alone, to anything like the same extent. Moreover the correspondents of Kew constantly send dried plants to be named, besides making demands for every kind of information which nothing but a herbarium and library on the spot could enable them to be supplied with.

The dried plants which are received at Kew from different sources necessarily include a large number of duplicates, that is, of specimens not needed for the herbarium. These, however, are not wasted, but are sent from Kew to various establishments with which exchanges can be effected. This is a most important matter, because the authentically named specimens of foreign botanists which are received in exchange are far more useful for purposes of comparison than any figures or descriptions.

The uses of a large herbarium are in the main two. In the first place it supplies the material for purely scientific investigations, both with regard to the structure and classification of plants as well as with regard to their geographical relations and the problem of how their world distribution has come to be what it is. But a herbarium is also most important on purely utilitarian grounds. An immense number of important products are derived from the vegetable kingdom, and it is very necessary to have exact and precise information as to the plants which produce these. Dried plants preserved in herbaria are standards of reference in comparison with which the names of specimens can be accurately determined. Botanical names have a universal currency, and therefore obviate all the divergencies and confusion of those which are merely local and vernacular. Horticulturists moreover look to those who have access to herbaria to guarantee the correctness of the nomenclature of garden plants.

Besides the herbarium at Kew there is the older one belonging to the British Museum. It is still in a measure *sub judice* what is to be the future position of these two institutions. That the Kew Herbarium should not be severed from the Garden is the all but unanimous judgment of those who are best qualified to give an opinion. With respect to the British Museum Herbarium there is greater difference. Some botanists have wished to see the valuable type specimens which it contains added to those at Kew, just as they might wish, if it were in their power, to condense there what is best in some of the leading foreign herbaria. In my opinion the transference to Kew of any portion of the British Museum collections would be very undesirable. The British Museum specimens are mounted on paper of a very different size, and the sheets could not be cut down without impairing their authenticity. Moreover, at the British Museum there is an extensive series of ante-Linnean herbaria most valuable from a historical point of view, but not otherwise available for study, and these would, on that account, be out of place at Kew. Again, with collections so combustible as those of dried plants, it is all but imperative to divide the risk of losing the whole national accumulations in one conflagration.

The two Herbaria have also two well-marked but distinct fields of activity open to them. Let the Kew Herbarium remain, as at present, to be used for the varied ends of the Kew establishment, and by such students as are engaged in important works, as original memoirs and colonial or forest floras executed for the Government. They would be willing to gain, as they do now by the distance from town, tranquillity from the incursion of visitors less permanently occupied with botanical pursuits. Then the British Museum collections (which, if it were possible, it would be a convenient arrangement to retain in Bloomsbury) would serve still for persons who would use them rather for reference than for continuous study, although this also would not be precluded. It must, however, be admitted that they are capable of very great improvement even for purposes of reference, and it would be very desirable to this end that the Kew and Bloomsbury establishments should be brought into some sort of amicable relation. I will give a few instances quite arbitrarily selected from my own experience, which will show how very far behind the British Museum Herbarium is in completeness to that of Kew.

The Indo-Malayan genus *Dipterocarpus* is represented in the former by 17 sheets, including 10 species, in the latter by 116 sheets, including 31 species: the South African genus *Stapelia*, consisting of plants very difficult to dry, in the former by 4 sheets of 3 species, in the latter by 48 sheets of 25 species; lastly the Tasmanian *Athrotaxis* (*Coniferæ*), of which one species is to be found in nurserymen's catalogues, is represented at Kew by 16 sheets, illustrating all the three known species; while at the British Museum I have not succeeded in discovering a single specimen in the arranged collection at all.

But a very large portion of the plants at the British Museum are practically inaccessible. Unfastened on paper, and much in the state in which they were received from the collectors, except a rough geographical distribution into cupboards, they are little more assorted than the plants which constitute a haystack. A considerable part, if not the whole, of the 7,000 specimens of plants from the expeditions of Hooker and Thomson, which cannot have been received less than fifteen years ago, were, quite lately, still unmounted and unincorporated. Again, merely to quote instances which have come unsought within my own observation, the plants collected in Nepaul half a century since by Wallich, and as I learn from a distinguished Indian botanist, in a district which has never since been botanically explored, were recently, and perhaps are still, amongst the unarranged collections. These altogether, I should judge, roughly form in bulk about one-sixth of the whole herbarium. The arranged portion is estimated to possess 77,400 species of flowering plants, contained in 306 cabinets with 8 shelves; the Kew Herbarium, on the other hand, possesses 105,000 to 110,000 species in 450 cabinets, on an average of 16 shelves. As I have ascertained that the shelves are in each case about the same width apart, and about equally filled, these figures give roughly three times as many shelves to the Kew Herbarium, and somewhat less than half as many more species.

There can be no doubt, therefore, that the British Museum Herbarium might be materially developed, especially when it is remembered that Mr. Bentham's herbarium, when presented to Kew, contained between 60,000 and 70,000 species, and that this was formed in less than forty years by a single individual. The examination of the unarranged collections in the British Museum would, no doubt, yield a large number of duplicates, and these should be exchanged with foreign herbaria. If this were done—and there is no reason why the appliances of Kew should not be utilised for the purpose—it would be easy, without interfering with the independent action of either establishment, to bring about for the future a mutual interchange of specimens. Nor is there any reason why, when needful, the type specimens of the older botanists should not be lent to Kew from the other Herbarium, considering that both are Government property.

The development of the botanical collections in the rooms open to the public at the British Museum into something more useful, educationally, would probably be achieved by the officers, if they possessed more space. In this case it would be very desirable to transfer to them the collections belonging to vegetable palæontology in the Geological department. At present the nucleus of a collection of fossil plants bequeathed to the Botanical department by Robert Brown is being gradually developed, so that there are now actually two distinct collections, both having the same object, and existing independently of one another, and in charge of different officers, in the same building. W. T. THISELTON DYER

THE RAINFALL AND TEMPERATURE OF NORTH-WESTERN EUROPE

THE Scottish Meteorological Society have just received letters from their observers in Iceland and Faroe, together with the regular observations made by them for the Society to the end of November last, which are of interest in connection with the unprecedentedly wet and changeable season we have had in Scotland and elsewhere.

The rainfall in Iceland this year to the end of October has been 4·84 inches under the average of the ten months, the deficiency occurring chiefly in January, February, July, September, and October. In Faroe the deficiency has, to the end of November, amounted to 11·00 inches, the dry months being February, 4·50 inches under the average; July, 1·09 inch; August, 2·97 inches, and November, 4·17 inches. In Scotland, February was everywhere a wet month, except in the northern and western islands and in Clydesdale; and September, October, and November were very wet months,—all these months being characterised by a small rainfall in the north.

The mean temperature at Stykkisholm, in the northwest of Iceland, was 33°·7 in January, or 6°·8 above the average, being the highest mean temperature recorded in January since 1846, except that of 1862, which was 1°·0 higher; 52°·7 in July, and 51°·6 in August, being respectively 3°·6 and 3°·4 above the average of these months, and the highest that has occurred since July 1847 and August 1846. And as June was 0°·6 and September 1°·0 above the average, the past summer has been one of the finest experienced in Iceland for many years. The temperature in April was 3°·5, in May 1°·4, and in October 1°·0 under the average. On the other hand, the temperature of Faroe closely agreed with that of Scotland during the year, viz., above the average in January, February, March, April, June, July, and November, and under the average during the other months, especially September.

At Melstadt, on the north coast of Iceland, the summer was very fine, but in the beginning of October the weather broke, and on the 13th the temperature fell to 3°·0 or 29°·0 below freezing. At Reykjavik, the summer was also fine, but the autumn was remarkable for north and north-east gales, frequent auroras, low sea temperature, and large amount of ozone. Along with the unusual manifestation of these phenomena, inflammatory diseases were prevalent, especially bronchitis, catarrh, croup, and diphtheria.

The temperature of the sea presented certain very interesting anomalies during the year. In the earlier months it was, equally with the temperature of the air, above the average of former years in Iceland, Faroe, and Scotland. But at Stykkisholm it was 2°·7 in May, and 4°·2 in June below the average, it being at the same time from half a degree to a degree above the average in Faroe and Scotland. On the other hand, the sea was, at Stykkisholm, 2°·8 in August, and 2°·6 in September above the average, whereas at Sandwick, Orkney, it was 1°·2 and 1°·1 below it in the same months. In Faroe the temperature of the sea was above the average every month of the year (except October, when it was 0°·3 below it), amounting during the eleven months to an average excess of 1°·1.

The following are the differences from the averages of the sea temperatures at Stykkisholm from March to October, 1872:—

March	+ 1°·5	July	+ 1·3
April	— 0·1	August	+ 2·8
May	— 2·7	September	+ 2·6
June	— 4·2	October	+ 0·4

In May the mean temperature of the sea was 36°·7, and in August 53°·1. So great an increase as 17°·6 has not been previously observed in these months.

It is also a noteworthy circumstance that the means of the nine months' barometric pressure, from February to October, at Stykkisholm, have been in every case above the average, amounting to an average monthly excess of 0·118 inch. In Norway also, from February to August, to which the observations have reached us, the means were every month above the average, amounting at Vardoe (lat. 70° 20′) to a mean monthly excess of 0·260 inch; Christiansund, 0·129 inch; Christiania, 0·151 inch; and Maudal, near the Naze, 0·084 inch. On the other hand, barometric pressure was every month from February to October, below the average; at Paris, and in Guernsey, the mean monthly deficiency being respectively 0·074 and 0·090 inch. At Greenwich, the mean deficiency for the last nine months was 0·083 inch; Glasgow, 0·091 inch; Edinburgh, 0·088 inch; Aberdeen, 0·072 inch; Culloden, near Inverness, 0·34 inch; and at Stornoway, the station nearest to Iceland, only 0·006 inch. This high barometer in Iceland and Norway has had an important bearing on the unprecedently wet weather, and the accompanying low barometer we have had south of that region.

ALEXANDER BUCHAN

ON THE SPECTROSCOPE AND ITS APPLICATIONS

IV.

IN what has now been stated we first saw Newton founding spectral analysis, by using a hole in a shutter and a prism; then we discussed Wollaston's substitution of the slit; after that Mr. Simms' introduction of the collimating lens was referred to; and then the growth of the modern spectroscope.

