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MR. BESSEMER'S SALOON STEAMER FOR THE CHANNEL PASSAGE

THE prevention of sea-sickness by means of a swinging cabin has nothing novel about it, but the originality and inventive merit in the suspended saloon devised by Mr. Bessemer, and now about to be actually constructed in a ship specially designed for it by Mr. Reed, the late Chief Constructor of the Navy, are of the highest order. The association of those names is in itself a sufficient guarantee that the idea will be carried into execution with complete security as respects the safety of the passengers and the seaworthiness of the ship, and a full knowledge of the scientific principles involved.

Persons suffering from sea-sickness complain not only of giddiness arising from themselves and everything about them being continually in motion, but also in particular of a qualm which comes over them every time the ship, or the part of it on which they are standing, is descending, sinking, as it were, from under their feet. An approach to this qualm is commonly felt in a garden swing during the descent, and also in jumping from considerable heights. There can be very little doubt that this is due to the fact that the intestines are then wholly or partially relieved from their own weight, and therefore exercise an unusual pressure against the stomach, liver, and diaphragm. This pressure produces the qualm, and its rapid and frequent alternations cause sufficient irritation to produce in most people sea-sickness, and in some persons more serious effects. Physiologists are by no means agreed as to how much of sea-sickness is due to this cause, and how much to the reaction upon the stomach of the brain-disturbance, due in part, perhaps, to the actual motion of the head, but largely to the optical effect of the motion. It is pretty certain that all these causes contribute to produce the effect of sea-sickness. It is beyond doubt that they all aggravate it.

Mere swinging cots or small cabins go but a very little way to remedy any of these evils. Even if suspended in two directions, like a compass or barometer upon jimbals, the translatory motion, whether up or down, or to and fro, remains wholly unaltered, and even the oscillatory motion is not got rid of, but only altered in character, being reduced to a minimum at a point near the middle of the ship. The distressing effect upon the eye of the relative motion of surrounding objects also remains. These effects will not be wholly eliminated by Mr. Bessemer's invention; but some of them will be very much reduced, and it remains to be seen whether the reduction is sufficient to get rid of the sickness.

The design, as settled by Mr. Bessemer and Mr. Reed, includes the construction of large steam vessels of light draught, 350 feet long, 40 feet beam, drawing 7 feet of water, and worked by two pairs of paddle-wheels. In the middle of each of these is provided a well, or hole, for the reception of a saloon 70 feet long, 20 feet wide, and 20 feet high, constructed so as to form a box girder in itself, and suspended at its extremities upon a pair of trunnions, on which it can turn, so that it may be kept steady as the vessel rolls from side to side. The saloon is not allowed to swing quite freely, but its motion is controlled by hydraulic machinery, acting either upon a rocking arm or a tangent bar (it does not appear as yet which has been selected), which enables a man to regulate its position at his discretion. This man sits opposite a spirit level, and, by merely turning a handle which opens certain valves, can keep the bubble of the spirit level at zero, so as to keep the saloon virtually upright at all times. The chief novelty of the invention consists in two points—the great size of the swinging cabin or saloon, and the controlling of its motion by hand, instead of trusting to self-adjustment. Both these are very important improvements on the simple swinging cabin.

This attempt to neutralise the motion of the vessel addresses itself to one phase of motion only, namely the rolling. Mr. Bessemer makes no attempt at correcting either the translatory part of a ship's oscillation, or the pitching. He considers that in large vessels such as he proposes to use, both these motions will be small, and not sufficient to cause sickness when once the rolling motion is got rid of. We think there is very much to bear out his view of the case; but we also think that, considering the difference which always exists between experimental and actual circumstances, and especially when we bear in mind that the plan does not correct the whole of the motion, its absolute and entire success is not by any means to be looked upon as a certainty.

The experiment recently made at Denmark Hill must be regarded rather as showing the efficiency of the hydraulic apparatus for regulating the motion, than the effect of its being so regulated.

In the regular heaving of the sea, after the wind has blown sufficiently long to cause regular waves or swell, each particle of water describes a circle in a vertical plane. At the surface, the diameter of these circles is the whole height of the wave from valley to crest. These circles rapidly diminish in size as their depth below the surface increases. Taking into account this diminution, as well as the effect of a ship's breadth, it is certain that the ship will not follow this circular motion at all to the same extent as a cork floating on the surface. In moderately heavy weather, it is probable that in such a ship as is proposed by Mr. Bessemer, any fixed point could describe a circle of five or six feet in diameter, quite independently of any rotatory (or rocking) motion. It is much to be regretted that the model at Denmark Hill was not mounted on a crank or eccentric, so as to combine this motion with the simple rocking, and to ascertain how far it remained as a cause of real uneasiness, when the rocking had been eliminated.