It is time, now, that we came to the applications of the instrument. And in dealing with these applications I shall divide my subject into two perfectly distinct portions. I shall first deal with those which depend upon the different modes in which light is given out or radiated by

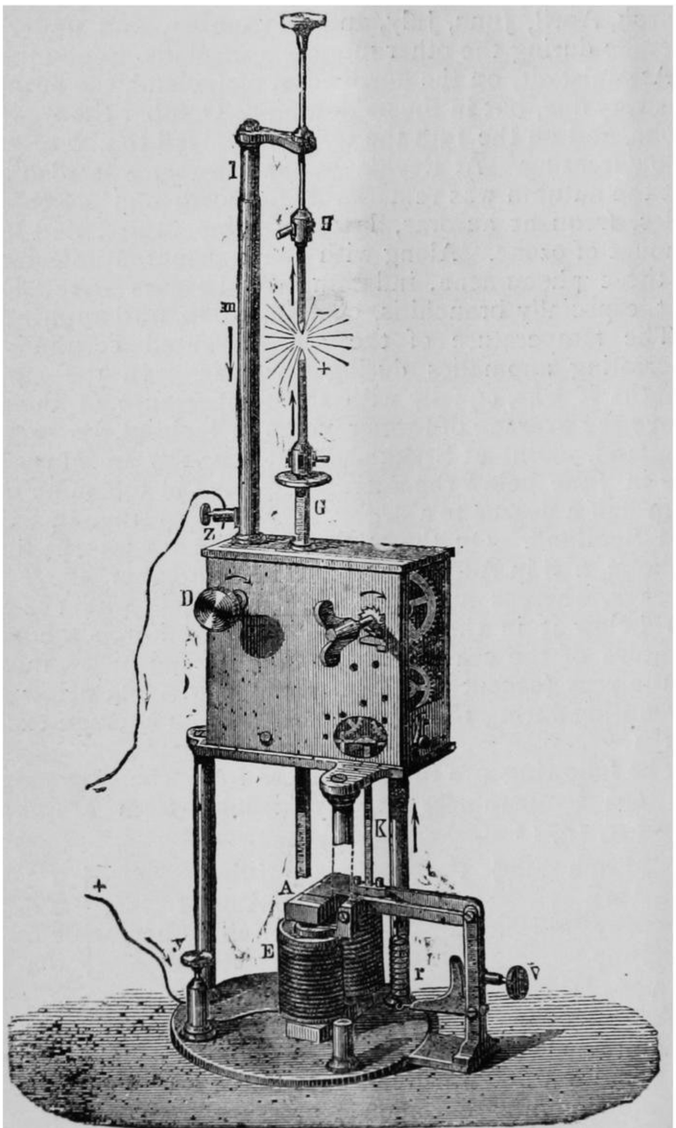

FIG. 9 Electric Lamp.

various bodies under different physical conditions, with, in fact, the *radiation* of light. And, in the second place, I shall deal with the spectroscope's story of the way in which white light giving a continuous spectrum is stopped or absorbed by different transparent bodies—with in fact the *absorption* of light.

The first application of this question of radiation is one of the most general importance. It enables us to differentiate between solid, liquid, and gaseous substances, and between gaseous or vaporous substances in different stages of pressure. If, for instance, we take a platinum wire and heat it to redness, and examine by means of the spectroscope, the light emitted we shall find that only red rays are visible, then if the wire be gradually heated more strongly, the yellow, green, and blue, rays will become visible, until finally when the wire has attained a brilliant white heat, the whole of the colours of the spectrum will be present. If I were to burn a piece of paper, or a match or an ordinary coal gas flame, you all know we should get a white light, but you may possibly not all know that if we raise any solid or liquid to a state of incandescence or glowing heat we should get exactly that same sort of light, which will always give us a continuous spectrum. Before a large audience the best method of showing this fact is to use an apparatus called the electric lamp, and to pass the current of electricity through two carbon points, which are intensely heated by their resistance to the passage of the current. The spectrum obtained from these points, by means of the dispersion of two bisulphide of carbon prisms, is quite continuous from end to end. Now carbon is a solid, and therefore if we take carbon as an example of a solid or liquid substance in a state of vivid incandescence, and we obtain from these carbon points a continuous spectrum, you must accept that as an indica-

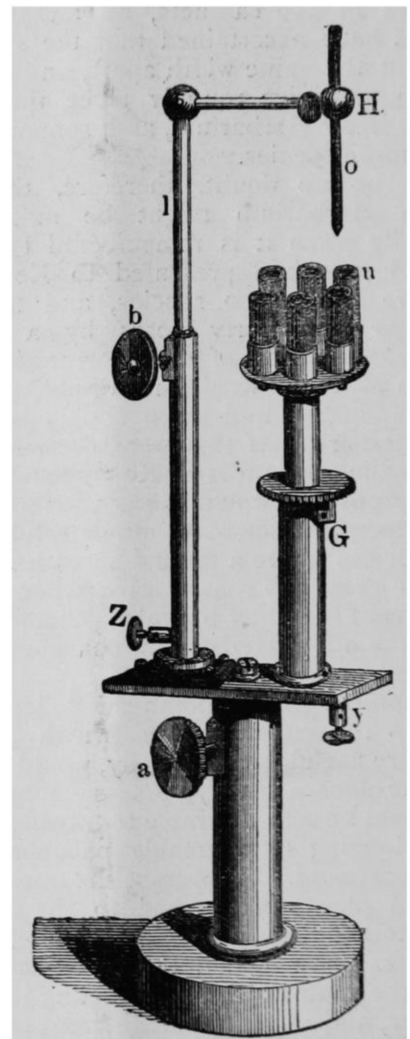

FIG. 20.—Arrangement of the electric lamp used for rapid comparisons.

tion of the truth of what I say, for I have not time to experiment on every solid and every liquid substance. The spectrum is received on the screen, and you see it is continuous, that is to say, there are no breaks, such as those we saw in the figure representing a portion of the solar spectrum on page 167 where the black lines represent the breaks in the solar spectrum which are called the Fraünhofer lines.

Let us then consider this fact established, namely, that solid or liquid bodies, when heated to a vivid incandescence, give a continuous sprectrum without bright lines. Under these circumstances the light to the eye, without the spectroscope, will be white, like that of a white hot poker; if the degree of incandescence is not so high, the light may only be red, like that of a red-hot poker. But so far as the spectrum goes—and it will expand towards the violet, as the incandescence increases, as before stated—it will be continuous.

Now, suppose, instead of giving you the spectrum of these solid white-light-giving carbon points or that from an ordinary gas flame, I show you the spectrum of a light source which is coloured. If, for instance, we burn some coloured fire, such as the red fire of our pyrotechnic displays. You must not consider that this is sensational, for Sir John Herschel, very many years ago, was on the eve

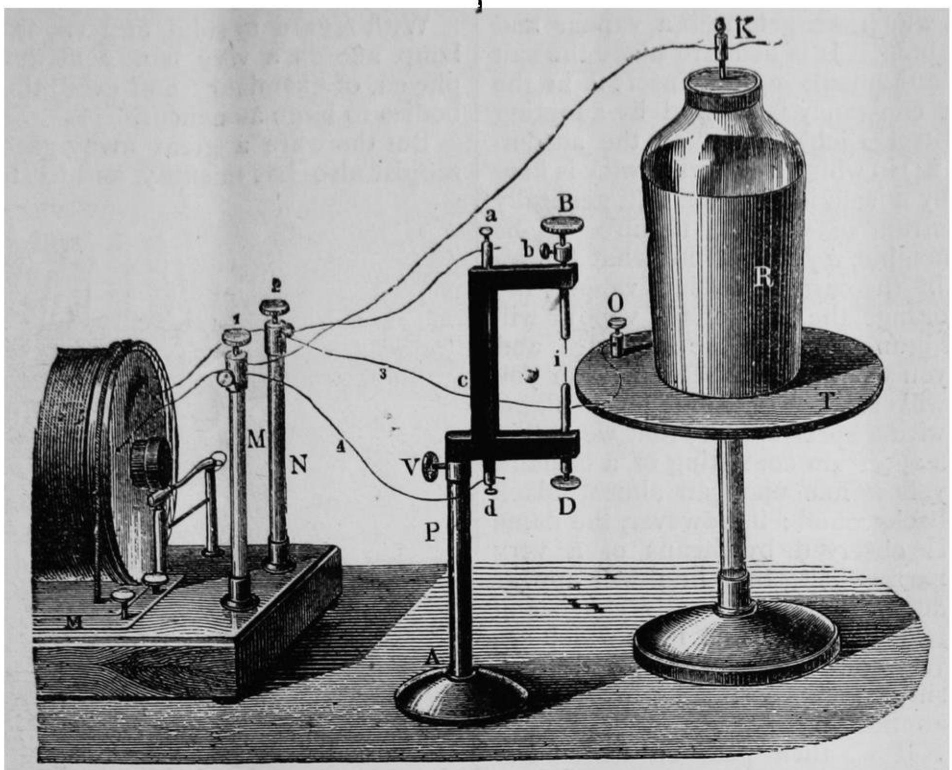

FIG. 21.—Arrangement for determining the spectra of metals by means of the electric spark.

of discovering the great point of spectrum analysis which I have to bring before you, by merely examining these coloured fires. If we examined such a light by means of the spectroscope you might expect that we should obtain the red

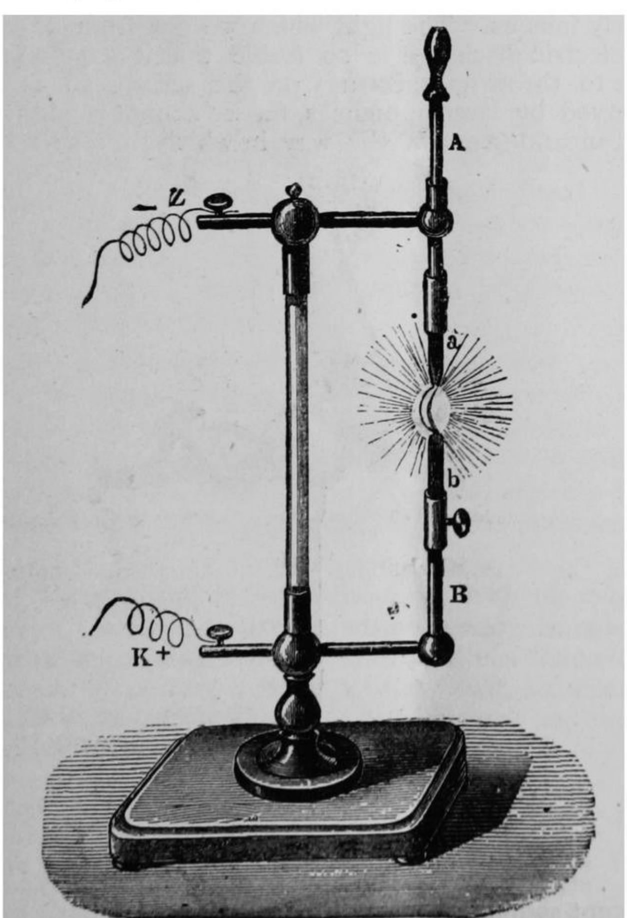

FIG. 22.—The Electric Arc

end of the continuous spectrum; that on burning green fire we should see the green portion of the spectrum and so on. But this is not so; we find that the background of the spectrum is dark or nearly so, and that we have certain localisations of light or bright lines in different parts of the spectrum. Now, the differences in colour are accompanied by differences in the spectra. We have something very different from the continuous spectrum we had before, and this is, in fact, one of the first practical outcomes of spectrum analysis. It enables you in a moment to determine the difference between a solid or liquid body, which gives you a continuous spectrum, and a vapour or gas, which gives you a spectrum containing bright lines. The reason that different vapours and gases are of different

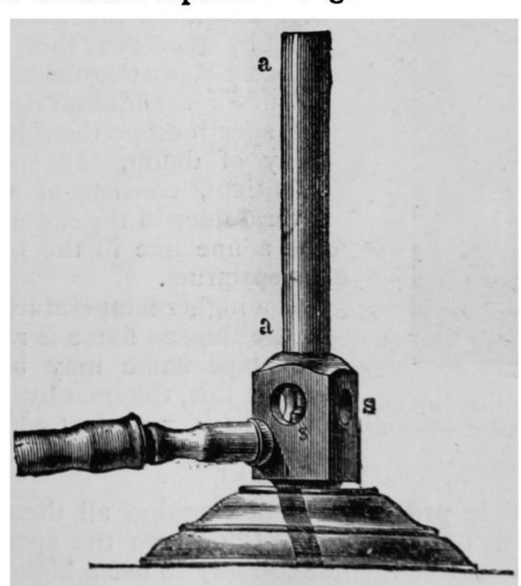

FIG. 23.—Bunsen's burner for flame spectra.

colours is now clear; if we examine the light by means of a spectroscope, we find that the light rays which they emit are located in different parts of the spectrum.

In these instances then, the spectra consist of lines which are located in different parts of the spectrum. Let us burn some sodium in air, and then examine the spectrum of its vapour, or better still, let us place some sodium, or a salt of this metal, such as table salt, in a gas flame which is consuming a mixture of air and gas, in a burner known under the name of a Bunsen's burner, the bluish flame of which is due to the complete com bustion due to the greater supply of air from the holes at the bottom. The flame immediately becomes of an intense yellow colour due to the vapour of sodium. In this we have further evidence of the connection between the colour of the light which we get from a vapour and the spectrum of that vapour. It is usual to place the salt to be examined in a platinum spoon, and insert it in the flame, but the utmost constancy is insured by adopting an arrangement of Mitscherlich's shown in the accompanying drawing, (Fig. 24) in which a platinum wick is kept continually moistened by a solution of the salt, generally the chloride, the spectrum of which is required to be examined. You will imagine, *à priori*, from what I have already said, that as in the case of sodium vapour, the colour of the light is orange, the line of the vapour will appear in the yellow or orange part of the spectrum, and you will not be mistaken. For you will see on examining this flame with a spectroscope, that we obtain a spectrum consisting of a brilliant yellow line upon an almost black background; if, however, the flame is observed by means of a very narrow slit, this line will appear double, that is it really consists of two extremely fine lines which are very close to each other, and if the slit be wide the images overlap one another.

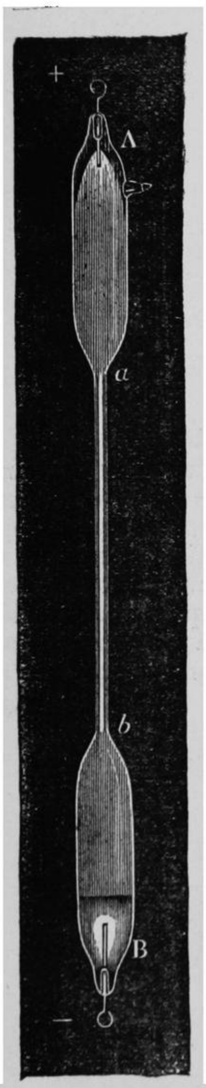

FIG. 24.—Geissler's tube, showing electric discharge.

If we then pass on to another substance, and take some lithium instead of sodium, we obtain a brilliant carmine tinted flame, which on examination by the spectroscope, is found to give a spectrum consisting of one splendid red, and a fainter orange line. Potassium gives a violet coloured flame, and yields in the spectroscope a red line and a violet line. If, again, we take a salt of strontium, which was one of the ingredients in red fire, it colours the flame crimson, and by the eye the flame can scarcely be distinguished from the colour of the lithium flame, but in the spectroscope there is no possibility of doubt, the spectrum of strontium, consists of a group of several lines in the red and orange, and a fine line in the blue end of the spectrum.

If a higher temperature than that of the Bunsen flame is required the blow-pipe flame may be resorted to; in this, the quantity of air and coal-gas is varied at pleasure, and a very high temperature may be obtained.

We might proceed thus to examine all the elementary substances one by one, but to observe the spectra of the metals, it will be found necessary to use a higher temperature still, and for this purpose the electric arc or spark is employed. If a temperature only slightly greater than that of the blow-pipe flame is used, the spark from an induction coil worked by five Grove cells may be taken as shown in Fig. 21, the Leyden jar not being employed; a few metallic lines will then be seen, and a background consisting generally of bands of light here and there.

If a higher temperature still is used, the jar may be thrown into the circuit, upon which the spark will become more intense, according to the power of the coil and size of the jar; or the electric arc may be employed. The spectra thus obtained are much more complex; the spectrum of iron, for instance, when examined at this high temperature, is found to consist of no less than 460 lines, many of which are situated in the green part of the spectrum.

With regard to solid and vaporous bodies, the electric lamp affords a very handy method when properly employed, of examining and exhibiting the spectra of these bodies to large audiences.

But there are a great many gases which the spectroscopist also has to study, and to study with the greatest

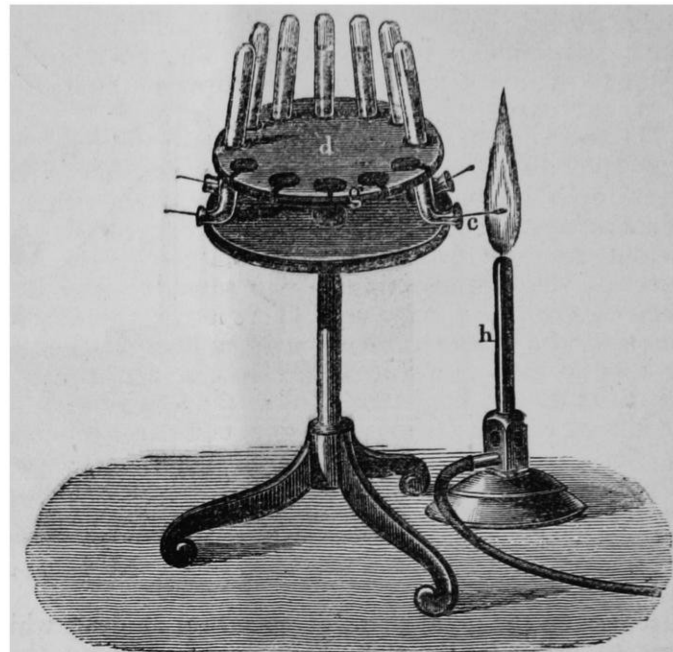

FIG. 25.—Mitscherlich's arrangement for flame spectra.

care; and here, I am sorry to say, the electric lamp utterly fails us. The light which we get from a gas by the electric discharge is so feeble that it is quite impossible to throw its spectrum on the screen, so as to be observed by large audiences, for we cannot render strontium incandescent in the way in which we render incan-

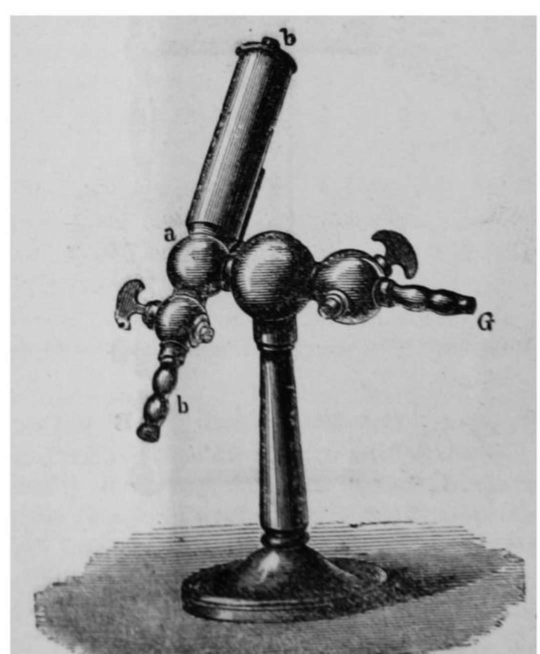

FIG. 26.—Herapath's Blow-pipe.

descent sodium and the other substances I have brought before you. But we have other means of examining the spectra. I have here some tubes containing hydrogen and other gases at different pressures, and when we wish to study the spectrum of a gas, we do it in this way: we enclose it in a tube, and send a current through it by means of an induction-coil. If we pass a stream of electric sparks through a tube containing hydrogen at the pressure of one atmosphere, we shall see that the colour of the incandescent gas is a bright carmine red, the spectrum of which can easily be observed by placing the spark tube in front of the slit of one of the spectroscopes before described. This arrangement is one that is in daily use in many of our laboratories, and it must be borne in mind as being the *modus operandi* by which a great deal of the work has been done to which I shall have to allude shortly. If again we take a tube which contains hydrogen that has been extremely rarefied, and pass a series of electric sparks through it, instead of having the brilliant red colour, we shall have a pale greenish spark, quite different from the former. This great difference is due to the difference in the pressures of the hydrogen of the two cases.

The two spectra are equally distinct, the red light shows three splendid lines, one in the red, another in the bluish green, and the third in the violet, together with a considerable amount of continuous spectrum, whilst almost the only spectrum which can be obtained in the second case, is a single green line in the same position as the former green line spoken of. There is also this difference which will be observed, that the green line obtained from the tube at the atmospheric pressure is very broad and indistinct at the edges; and that the line as seen from the almost vacuous tube is very thin, comparatively speaking, and perfectly sharp and well defined. If we were to take another tube, with a pressure somewhere between the two already mentioned, it would be seen that this green line was not so wide and woolly as in the tube at one atmosphere, and yet not so sharp and well defined as in the almost vacuous tube. Thus it will be seen that this widening out of the line is due to the difference of pressure.

J. NORMAN LOCKYER

(*To be continued.*)

NOTES

OUR readers will be sorry, though not surprised, to hear that the venerable Professor Sedgwick died at Trinity College, Cambridge, on the morning of the 27th instant, aged 87 years. He was fifth wrangler in Trinity in 1808, and was elected to a fellowship in 1810. His contributions to science were very numerous, and are mainly to be found in the Transactions of various learned societies.

THE Vice-Chancellor of Cambridge University has given notice that the election of a Woodwardian Professor of Geology, in the place of Dr. Sedgwick, will be held in the Senate House on Thursday, February 20, at 1 P.M. The Vice-Chancellor and Proctors will receive the votes from 1 to 2.30, when the election will be declared. The stipend attached to the professorship is 500*l*. per annum.