It is to be observed that a level does not give a fixed direction when a ship is moving upon waves. Apart from any rolling of the ship's own, it gives, when its centre is describing a circle uniformly, not the direction of actual gravity, but the resultant of gravity and of the centrifugal force. In fact, instead of being horizontal with reference to the earth, it is horizontal with reference to the effective wave surface. But as this is also the direction with reference to which a man has to balance himself in sitting or standing, it tells us what is practically, though not actually, the upright, and therefore is probably a better guide than a truly vertical or horizontal line.

It must not be supposed that the feeling of the dec sinking under one, or the motion which produces thi effect, is an actual translatory motion shared by the whole vessel. By far the greater part of it is due to rocking about some centre (whether fixed or instantaneous), at some distance from the passenger, just as a boy moves really up and down on a see-saw, while the plank simply rocks about a fixed centre. A very large portion of the apparent motion of translation will therefore be cured by neutralising the rocking; and so far as rolling is concerned, we have no doubt that all rocking will be effectually cured. Even as regards pitching, we are disposed to think that in large vessels this is seldom very troublesome when there is pitching and nothing else. It is the combination of pitching with rolling which is so difficult to bear; and we have reason to know that a vessel's pitching is almost invariably accompanied with a roll of very considerably greater amount than the fore and aft motion. Apart from the much more confused and distressing character of the combined motion, we think that the pitching would be found to be a much smaller effect than is commonly believed, if the rolling were wholly got rid of.

On the whole, while we are unwilling to commit ourselves to any prophecy, either of complete success or of partial failure, we think very favourably of the proposal. As a mere scientific experiment it is one of the very highest interest. As a practical design it offers a sure prospect of realising a large part of its intention, and a fair prospect of attaining a high degree of success. We feel confident that it will save a great many who would otherwise suffer, from being sea-sick at all, but we can hardly hope that there will not be sufficient residual motion in very heavy weather to cause some degree of uneasiness to very sensitive persons; nor would we venture to predict what will be the numerical reduction in the proportion of persons relieved from sickness, or the amount of alleviation to those not wholly saved from it.

It remains to say a few words on the question of safety. The inquiry of the timid will be, What if anything goes wrong? How will you control this great moving mass of 150 or 200 tons if a valve should give way or a pipe burst? The answer is immediate. In case of accident, the saloon would simply be disabled from moving independently of the ship, and the worst that could happen would be that the passengers would not get the relief desired, but would simply be as in the saloon of an ordinary vessel, and with much better ventilation. Even if the machinery broke down badly, it would be the work of a moment for those in charge to jam the saloon most effectually, so as to make it a fixed part of the ship. The hydraulic machinery is similar to that which has been for a long time used by Mr. Bessemer in controlling large masses of molten iron, and has, therefore, been fully tested and shown to be efficient.

SCIENCE IN CEYLON

A SUPPLEMENT to a recent number of the *Ceylon Observer* contains the first address of the new Governor of Ceylon, his Excellency the Right Hon. W. H. Gregory. On the opening of the session of the Legislative Council, his Excellency proposes to take a vote of 50,000 rupees for the commencement of a Museum of Natural History and Antiquities. The cost of the building when completed in the rough is to be 80,000 rupees. He says, "the want of a museum in which may be represented the natural history, antiquities, and industrial products of the island has been forcibly urged on me by persons of all classes. For a comparatively small sum, considering the object in view, a museum may be constructed, which shall not be a mere random collection of miscellaneous objects, but a scientific teaching exhibition. To carry out thoroughly our purpose, it will be necessary that the head of the institution should be a person competent from knowledge and scientific training to arrange in proper sequence the various specimens as they come in, to give information to the student, and probably to give lectures occasionally on the different branches of the collections, such as on the principles of classification, the habits, instincts, and economical uses of each class." The salary of the Director to be appointed is to be a liberal one, in order that a man of high acquirements may be induced to undertake the task. The archæology of the island is to be well represented in the museum, and to contain reproductions of the many ancient inscriptions therein existing in the form of photographs, casts, and hand copies. The collection generally is to be strictly confined to the products of Ceylon. New regulations are to be made for the management of the forests and to prevent the present waste of timber, for the carrying out of which foresters are to be appointed. A hope is expressed that the cultivation of cinchona will be extended. The soil and climate of Ceylon are peculiarly adapted to the growth of this plant, Ceylon samples of bark fetching a higher market price than similar ones from Ootacamund. It is also hoped that the production of tea may be taken up by the planters. Silk may, perhaps, also be added to the productions of the island. The mulberry tree grows quickly and vigorously in Ceylon, the worms are reported hardy and to thrive well; but difficulties arise from the want of patient and skilled hands in the winding of the silk. The dried cocoons would probably have to be sent to Europe to be spun, as they are at present in largely increasing quantities from various parts of the East. Regulations are to be made for the preservation of game, *i.e.*, deer, elk, buffaloes, and pea-fowls, not for the benefit of the sportsmen, but for that of the native population.