WE are very glad indeed to hear that renewed and better organised efforts are likely to be made to induce Government to undertake the expense of an Arctic expedition. We have good reason to believe that Sir Henry Rawlinson will address a letter to the President of the Royal Society urging the importance of that body taking a lead in the advocacy of such an expedition. This is as it should be, and we have no doubt if the matter is gone about in a thoroughly well considered manner, a second rebuff will not be experienced. Meanwhile we are glad to learn from an obliging correspondent that Mr. Leigh Smith will proceed on his third voyage of Arctic discovery in the spring. He has a fine strong steamer, the *Diana*, admirably adapted for the purpose; and will undoubtedly achieve all that can be done in the way of discovery in the Spitzbergen seas, during the season of 1873. For Mr. Smith is a good observer and explorer, and is now becoming a veteran Arctic voyager. In 1871 he made the most remarkable voyage in that direction since 1707, discovering a large extent of coast line both on the north and south sides of North East Land. He also attained the highest latitude that has been reached in a ship, except by Scoresby and the Swedes. In 1872 he went out again, and though the unfavourable state of the ice prevented him from doing much, he succeeded in taking a very important series of observations of sea-temperatures at various depths. In 1873 he will again, with better means and in a steamer instead of a sailing vessel, make an attempt to explore the unknown lands east of Spitzbergen, and to attain the highest latitude that skill and perseverance will enable him to reach.

THE Senior Wrangler at Cambridge this year is Mr. Thomas Olver Harding, eldest son of the Rev. Thomas Harding, Wesleyan minister of Whitehaven. Mr. Harding, in January, 1866, gained the first exhibition at the matriculation examination of the London University, and the Gilchrist Scholarship at University Hall. In 1867 he gained the Andrews Scholarship in mathematics at University College. In 1868 he proceeded to the degree of B.A., in the University of London; and in 1869 and 1871 he passed the first and second examinations for the degree of B.Sc., gaining the exhibition in mathematics at each. Last year he was elected fellow of University College. In 1869 he entered Trinity as senior minor scholar in mathematics, and was elected foundation scholar in 1871. Mr. Harding has just completed his twenty-third year. His private tutor was Mr. Routh; his college tutor the Rev. E. W Blore. The Second Wrangler, Mr. Edward John Nanson, was educated at the Grammar Schools of Penrith and Ripon. In 1869 he obtained a Minor Scholarship at Trinity College. In July 1869, he commenced reading with Mr. Routh, of St. Peter's College. In 1870 he obtained a Foundation Scholarship. He was Prizeman, and placed in the first class at each of the annual College Examinations. His college tutor was Mr. Blore.

AN alteration has been made in Prof. Tyndall's arrangements. We are now enabled to state that he will leave America on the 5th of next month in the *Cuba*.

WE are glad to see from the account of the annual meeting of the Anthropological Institute officially forwarded to us, that Prof. Busk has been elected President, and along with him the following strong Council:—Vice-Presidents—John Beddoe, M.D.; J. Barnard Davis, M.D., F.R.S.; John Evans, F.R.S.; Col. A. Lane Fox, F.S.A.; Prof. Huxley, F.R.S.; Sir John Lubbock, Bt., F.R.S. Director—E. W Brabrook, F.S.A. Treasurer—J. W Flower, F.G.S. Council—H. G. Bohn, F.R.G.S.; Capt. R. F. Burton; A. Campbell, M.D.; Hyde Clark; W Boyd Dawkins, F.R.S.; Prof. P. M. Duncan, F.R.S.; Robert Dunn, F.R.C.S.; David Forbes, F.R.S.; A. W Franks; Francis Galton, F.R.S.; C. R. Markham, C.B.; Capt. Sher. Osborn, C.B., R.N.; Capt. Bedford Pim, R.N; F G. H. Price, F.G.S.; J. E. Price; F. W Rudler, F.G.S.; C. R. Des Ruffières, F.R.S.L.; W Spottiswoode, V.P.R.S.; E. Burnet Tylor, F.R.S.; A. R. Wallace, F.L.S.

A WORK of considerable importance, a geological map of Australia and Tasmania, has been recently commenced by Mr. R. Brough Smyth, secretary to the Mining department of the Australian Government, which, when finished, will be of value not only to the colony, but to the whole scientific world. As the Minister of Mines has cordially approved of the work, it is intended to communicate with the Governments of the various colonies, forwarding a draft of the map after it has been partially completed from the sources at hand, and a scale showing the colours of the various rock formations, with a request that they will as far as possible fill in the blanks from the records of the departments in the respective colonies. By this means it is anticipated that much reliable information will be obtained, as no doubt the surveyors-general of the colonies have in their possession many reports relative to the rock formations of their colonies. The map has been compiled from various sources, some of the maps and reports from which it has been taken having been completed as far back as 1834; but to show the accuracy with which the various surveys have been made, it may be mentioned that in some cases where the geological formation of a district has been compiled from two surveys, made perhaps at the interval of many years, and by different individuals, they have been found to join one another without the slightest mistake. Northern Australia is at present considered almost a *terra incognita* with regard to its geological character, but still a good portion of this part of the continent has been completed from the records of old explorers. It is intended by the compiler that in the first map only the boundaries of the several rock formations will be shown, as there are many large areas whose geological position has not yet been ascertained, and therefore no attempt will be made to classify them unless such classification is based on thorough geological information. The map will not be complete at first, but even in its present condition it will be of considerable value, and as the information it contains will be added to year by year, in the end it will become invaluable to the geological students of Australia.

THE Atlantic telegraph cable authorities have just done a very handsome thing. Astronomers belonging to different countries have, for some time past, felt the great inconvenience caused by the delay in transmitting notes of observations of new planets, comets, &c., by post, and therefore, especially in America, the Atlantic Cable naturally suggested itself as a means of exchanging discoveries. But the great expense of despatches by it, and the poverty of astronomers, have prevented their making use of this means of communication to any great extent. For some time past, the scientific editor of *Harper's Weekly* informs us, Prof. Henry, of the Smithsonian Institution, has been in correspondence with the authorities of the cable for the purpose of inducing them to transmit such communications free, and at last has had the pleasure of receiving from Mr. Cyrus W. Field the announcement that this boon has been granted. The precise details of the arrangement to be made are not yet fully established, but it is probable that, in case of important discoveries in America, the fact will be communicated by telegraph to the Smithsonian Institution, which will at once forward it to the observatories in Paris, London, Berlin, and Vienna, which, in turn, will supply the information to their associates. These same institutions will be the recipients, by telegraph, of the first announcements in Europe, to be transmitted to the Smithsonian Institution as before, and the information sent from Washington, either by the medium of the Associated Press, or by direct telegraphic despatch. The directors of the Atlantic Telegraph deserve great credit for their enlightened liberality, and for thus aiding in the scientific work of the day; and it is to be hoped that the inland American telegraph lines, as well as those in Europe, will not be behind in their co-operation, so as to make it an absolutely free interchange from one country to the other. It is probable that the information in regard to the discovery of comets in America will be sent more directly to the Vienna Academy of Sciences, as that body has a standing offer of reward for all such announcements, made under certain specific conditions.

M. LE BARON PIERRE CHARLES FRANCOIS DUPIN, who, so long ago as 1818, was elected to the French Academy for his geometrical writings, died on January 18, aged 89 years.

PROF. HUXLEY, the new Lord Rector of Aberdeen University, has given his friends there to understand that it will be impossible for him to deliver an inaugural address during the currency of the present session. He hopes to be able to do this at the beginning of next session.

THE following are the scientific arrangements at Oxford for this term:—The Rev. Bartholomew Price, M.A., will lecture on the "Dynamics of Rigid Systems," beginning on Thursday, Feb. 6. The Rev. C. Pritchard, M.A., will lecture on "The Ninth and Eleventh Sections of the Principia and the Lunar and Planetary Theories," beginning on Tuesday, Feb. 4. R. B. Clifton, M.A., will lecture on "Optical Instruments and Physical Optics," beginning on Saturday, Feb. 1. The Physical Laboratory of the University will be open daily for instruction in Practical Physics, from 10 to 4 o'clock, on and after Thursday, Jan. 30. G. Rolleston, D.M., will lecture on the "Nervous System," beginning on Friday, Jan. 31. The workrooms in the Anatomical Department are open daily, from 10 A.M. to 5 P.M. for practical instruction, under the superintendence of Mr. Charles Robertson, the Demonstrator of Anatomy, and Mr. S. J. Sharkey, of Jesus College. A special class will be formed for instruction in Practical Microscopy. Mr. E. Ray Lankester, M.A., of Exeter Coll., will lecture "On the General Classification of the Animal Kingdom," on Saturdays, at 1 o'clock, beginning Feb. 1. J. O. Westward, M.A., will deliver four lectures on Entomology—1, Structure; 2, Transformations; 3, Economy; 4, Classification of Articulata, beginning Feb. 14. J. Phillips, M.A., being engaged in arranging a part of the Museum collections, does not purpose to lecture in the present term; but he will be happy to meet members of the University, and to assist students of geology, *sine ulla solennitate*, on Mondays and Wednesdays, in the Museum, at 12 o'clock. Marmaduke Lawson, M.A., will continue his course of lectures this term.

THE following Lectures in Natural Sciences will be given at Cambridge during Lent Term. On Electricity and Magnetism, by Dr. Trotter, Mondays, Wednesdays, Fridays, at 11, commencing Friday, Jan 31. On Electricity and Magnetism (for the First Part of the Natural Sciences Tripos and the Special Examination for the Ordinary Degrees), by Mr. Trotter, Tuesdays, Thursdays, Saturdays, at 11, commencing Thursday, Jan. 30. On Chemistry, by Mr. Main, St. John's College, Tuesdays, Thursdays, Saturdays, at 12, commencing Thursday, Jan. 30. Instruction in Practical Chemistry will also be given. On Palæontology (the Annuloida, &c.), by Mr. Bonney, St. John's College, Tuesdays and Thursdays, at 9, commencing Thursday, Jan. 30. On Geology, (for the Natural Sciences Tripos, Physical Geology), by Mr. Bonney, Mondays, Wednesdays, and Fridays at 10, commencing Wednesday, Jan. 29. Elementary Geology (for the First Part of the Tripos and the Special Examination), Tuesdays and Thursdays at 11, commencing Tuesday, Feb. 4. On Botany (for the Natural Sciences Tripos), by Mr. Hicks, Sidney College, Tuesdays, Thursdays, Saturdays, at 11, in Lecture Room No. 1, beginning on Thursday, Jan. 30. On the Physiology of the Senses, by Dr. M. Foster, Mondays and Wednesdays at 1. A Course of Practical Physiology on Thursdays, at 11 A.M., commencing Thursday, Feb. 6. An Advanced Course of Practical Histology on Tuesdays, at 11 A.M., commencing Tuesday, Feb. 4.

A SLIGHT eruption of Vesuvius occurred last Saturday. Red-hot stones were thrown up in the midst of flames to a considerable height throughout the whole of yesterday, and at Castellamare the windows were shaken. On Sunday morning an unusual amount of smoke was issuing from the mountain.

THE Meteorological Society of Mauritius have resolved to prepare as complete a list as possible of the hurricanes which have been felt at Mauritius and at Bourbon in former times, and of the years that have been remarkable for droughts or rainfall. Their main purpose in doing so is to test the hypothesis that the frequency of storms and the amount of rainfall have periodicities. Meantime preliminary lists of hurricanes at the two places have been prepared, in the case of Bourbon from 1733 to 1754, and in the case of Mauritius from 1695 to 1847. In the former list there are only two years, 1741 and 1740, in which no mention is made of hurricanes, while the latter is apparently much more incomplete, having many gaps. While some of these gaps may be owing to the absence of hurricanes, still, no doubt, hurricanes have occurred which are not included in the list. But it is remarkable that many of the gaps occur about the time of minimum frequency of sun spots. It is to be hoped that the Society will be able to compile a pretty complete and trustworthy list, as such a list would go far to solve questions of high importance. It is to be hoped that with an efficient observatory, which Mauritius is likely soon to possess, and uninterrupted observation, complete data for future meteorologists may be gradually collected.

THE following note from the *Colonial Farmer* (Frederickton, New Brunswick), concerning the recent shower, has been forwarded us:—A brilliant meteoric display was observed in the heavens early on Wednesday evening, Nov. 27th, and the clearness of the night gave every facility for witnessing this attractive exhibition. For at least two hours the falling meteors were visible in hundreds, and seemed to come from the Milky Way, with a course from the zenith to the south and south-west. Above 190 were counted in about twenty minutes. The shower commenced at dusk, and continued for two hours with increasing brilliancy, after which it gradually faded away.

SOME months ago we announced that the glass of the great telescope of the Alleghany Observatory, one of the largest of the kind in America, and valued at about 4,000 dols., was stolen from the building, and all efforts to detect the robber and regain the plundered article were unavailing. We now learn from the *College Courant* that the lens has been recovered, having been stolen by two men, but for what purpose is not said. It was found to have received serious damage in the form of several scratches, which may require the regrinding of the glass at a cost of 30 or 40 per cent. of the original cost.

WE learn from the *Athenæum* that Mr. Edward Thomas has been elected corresponding member of the French Academy, for his contributions to Oriental Numismatic Archæology.

WE learn from the *British Medical Journal*, that Dr. C. J. B. Williams has been nominated by the Council of the Royal Medical and Chirurgical Society for the Presidency.

MR. E. B. NICHOLSON, librarian of the Oxford Union Society, has been appointed to the Librarianship of the London Institution, in room of the late Mr. J. C. Brough.

THE Fifth Annual Report of the Eastbourne Natural History Society shows that it continues prosperous, and has been making valuable additions to our knowledge of the Natural History of the district in all its departments.

THE lioness, which has so successfully reared the cubs born in the Zoological Gardens, July 8, 1872, died on the 21st inst.

WE have received an advance sheet of the next number of Petermann's *Mittheilungen* containing the second article on Dr. Livingstone's Exploration of the Upper Congo, appended to which is a splendidly constructed map of the section of Africa included between 2° and 12½° S. lat. and 22°—40° E. long., in which not only the most recent discoveries are filled in, but the routes of all travellers are given from Lacerda in 1798 down to Livingstone and Stanley in 1871-2. Moreover by seven shades of colour the heights of the various regions are indicated from 1000 up to 18,710 feet.

THE whole of No. 34 of the supplement to Petermann's *Mittheilungen* is occupied with the journal kept by Jerhard Rohlfs, who in 1865-6-7, journeyed through North Africa, from Lake Tsad to the Gulf of Guinea. Two magnificent maps accompany the narrative, the one representing the region to the south of Lake Tsad, and showing the routes of Rohlfs and of all previous travellers through that region; the other represents the country from Borneo to Lagos, and contains the routes of travellers from Clapperton and Landor down to Rohlfs.

LIEUTENANT GRANDY, leader of the Livingstone Congo Expedition, has written to Sir Henry Rawlinson reporting his arrival at Sierra Leone on December 14, where he got together his exploring party, consisting of his brother, Mr. M. B. Grandy, two Congo men to act as interpreters, 19 Kroomen, and a steady native from the police, Daniel E. Gabbidon. The party left for the South Coast on the 27th, in good health, after an inspection and a few cheering words at Government-house. The local Government presented Lieutenant Grandy with a travelling tent, water-proof blankets, and other useful articles.

WE are glad to see that the botanical members of the Perthshire Society of Natural Science are preparing "a Flora of Perthshire," one of the richest counties, botanically, in the kingdom. Botanists who can assist with information are requested to communicate at once with Dr. Buchanan White, Dunkeld, than whom no more competent editor could be found.

A MEETING was held the other evening which pledged itself to use every effort to establish a South London Museum on the model of that recently opened at Bethnal Green.

THE first of a series of lectures was given on Tuesday evening the 21st inst., on the "Physical Geography of the Sea," in the Town Hall, Shoreditch, by Dr. Carpenter. The lecture was listened to by an audience of 2,000 persons, chiefly of the working classes, men and women, with marked attention, for nearly two hours.

A COLLECTION of Saxon antiquities, of rare value, has been presented to the library and museum of Trinity College, Cambridge, by Mr. White, sub-librarian of the society. These were obtained from the site of an Anglo-Saxon cemetery, situate at a place known (and described on maps 200 years old) as "Edixhill hole," near Orwell, Cambridgeshire. Mr. White's donation includes various implements in iron and spear heads, shield bosses, and handles, &c., and some articles used in hunting and for domestic use. Among the collection are three jaw bones, one of immense size, all having the teeth perfectly sound. The collection has been deposited in the library.

THE *Medical Record* for January 15, in a note entitled "Science the Peace-maker," has the following:—"Immediately after the war, the French Societies occupied themselves in striking off the roll the names of all German Associates, and French *savans* withdrew theirs from the German societies of which they were honorary members. We are glad to note, as indicating a return to a more sound and philosophic mind, that at a recent meeting of the Berlin Chemical Society M. Cahours, an eminent Frenchman, applied for, and was accorded, admission to the honorary membership."

THE principal article in the *Revue Scientifique* for January 25 is a long one by M. Léon Dumont on the theory of evolution in Germany, with special reference to the doctrines of Haeckel.

A WELL-KNOWN British explorer, in the person of Commander Alexander John Smith, has recently died at Sandhurst, Victoria. This gentleman was lieutenant on board the *Erebus*, under Captain Sir James Clark Ross, in the expedition to investigate the magnetism of the Antarctic region, and was subsequently one of the officers in charge of the magnetic observatory at Hobart Town.

THE SCIENTIFIC ORDERS OF THE "CHALLENGER" *

II.

II. *Chemical Observations*

SAMPLES of sea-water should be collected for chemical analysis at the surface and at various depths, and in various conditions. Each sample should be placed in a Winchester quart glass-stoppered bottle, the stopper being tied down with tape and sealed in such a manner that the contents cannot be tampered with.

2. Portions of the same samples should be, immediately after their collection, boiled *in vacuo*, the gases collected, their volume determined as accurately as may be, and a portion, not less than one cubic inch, hermetically sealed in a glass tube, to be sent home at any time for complete analysis.

3. Frequent samples of sea-water taken at the surface, and others taken beneath as opportunity offers, should have determinations of chlorine made upon them at once or as soon as convenient.

This operation could easily be carried on in any but very heavy weather. On the other hand, it is not thought that any trustworthy analyses of gases could be made on board ship, unless in harbour or in the calmest weather.

4. Such samples of the sea-bottom as are brought up should be carefully dried and preserved for examination and analysis.

5. The gas contained in the swimming-bladders of fishes caught near the surface and at different depths should be preserved for analysis. In each case the species, sex, and size, and especially the depth at which the fish was caught, should be stated.

III. *Botanical Observations*

The duties of a botanist in travelling are twofold, and in the case of the voyage of circumnavigation about to be undertaken by H.M.S. *Challenger* they are of equal importance.

Of these, the one refers to forming complete collections of the plants of all interesting localities, and especially of the individual islands of oceanic groups.

The other, to making observations upon life, history, and structure in the case of plants where special knowledge is concerned.

In the first of these the botanist must necessarily be largely helped by the assistance to be obtained on board ship from the officers and crew, working under his guidance and close supervision. When time and opportunity are wanting for making complete collections, preference should be given to the phanerogamous vegetation.

In the second he will have to depend upon his own resources, and will therefore require that the mere process of collection does not make too great demands upon his time, although in itself exceedingly important, and by no means to be neglected.

The general directions for travellers, printed in the Admiralty Manual of Scientific Inquiry, will of course be kept in view.

Especial stress must, however, be laid upon the necessity of obtaining information about the vegetation of oceanic islands. These are, in many cases, the last positions held by floras of great antiquity; and, as in the case of St. Helena, they are liable to speedily become exterminated, and therefore to pass into irremediable oblivion when the islands become occupied.

Of many that lie not far from the usual tracks of ships, absolutely nothing is known, whilst of the flora of a vast majority we possess most imperfect materials. The following are especially worth exploring; and to the list is added an indication of the least explored coast lines of the great continents. As far as possible complete dried collections should be made, not only of each group, but of each islet of the group; for it is usually the case that the floras of contiguous oceanic islets are wonderfully different. Of those in italics the vegetation is absolutely unknown, or all but so.

1. ATLANTIC OCEAN. Cape de Verd, Tristan d'Acunha *Fernando Noronha*, *Trinidad* and *Martin Vaz* (off the Brazil coast), *Diego Ramirez*, S. Georgia. The African coast between Morocco and Senegal, the Gaboon, and Damara Land offer the most novel fields. On the American coast, Cayenne, Bahia to Cape Frio, Patagonia.

2. WEST INDIES. The Bahamas and St. Domingo and the Antilles have been very imperfectly explored except Dominica, Trinidad, and Martinique. On the mainland, Honduras, Nicaragua, and the coast region of Mexico, the Mosquito shores, and Guatemala offer rich fields for botanical research.

3. INDIAN OCEAN. The Seychelles, *Ammirantes*, Madagascar, Bourbon, *Socotra*, St. Paul's, and Amsterdam Islands, *Prince Edward's*, the *Crozets* and *Marion* groups. Of the E. African coast to the north of Natal no part is well explored, and the greater part is utterly unknown botanically.

4. PACIFIC OCEAN. (1.) N TEMPERATE. Collections are wanted from N. Japan and the Kuriles and Aleutian Islands. (2.) TROPICAL. Considerable collections have been made only in the Sandwich Islands, Figi Islands, Tahiti, and New Caledonia; from all of which more are much wanted. The Marquesas, New Hebrides, *Marshall's*, Solomon's and *Caroline's*, together with all the smaller groups, are still less known. Of the American continent, the Californian peninsula, Mexico, and the whole coast from Lima to Valparaiso, are but imperfectly known. Of the small islands off the coast, Juan Fernandez and the Galapagos alone have been partially botanised. 3. S. TEMPERATE. Juan Fernandez, *Masafuera*, St. Felix, and Ambroise, *Pitcairn*, *Bounty*, *Antipodes*, *Emerald*, *Macquarie* Islands.

5. INDIAN ARCHIPELAGO. Java alone is explored, and the Philippines very partially; collections are especially wanted from all the islands east of Java to the Louisiade and Solomon Archipelagos, especially Lombok and New Guinea. Siam, Cochin China, and the whole Chinese sea-board want exploration.