The natives complain that bodies of strangers enter a district, drive into a narrow compass and shoot down and wound large quantities of deer, the flesh of which is dried, carried away, and sold; that this wholesale destruction goes on at all seasons; and that the breed of buffaloes is deteriorating by the slaughter of the wild males. The tame buffaloes are, in Ceylon, turned out loose into the jungle when not employed in the paddy fields or elsewhere, and interbreed with the wild ones. During the whole of the Governor's journeys in the northern and eastern provinces he saw only two deer and heard one pea-fowl, although riding over ground where, a few years previously, all kind of game abounded. We think the Governor was unlucky in his experiences. There are still plenty of peacocks to be seen about Trincomalee, at least where we lately came across upwards of thirty in one afternoon. It is still extremely desirable that the wanton destruction of game should be put a stop to. A close time is to be enforced, and driving prohibited except by the inhabitants of a district. Reference is further made to the late floods. Within the last fortnight a great calamity has befallen us. Inundations to an extent unknown in the colony for a long series of years have inflicted serious though only temporary damage on a large tract of country. The loss of life, so far as I can ascertain, has been but small, considering the suddenness and extent of the floods; but many houses have been swept away, and a large amount of native property destroyed."

It appears that a bridge on the Randy railway, that over the Hanwella road, was broken down by the flood, and at the time the Governor spoke traffic with the Central Province was interrupted. Three persons employed in the department were drowned when the railway bridge was swept away. Science is evidently not likely to suffer in the hands of Mr. Gregory.

OCEAN METEOROLOGICAL OBSERVATIONS

Remarks to accompany the Monthly Charts of Meteorological Observations for No. 3 *Square, extending from the Equator to* 10° *N., and from* 20° *to* 30° *W* (Printed for private circulation, by authority of the Meteorological Committee of the Board of Trade.)

THIS portion of the Meteorological Committee's work in the discussion of Ocean Meteorology has been printed by the Committee for distribution among meteorologists and others, with the view of eliciting their opinions on the utility of the method adopted, together with any suggestions they may have to offer. The chart issued with the remarks gives the results of the discussion of No. 3 Square of Marsden's numbered squares for the month of January. This square has been selected as the one of greatest importance, and in which the largest number of observations have been collected. It is divided in the chart into 100 squares of 1° each, in which are set down, in a compact form, the results of the discussion as respects wind, variation, atmospheric pressure, air and sea temperature, humidity, the currents and specific gravity of the sea, and, in the margin, weather and cloud.

In attempting to give the results of so many subjects in a small space, and with one printing, not a little has been sacrificed to clearness. The chart has considerable merit as an ingenious and compact tabulation of results; but little praise can be awarded to it as a chart or diagram telling its own story at once clearly and readily to the eye—a characteristic which charts specially addressed to seamen ought to have. Printing in colours would introduce some improvement, but as regards the important subject of the winds more will be required, if the present method of presenting the results be adhered to. By this method the arrow representing the largest number of wind observations extends to the centre of the circle included in each square; and hence the arrows representing the winds of *different* squares cannot be directly compared together. Since such comparisons can only be made by the arrows of each square being drawn to show by their lengths the percentages each wind direction is of the whole number of winds observed in the square, a separate wind chart will be necessary in the text accompanying the charts.

Three small charts are given with the Remarks (p. 43), showing the pressure and temperature of the air and the temperature of the sea. These have been constructed by grouping the 100 squares into twenty-five squares of 2° each. As respects pressure, the isobarics are drawn for every two-hundredths of an inch of mean pressure. The *outré* forms of the isobarics are such as to suggest the idea that the method of discussing the barometric observations is faulty. An examination shows it to be so on two important points, which will appear from the following extract from the chart of the observations of the four contiguous sub-squares (Nos. 59, 58, 49, and 48), of which the mean pressures are stated in inches, the number of observations in each case being printed within brackets:—

	30° W. – 29° W.	29° W. – 28° W.
6° N. – 5° N.	29·882 (3)	29.963 (14)
5° N. – 4° N.	29·870 (2)	29·939 (15)

In the small isobaric chart these four results are treated as of equal value, and the average of this 2° square is calculated by taking their simple arithmetical mean; accordingly 29·914 inches is entered as the mean. Now a little reflection shows that the averages 29·882 and 29·870 inches, based respectively on 3 and 2 observations, are very faulty as approximations to the true averages of their squares. In such cases the method of discussion is to deduce the new averages not from the averages of the four sub-squares, but from the whole of the observations added together and divided by 34, the number of the observations. By doing so we obtain in the above case the average 29·940 inches. Similarly we have discussed the whole of the 100 squares, and the result is the disappearance of several of the anomalies in the new isobarics drawn from the twenty-five new averages thus calculated.