6. AUSTRALIA. All the tropical coasts are very partially explored.

Photographs or careful drawings of tropical vegetation often convey interesting information, and should contain some reference to a scale of dimensions.

An inquiry of much importance, for which the present expedition affords a favourable opportunity, is that into the vitality of seeds exposed to the action of sea-water.

Observations should especially be made on the fruits and seeds of those plants which have become widely distributed throughout the tropical regions of the world, apparently without the intervention of man; but further observations on other plants of different natural orders may be of great value with reference to questions of geographical distribution.

The following instructions have been drawn up for the botanical collectors as to objects of special attention at particular places:—

Porto Rico.—In collecting, distinguish the plants of the Savannahs from those of the mountains, which, if possible, should be ascended. The palms and tree-ferns are quite unknown; marine algæ also are wanted.

Cape de Verdes.—Make for the highest peaks, where the vegetation is peculiar, and analogous to that of Madeira and the Canaries.

Fernando de Noronha.—Land if possible. Very remarkable plants are said to occur, different from those of Brazil.

Trinidad.—A complete collection is required. A tree-fern exists, but the species is unknown.

Prince Edward's Island and Crozets.—Two spots more interesting for the exploration of their vegetation do not exist upon the face of the globe. Every effort should be made to make a complete collection.

Kerguelen's Land.—A thorough exploration should be made, and the cryptogamic plants and algæ diligently collected. The Antarctic Expedition was only there in midwinter; flowering specimens of *Pringlea* are wanted.

Auckland and Campbell Islands.—The floras should be wel explored.

South Pacific and Indian Oceans.—Attend to general instructions, more especially as regards palms and large monocotyledons generally. Marine algæ are said to be scarce, and should be looked for all the more diligently. In the North Pacific, south temperate algæ are said to prevail.

Aleutian Islands.—Collections are particularly wanted.

Every effort should be made to land on islands *between lat.* 30° N. *and* 30° S. along the marked track (between Vancouver Island and Valparaiso), so as to connect the vegetation of the American continent with the traces of it that exist in the Sandwich Islands.

Straits of Magellan.—Cryptogams are abundant, but very partially explored.

The following additional notes have been drawn up for the

* Continued from p. 193.

more especial guidance of the botanists of the circumnavigation :—

Phanerogams.—1. Fleshy parasitic plants (*Balanophora*, *Rafflesia*, &c.) are little suitable for dissection and examination unless preserved in spirit, and the same remark applies to fleshy flowers and inflorescences generally. Dried specimens, however, are not without their value, and should always be obtained as well.

2. The stems of scandent and climbing plants are often very anomalous in their structure. Short portions of such stems should be collected when the cross section is in any way remarkable, with the foliage, flowers, and fruit when possible. A few leaves and flowers should also be tied up between two pieces of card, and attached at once to the specimens of the stem, so as to ensure future identification.

3. Attention should be given to the esculent and medicinal substances used in various places. Specimens should be obtained, and whenever possible, they should be accompanied by complete specimens of the plants from which such substances are obtained.

4. The common weeds and ruderal plants growing about ports or landing-places should not be overlooked, and, as far as practicable, trustworthy information should be recorded as to the date and circumstances of the introduction of foreign species.

5. The distribution of marine Phanerogamic plants (*Zostera*, *Cymodocea*, &c.) should also be noted, and specimens preserved with their latitude and longitude. Their buds and parts of fructification should be put into spirit.

6. The flowers of *Loranthaceæ* and *Santalaceæ* should be preserved in spirit, and also dried to exhibit general habit.

7. The inflorescence of Aroids should be dissected when fresh, or put into spirit. Note the placentation and position of the ovules.

8. Devote especial attention to the study of Screw-Pines and Palms when opportunity arises, even if necessary to the neglect of other things. The general habit of the plants should be sketched; the male and female inflorescence should be preserved, and also the fruit; the foliage should be dried and folded, and packed in boxes. Many fleshy vegetable objects may be "killed" by a longer or shorter immersion in spirit. They then dry up without decaying, and form useful specimens.

9. With respect to Palms, further note the height, position of the spadix, and preponderance of the sexes in both monœcious and diœcious species, also form and dimensions of leaves.

10. Surface-drifting should be examined, and any seeds or fragments of land-plants carefully noted when determinable, with directions of currents and latitude and longitude.

11. Facts are also required as to the part played by icebergs in plant-distribution. If any opportunity occurs for their examination, it would be desirable to preserve and note any vegetable material which might be found upon their surface; also to examine any rock-fragments for lichens.

12. *Ferns.*—Ferns should always, when possible, be obtained with fructification. In the case of tree-ferns, our knowledge of which, from the imperfection of material for description, is very defective, a portion of the stem sufficient to illustrate its structure should be obtained, with notes of its height; a fragment of a frond (between pieces of card) and the base of a stipes should be tied to the specimen of the stem; also a note as to whether the adventitious roots were living or dead.

The number of fronds should be counted, their dimensions taken, and the basal scales carefully preserved.

Note if tree-ferns are ever attacked by insects or fungi, and whether they form the food of any class of animals.

13. *Mosses, &c.*—Many mosses are aquatic. In the case of diœcious species of mosses, plants of both sexes should be, when possible, secured.

14. Aquatic species of *Ricciaceæ* should be looked for. Minute *Jungermanniaceæ* are found on the foliage of other plants.

15. *Podostemaceæ* are found in rocky running streams in hot countries. They have a remarkable superficial resemblance to Hepaticæ. Except at the flowering season they are altogether submerged. Specimens should be preserved in spirit as well as dried.

16. *Fungi.*—Take notes of all fleshy fungi, especially as regards colour; the spores should be allowed to fall on paper, and the colour of these noted also. The fleshy species may sometimes be advantageously immersed in spirit before preparing for the herbarium.

17. Examine the fungi which grow on ants' nests, taking care to get perfect as well as imperfect states, and to secure, if possible, specimens which have not burst their volva.

18. Look out for luminous species, and ascertain whether they are luminous in themselves, or whether the luminosity depends on decomposition.

19. Secure specimens of all esculent or medicinal fungi which are sold in bazaars, noting, if possible, the vernacular name.

20. Note any species of fleshy fungi which arise like the *Pietra Fungaja* from a mass of earth impregnated with mycelium, or from a globose resting-mass.

21. Attend especially to any fungi which attack crops, whether cereal or otherwise; and particularly gather specimens of vine-mildew and potato-mildew, should they be met with. Even common wheat-mildew, smut, &c., should be preserved.

22. In every case note date of collection, soil, and other circumstances relative to particular specimens.

23. Look after those fungi which attack the larvæ of insects.

24. In the case of the *Myxogastres*, sketches should be made on the spot of their general form, with details of microscopic appearance. It would be worth while attempting to preserve specimens for future microscopic examination by means of osmic acid.

25. *Algæ.*—Marine algæ may be found between tide-marks attached to rocks and stones, or rooting in sand, &c.; those in deeper water are got by dredging, and many are cast up after storms; small kinds grow on the larger, and some being like fleshy crusts on stones, shells, &c., must be pared off by means of a knife.

The more delicate kinds, after gentle washing, may be floated in a vessel of fresh water, upon thick and smooth writing or drawing paper; then gently lift out paper and plant together, allow some time to drip; then place on the sea-weed clean linen or cotton cloth, and on it a sheet of absorbent paper, and submit to moderate pressure—many adhere to paper but not to cloth; then change the cloth and absorbent paper till the specimens are dry. Large coarser kinds may be dried in the same way as land-plants; or are to be spread out in the *shade*, taking care to prevent contact of rain or fresh water of any kind; when sufficiently dry, tie them loosely in any kind of wrapping paper; those preserved in this rough way may be expanded and floated out in water at any time afterwards. A few specimens of each of the more delicate algæ ought to be dried on mica or glass. A note of date and locality ought to be attached to every species.

Delicate slimy algæ are best prepared by floating out on smooth-surfaced paper (known as "sketching paper"), then allowed to drip and dry by simple exposure to currents of air, without pressure.

26. Very little information exists regarding the range of depth of marine plants. It will be very desirable that observations should be made upon this subject, as opportunity from time to time presents itself.

Professor Dickie remarks, and the caution should be borne in mind:—"When the dredge ceases to scrape the bottom, it becomes in its progress to the surface much the same as a towing-net, capturing bodies which are being carried along by currents, and therefore great caution is necessary in reference to any marine plants found in it. Sea-weeds are among the most common of all bodies carried by currents near the surface or at various depths below, and from their nature are very likely to be entangled and brought up."

27. Carefully note and preserve algæ brought up in dredge in moderate depths, under 100 fathoms, or deeper. Preserve specimens *attached* to shells, corals, &c. which would indicate their being actually *in situ*, and not caught by dredge as it comes up.

28. Examine mud brought up by dredge from different depths for living Diatoms; examine also for the same purpose the stomachs of *Salpæ* and other marine animals.

29. Note algæ on ships, &c. with the submerged parts in a foul condition; also preserve scrapings of coloured crusts or slimy matter, green, brown, &c.

30. Observe algæ *floating*, collect specimens, noting latitude and longitude, currents, &c.

31. Examine loose floating objects, drift-wood, &c. for algæ. If no prominent species presents itself, preserve scrapings of any coloured crusts. Note as above.

32. It might be useful to have a few moderate-sized pieces of wood, oak, &c. quite clean at first, attached to some part of the vessel under water to be examined, say, monthly. The larger

or shorter prominent algæ should be kept and noted, and crusts on such examined and preserved, with notes of the vessel's course.

33. Various instances have been mentioned by travellers of the coloration of the sea by minute algæ as in the Straits of Malacca by Harvey; any case of this kind would be worth especial attention.

34. The calcareous algæ (*Melobesia*, &c.) are comparatively little known, and are apt to be overlooked.

35. Fresh-water algæ should be collected as occasion presents. Prof. Dickie states that they may be either dried like the marine kinds, or preserved in a fluid composed of 3 parts alcohol, 2 parts water, 1 part glycerine, well mixed.

36. Cases are recorded of the presence of algæ in hot springs. If such are met with, the temperature should be noted and specimens preserved.

IV *Zoological Observations*

As the scientific director of the expedition is an accomplished zoologist, and has already had much experience in marine exploration, it will suffice to offer a few suggestions under this head.

The quadrant-like zone of the Pacific, which separates the northern and eastern boundaries of the Polynesian Archipelago (using "Polynesia" in its broadest sense as inclusive of "Micronesia") from the coasts of N. Asia and America, is as little explored from the point of view of the physical geographer as from that of the biologist. It would be a matter of great importance to examine the depth, and the nature of the deep-sea fauna, of this zone by taking a line of soundings and dredgings in its northern half (say between Japan and Vancouver) and in its eastern half (say between Vancouver and Valparaiso). If practicable, it would further be very desirable to explore the littoral fauna of Waihou, Easter Island, or Sala y Gomez, with the view of comparing it critically with that of the west coast of South America.

If H.M.S. *Challenger* passes through Torres Straits, it will be very desirable to examine the littoral fauna of the Papuan shore of the straits in order to compare it with that of the Australian shore. The late Professor Jukes, in his "Voyage of the *Fly*" many years ago, directed attention to this point and to its theoretical bearings.

The hydrographic examination of "Wallace's line" in the Malay archipelago, and of the littoral faunas on the opposite sides of that line, is of great importance, considering the significance of that line as a boundary between two distributional provinces. An additional interest has been given to the exploration of this region by Capt. Chimmo's recently obtained sounding of 2,800 fathoms in the Celebes Sea, the mud brought up being almost devoid of calcareous organisms, but containing abundant spicula of sponges and *radiolaria.*

The light from any self-luminous objects met with should be examined with a prism as to its composition. The colours of animals captured should also be examined with a prism, or by aid of the microscopic spectroscope.

V. *Concluding Observations*

Attention should be paid to the Geology of districts which have not hitherto been examined, and collections of minerals, rocks, and fossils should be made. Detailed suggestions as to the duties of the geologist accompanying the expedition are unnecessary; but it seems desirable that at all shores visited, evidence of recent elevation or subsidence of land should be sought for, and the exact nature of these evidences carefully recorded.

Every opportunity should be taken of obtaining photographs of native races to one scale; and of making such observations as are practicable with regard to their physical characteristics, language, habits, implements, and antiquities. It would be advisable that specimens of hair of unmixed races should in all cases be obtained.

Each station should have a special number associated with it in the regular journal of the day's proceedings, and that number should be noted prominently on everything connected with that station; so that in case of labels being lost or becoming indistinct, or other references failing, the conditions of the dredging or other observations may at once be forthcoming on reference to the number in the journal. All specimens procured should be carefully preserved in spirit or otherwise, and packed in cases with the contents noted to be dealt with in the way which seems most likely to conduce to the rapid and accurate development of the scientific results of the expedition.

A diary, noting the general proceedings and results of each day, should be kept by the scientific director, with the assistance of his secretary; and each of the members of the scientific staff should be provided with a note-book in which to enter from day to day his observations and proceedings; and he should submit this diary at certain intervals to the scientific director, who would then abstract the results, and incorporate them, along with such additional data as may be supplied by the officers of the ship, in general scientific reports to be sent home to the hydrographer at every available opportunity.

The scientific staff should be provided with an adequate set of books of reference, especially those bearing on perishable objects.

SCIENTIFIC SERIALS

A LARGE portion of the *American Naturalist*, for October, is occupied by Prof. Asa Gray's address at the Dubuque meeting of the American Association for the Advancement of Science, to which we have already alluded. Mr. B. Pickman Mann then concludes his paper on the white coffee-leaf miner (*Cemeostoma coffeelum*), a subject of great importance to coffee-growers, treated in an exhaustive manner. Prof. C. F. Hartt, from whom articles on the same subject have already appeared in the *Naturalist*, contributes a further paper on the occurrence of Face-urns in Brazil; and Prof. N. S. Shaler concludes his article on the Geology of the Island of Aquidneck, illustrated by maps and sections; and Mr. C. V. Riley his important article on the cause of Deterioration of Grape-vines.—The November number commences with an article by Mr. J. G. Henderson on some aboriginal relics known as "plummets," which are abundant in various parts of the United States from the Atlantic to the Pacific, with speculations as to their use. Prof. James Orton continues his contributions to the Natural History of the Valley of Quito, the present article being devoted to the Articulata and Plants; in the latter department the author notices the similarity of the features of the flora of the Andes to those recorded by Kerner in the Tyrolese Alps. Mr. R. Ridgway commences some Notes on the Vegetation of the Lower Wabash Valley, with an account of the Forests of the Bottom-lands. Mr. Samuel H. Scudder, in an article on Fossil Insects from the Rocky Mountains, records nearly 40 species, belonging to nearly all the principal groups, found in Tertiary deposits. Prof. Cope, in a paper read at Dubuque, discusses the geological age of the Coal of Wyoming, which he refers without doubt to the Cretaceous period. Prof. Shaler has a short note on the effects of extraordinary seasons on the distribution of Animals and Plants.—In the number for December we find a short article by the Rev. Samuel Lockwood on the Baltimore Oriole and Carpenter-bee, followed by a continuation of Mr. Ridgways's notes on the Vegetation of the Lower Wabash Valley, treating of the Peculiar Features of the Bottom-lands. This is followed by an interesting account of the Alpine Flora of Colorado, by the Rev. E. L. Greene; and Dr. J. W Foster then contributes an abstract of a paper read at Dubuque on certain peculiarities in the Crania of the Mound-builders, illustrated with drawings. Another Dubuque paper of a speculative character is by Dr. H. Hartshorne, on the relation between organic vigour and sex; and Prof. Shaler then gives a further instalment of his paper on the Geology of Aquidneck. In all these three numbers is the usual amount of Reviews, and interesting short paragraphs and notes.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Jan. 23.—Dr. Stenhouse read a paper, "Contributions to the History of the Orcins.—No. III. Amido-derivatives of Orcin." He has confined his investigations to an examination of the products obtained from Trinitro-orcinic acid.

Amido-diimido-orcin, $C_7H_5(NH_2)(NH)_2O_2$.—This compound, which has the properties of a base, is formed by the oxidation of triamido-orcin, and is most conveniently obtained in a pure state by decomposing a solution of the acetate with a slight excess of ammonia. The most advantageous method of preparing the base is to reduce trinitro-orcin with sodium-amalgam, and to oxidise the alkaline solution of triamido-otcin by exposure to the air. Trinitro-orcin is also reduced by treatment with tin and hydrochloric acid, or zinc and hydrochloric or sulphuric acid.

Amido-diimido-orcin hydrochloride.—The hydrochloride obtained in the preparation of amido-diimido-orcin may be purified by crystallisation from hot water; but as heat decomposes solutions of the salts of this base, it is better to precipitate a cold solution of the acetate by a slight excess of hydrochloric acid, in which the hydrochloride is but slightly soluble; the precipitate should be thoroughly washed with alcohol, pressed and dried.

Amido-diimido-orcin sulphate is readily prepared by precipitating a dilute solution of the acetate with sulphuric acid, when it forms minute lustrous plates which are purple by reflected light.

Amido-diimido-orcin nitrate is prepared, like the sulphate, by adding a slight excess of nitric acid to a moderately strong solution of the acetate and washing the precipitate with alcohol.

Amido-diimido-orcin acetate dissolves readily in acetic acid, and on carefully evaporating the solution at a low temperature, the acetate is obtained in ill-defined crystalline plates having a purple iridescence. It is readily soluble in cold water, but only slightly soluble in glacial acetic acid.

Amido-diimido-orcin oxalate.—Very slightly soluble purple scales obtained by precipitating a solution of the acetate with oxalic acid.

Amido-diimido-orcin picrate.—On adding a solution of picric acid to a dilute solution of amido-diimido-orcin acetate and washing the precipitate with alcohol, the picrate is obtained in iridescent green needles and plates. It is insoluble in alcohol, and but slightly soluble in water.

Prof. Owen read a paper "On the Fossil Mammals of Australia.—Part VIII. Family *Macropodidæ*; Genera *Macropus*, *Osphranter*, *Phascolagus*, *Sthenurus*, and *Protemnodon*."

In the present part of the series of papers on the fossil mammals of Australia, the author enters upon the description and determination of the fossils referable to the family of Kangaroos (*Macropodidæ*); restricting, however, the latter term to the species in which the molar teeth have two transverse ridges for the chief character of their grinding-surface, and excluding the Potoroos (*Hipsiprymnidæ*), in which the working-surface of the molars is formed by four tubercles in two transverse pairs. The large extinct species of Kangaroo indicated under the names *Macropus Titan*, *M. Atlas*, and *M. Anak* in former publications here receive further elucidation of their specific distinction from any known living Kangaroos and of the grounds (according to the value assigned thereto by present zoologists) for referring two of these (*M. Atlas*, *M. Anak*) to distinct subgenera of *Macropodidæ*. The author then enters on the elucidation, aided by the facts premised, of *Macropus Titan*, *M. affinis*, *Osphranter Cooperi*, *O. Gouldii*, *Phascolagus altus*, *Sthenurus*, *Atlas S. Brehus*, *Protemnodon Anak*, *P. Og*, *P. Mimas*, and *P. Ræchus*. The maxillary, mandibular, and dental characters of these extinct species are illustrated by the subjects of eight plates.

Zoological Society, January 21, Prof. Newton, F.R.S., V.P., in the chair.—Dr. Günther, F.R.S., exhibited and made remarks on a supposed ancient Egyptian skull.—A communication was read from the Rev. John T. Gulick, containing remarks on the classification of the family *Achatinellinæ*; which he regarded as containing ten well established genera, seven of which were arboreal and three terrestrial in habit.—Mr. A. H. Garrod, read a paper on the visceral anatomy of the Sumatran rhinoceros (*Ceratorhinus sumatrensis*) based on a specimen of this species lately living in the Society's gardens.—Mr. A. D. Bartlett gave an account of the birth of a Sumatran rhinoceros which had taken place on board the *Orchis* at the Victoria Docks on December 7. The mother and an adult male of the animal along with her had been brought from Singapore, but the male had died on the passage. The young one suckled freely and lived for about a fortnight, and was said to have been accidentally killed.—A communication was read from Surgeon-Major Francis Day on some new or imperfectly known fishes of India and Burma.—A communication was read from the Rev. O. P. Cambridge on some new genera and species of Araneidea, chiefly from Mr. Thwaites' Ceylonese collections.—A communication was read from Dr. J. E. Gray containing a description of the skeleton of the New Zealand Right Whale (*Macleayius australiensis*) and of other whales. Dr. Gray concluded with a general list of the known species of the marine mammalia of New Zealand.—A communication was read from Mr. G. B. Sowerby, giving descriptions of several new shells of the genus *Conus*.—A communication was read from Dr. J. C. Cox, containing descriptions of new land shells from Australia and the Solomon Islands.

Anthropological Institute, Jan. 21. Annual general meeting.—Sir John Lubbock, Bart, F.R.S., president, in the chair. The Report of Council showed that the income for 1872 was 1,238*l.* 5*s.* 4*d.*, and the expenditure 1,084*l.* 18*s.*, leaving a balance in hand of 153*l.* 7*s.* 4*d.*; and that after deducting the expenses of the year, the debt of the Institute had been reduced by 249*l.* 9*s.* 6*d.* The president delivered an address, in which he reviewed the chief anthropological works of the past year by continental and American authors. He also drew attention to the continued destruction of prehistoric monuments, and made further suggestions for their preservation. Prof. George Busk, F.R.S., was elected president.

Meteorological Society, Jan. 15.—Dr. Tripe, president, in the chair. The first paper read was on solar radiation, by Rev. Fenwick W. Stow, M.A. This paper treated of the comparison of the measure of solar radiation obtained by a Herschel's actinometer with that indicated by the difference between the temperature of a blackened bulb *in vacuo*, and that of the air in the shade; the comparison of the latter with the difference of temperature of blackened and unblackened bulbs *in vacuo*; suggestions for a standard solar thermometer or actinometer; errors of thermometers *in vacuo*, and the necessity of comparing them; experiments with blackened bulbs in glass air-jackets; and the objects to be aimed at in investigations of solar radiation, and the importance of such investigations to meteorology and physics. The next paper, also by the Rev. F W Stow, entitled "On Temperature in Sun and Shade," was an account of experiments with different thermometers exposed (1) to full sun, (2) to sun, but not to sky in zenith, (3) to sky in zenith, but not to sun, (4) on open thermometer stand, and (5) in louvre board screen. The author found that ordinary mercurial thermometers are affected more by radiation from the ground than from the other sources of heat; and concluded with some remarks on open stands and louvre board screens.—The other communications read were—"On the 'Pocky' Cloud observed July 27, 1872," by J. S. Harding, F.M.S.; "Account of the Hurricane which passed over the Nichol Bay district of Western Australia on March 20, 1872," by R. J. Sholl, Government Resident; and an "Account of a phenomenon observed on board H.M.S. *Fawn*, on May 16, 1872," by H. P. Knevitt.

Institution of Civil Engineers, Jan. 14.—Mr. Thomas Hawksley, president, in the chair. Colonel W H. Greathed, C.B., R.E., Chief Engineer of Irrigation to the Government of the North-Western Provinces, read a paper "On the Practice and Results of Irrigation in Northern India." The object of the Paper was to describe what had been done and what was now doing in that portion of Upper India where irrigation had been longest practised, and on the largest scale.

Glasgow

Geological Society, Jan. 9,—James Bryce, LL.D., F.G.S., read a paper on "The Upper Secondary Rocks of Sky and Raasay." After referring to the observations which have previously been published on the Lias and Oolite of Sky, Dr. Bryce noticed the great geological interval which separates these upper Secondary rocks in Scotland from the deposits on which they rest. In the east of Scotland they are found overlying the Old Red sandstone; but in Skye and Raasay their base is formed of the Torridon or Cambrian Sandstone, in a great trough or hollow, in which they seem to have been deposited. He then described at length the general succession of beds observed in Skye, from the lower Lias at Lucy Bay to the middle Lias at Broadford, Pabba, and Raasay, and the upper Lias and inferior Oolite in the neighbourhood of Portree. Passing northwards these were succeeded by beds still higher in the scale, till, at Loch Staffin on the one side, and Uig on the other, members of the upper Oolite were found. He had also found indications of what appeared to be the equivalents of the "Purbeck beds" in England, and the fossils from these were now under careful examination. The paper was illustrated by maps and carefully-prepared sections, together with a tabular view of the beds referred to, and a copious list of the fossils belonging to each horizon, including some new species not yet named.

CALIFORNIA

Academy of Sciences, Dec. 17, 1872.—Mr. W. H. Dall read, "Preliminary Descriptions of new Species of Mollusca from the N.W. coast of America." The *Magasella Aleutica* (Dall, n. s.), has its *habitat* in the Aleutian Islands from Akutan Pass to the Shumagins, attached to the under surface of rocks at extremest low water of spring tides. This pretty species resembles in miniature *Laqueus rubella* of Sowerby, but is proportionately shorter and broader. The animal is rather sluggish. *Acmæa* (*Colisella*) *peramabilis* (Dall, n. s.), inhabits the Shumagin group of islands, Alaska Territory, on rocks near low water mark. This lovely species has no relations with *A. sybaritica*, Dall, and *rosacea*, Cpr., except those of colour. The two latter are much smaller and the rose colour is much lighter and differently disposed. Its nearest allies are some varieties of *A. patina*. *Argonauta expansa* (Dall, n. s.) The interior of the shell is smoothly polished, the exterior, especially on the protuberances of the carinæ, is covered with a multitude of exceedingly minute rough pustules, which give a very rough, harsh feel to the shell, and under a lens appear hemispherical. Laying the shell upon its aperture, with the apex posterior, we have the following measurements. Total length 3·25 in. Width of dorsal area posteriorly 0·32 in.; ditto, anteriorly 0·7. Height of shell 2·0 in. Total extension of axis from end to end, 4 in Total length of aperture 2·25 inches; length from the anterior edge of the spire to the anterior edge of the aperture 1·9 in. *Habitat*, in the Gulf of California. This pretty and peculiar argonaut possesses an assemblage of characters not common to any described species, though there are several which have a somewhat similar lateral extension of the axis.

PARIS

Academy of Sciences, January 20.—M. de Quatrefages, president, in the chair. The President announced the death of M. le Baron C. Dupin, member of the Mechanical Section.—M. Chasles read a paper on the number of points of intersection of two curves of any order at a finite distance.—M. Cahours read a note on certain new derivatives of Propyl. The bodies described were propylic sulphide, mercury propyl, tin propyl, and nitro-propane; the author finds that propylic iodide, which occupies a place between the iodides of ethyl and amyl, behaves like them.—M. A. Trécul read the first part of a paper on the carpellary theory of the *Papaveraceæ*. This part of the paper was devoted to the Papaver family.—An account of some new researches on the tympanic chord, by M. A. Vulpian, followed.—M. A. Dumont sent a paper on the possibility of destroying the Phylloxera in the Valley of the Rhone by submerging the vines.—M. du Pepin sent a note on the residues of the fifth power and one on the quadratic forms of certain powers of the primary numbers.—M. O. Tamin-Despalles sent a note on the connection between ozonometric determinations and the death-rate of Paris. The author finds that the winds from south to north round by west are favourable to health, and that large ozone indications are accompanied by small death-rates.—M. Yvon Villarceau read a letter from M. Borrelly detailing some observations of No. 128, and the discovery of a new variable star. The latter is situated in the Balance; its mean position for 1873 is, $15^h\ 14^m\ 5{\cdot}69^s$ R. A.; $109^\circ\ 55'\ 42{\cdot}7''$ N.P.D.—M. P. Volcipelli sent his fifteenth note on the "Electric Influence."—M. Ch. Viollette sent a note in reply to the late communication of Messrs. Tomlinson and Van der Mensbrugghe on the action of thin films of liquid on supersaturated solutions. He asserts that the ten-atom sodic sulphate crystal always caused the solidification of the solution of that salt, and that it does this of itself, and not by means of its chemical dirtiness.—M. Arm. Gautier sent a note on certain phosphorous compounds, in which that body appears to exist in the amorphous form. The formula for one of these bodies is P_5H_3O; it is formed by the action of water on PI_2.—M. A. Chevalier sent a note on the modifications produced on coloured light by the various tinted glasses used for spectacles. He decides that as the neutral tint alone cuts out the very brilliant red and yellow portions of the spectrum that it alone is of any use.

DIARY

THURSDAY, JANUARY 30.

ROYAL SOCIETY, at 8.30.—Note on the Origin of Bacteria, and on their Relation to the Process of Putrefaction: Dr. Bastian.—On Just Intonation in Music: R. H. M. Bosanquet. On the Composition and Origin of the Water of a Salt Spring in Huel Seton Mine, with a Chemical and Microscopical Examination of certain Rocks in its Vicinity: J. A. Phillips.

SOCIETY OF ANTIQUARIES, at 8.30.—Oriental Bronze Implements: A. W. Franks.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 9.—Music of the Future: Mr. Dannreuther.
SOCIETY OF ARTS, at 8.—Progress of India during the last Fourteen Years: J. H. Stocqueler.

SATURDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 3.—On Comparative Politics: E. A. Freeman.

SUNDAY, FEBRUARY 2.

SUNDAY LECTURE SOCIETY, at 4.—The Early History of Domestic Animals: L. C. Miall.

MONDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 2.—General Monthly Meeting.
ENTOMOLOGICAL SOCIETY, at 7.
ASIATIC SOCIETY, at 3.
LONDON INSTITUTION, at 4.—Physical Geography: Prof. Duncan.

TUESDAY, FEBRUARY 4.

ROYAL INSTITUTION at 3.—Forces and Motions of the Body: Prof. Rutherford.
SOCIETY OF CIVIL ENGINEERS, at 8.
ANTHROPOLOGICAL INSTITUTE, at 8.—On the Looshais: A. Campbell.—The Inhabitants of Car Nicobar: A. L. Distant.
SOCIETY OF BIBLICAL ARCHÆOLOGY, at 8.30.—On the Era of Ezra and Nehemiah: Dr. H. Haigh.—On an Assyrian Patera with an Inscription in Hebrew Characters.—Rev. J. M. Rodwell.—Some Remarks upon a Passage in the Pœnulus of Plautus: Rev. J. M. Rodwell.
ZOOLOGICAL SOCIETY, at 8.30.—On a certain Class of Cases of Variable Protective Colouring in Insects: B. Meldola.—Report on the Hydroida collected during the Expeditions of H.M.S. Porcupine: Prof. Allman.—Measurements of the Red Blood Corpuscles of Batrachians: G. Gulliver.—Notes on some Reptiles and Batrachians obtained by Dr. Adolf Bernhard Meyer in Celebes and the Philippine Islands: Dr. Günther.

WEDNESDAY, FEBRUARY 5.

LONDON INSTITUTION, at 7.—Fresco and Siliceous Painting: Prof. Barff.
SOCIETY OF ARTS, at 8.
GEOLOGICAL SOCIETY at 8.
MICROSCOPICAL SOCIETY, at 8.—Anniversary.

THURSDAY, FEBRUARY 6.

CHEMICAL SOCIETY, at 8.—On Anthrapurpurin: W. H. Perkin.—On the Solidification of Nitrous Oxide: T. Wills.—On Isomerism in the Terpene Family: Dr. C. A. Wright.

BOOKS RECEIVED

ENGLISH.—Lectures on the Philosophy of Law: J. H. Stirling (Longmans).—The Botanist's Pocket-Book: W. R. Hayward (Bell & Daldy)—The School Manual of Geology. Second Edition: Jukes Browne (A. & C. Black).—History of Bokhara: A. Vambéry (H. S. King & Co.).—Ozone and Antozone: Dr. C. B. Fox (J. and A. Churchill).

FOREIGN.—Reisen in der Phillippen: F. Jager. (Berlin.)

PAMPHLETS RECEIVED

ENGLISH.—National Education and New School Boards: Thomas Bonnar. Quarterly Weather Report of the Meteorological Office, No. 14, Part 2, April to June, 1871.—Journal of the Women's Education Union, No. 1, January, 1873 (Chapman & Hall).—Report of the Kew Committee for fifteen months, ending October 31, 1872.—Quarterly Journal of Science, No. 37, January 1873.—On the Genetic Relation of Cetaceans and the Methods involved in Discovery: Theodore Gill.

FOREIGN.—Zeitschrift fur Meteorologie, No. 1, Vol. viii. January 1873.—Uber den Von Pogson, am 2 December, Aufgefunden der Komete Von Prof. Theodore V. Oppalzer.

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