But other anomalies remain, which lead to the second point on which the method of discussion is defective. The method is thus described in the Introductory Remarks (page 1):—

"The various hours at which the observations were taken may not give the mean result for the twenty-four hours; still, as the same hours have been generally extracted, we may confidently hope that the temperatures and pressures obtained from the means of the whole will give very good relative results for comparing the meteorological state of one part of 10° square with that of another. In making the extracts the hour of each observation has been recorded, so that any inquiry depending on the hours might be carried out if thought requisite."

The confident hope here expressed is very remarkable in the face of the averages printed on the chart, of which an example is given above. The truth is, comparableness of the results of the different squares is not to be looked for except in cases where the observations are numerous. Since the daily range of the barometer is large in these regions, averages based only on a few observations—regarding the hours at which they were made we have no information—are worthless in every inquiry in which comparisons require to be made. Now looking at the squares, we find from the chart that there are fifty-one out of the 100 whose pressure averages are based on fewer than twenty observations; thirty-five averages on fewer than fifteen observations; and sixteen averages, or a sixth of the whole, based on fewer than ten observations. Hence the incomparableness of the results of the 1° and 2° squares, *inter se*, and the general unsatisfactoriness of this part of the work. The same objections apply with perhaps equal force to the discussions of the temperatures of the air and those of the sea.

Range corrections for pressure and temperature over the region under discussion are not yet accurately enough known to justify the committee in "correcting" the results on the large chart by hypothetical corrections. Since, however, it is most desirable to attempt a discussion of the results of the squares, so as to arrive at a knowledge of the approximate distribution of the temperature and pressure of this important part of the ocean; and since such a discussion necessarily calls for a preliminary preparation of the results by the application of such approximate corrections for range as we are in possession of, and which cannot be far from the mark; the Meteorological Committee will require to give *the mean day of the month and the mean hour of the day for each of the averages of the squares.* Indeed, without this additional information the results can scarcely be said to possess any strict scientific value.

With this additional information, some highly interesting questions suggested by the chart could be examined, such as the relations of the pressure, air and sea temperature, and humidity in these 1° squares, viz., Nos. 93, 94; 82, 83; and 72, 73, to the squares contiguous to them. But, so far as the chart informs us, the interesting anomalies here indicated may be due to no more than differences in the mean hour of the observations of each square.

We should also wish to see added, as respects each square, an enumeration of all the unusually low and unusually high observations of pressure and temperature which have been made use of in calculating the averages. This will be the more desirable as the discussion proceeds into other parts of the ocean where barometric and thermometric disturbances are of more frequent occurrence, and where the number of observations is fewer than in this No. 3 square "in which the largest number of observations have been collected."

The vital importance of a knowledge of pressure and temperature range in discussing Ocean Meteorology it is unnecessary to insist upon. For this information we must look, perhaps we may say exclusively, to the Boards of Admiralty of this and other countries, it being only through such bodies that systems of hourly or two-hourly observations at sea can be organised and carried out. May we hope that, among the contributions to science which Prof. Wyville Thomson will bring back from his circumnavigation cruise, one will be data for the determination of barometric and thermometric constants which are so indispensable in the reduction of Ocean Meteorological statistics.

In offering these suggestions to the consideration of the Meteorological Committee, we desire to express our deep sense of the importance of this department of their work, and our hearty thanks for the care they are taking to ensure its efficient execution; and we may confidently hope that the method of discussion finally resolved on will lead to results which, taken in connection with similar discussions undertaken by the Dutch, French, German, Norwegian, and other Governments, will place Ocean Meteorology on a broad and sound basis, and thus lead towards the solution of many questions vital, not merely to navigation, but to a right understanding of the more complex problems of the Land Meteorology of the Globe.

GIEBEL'S THESAURUS ORNITHOLOGIÆ

Thesaurus Ornithologiæ. Repertorium der gessammten ornithologischen Literatur und Nomenclatur sammtlicher Gattungen und Arten der Vögel nebst Synonymie und geographischer Verbreitung. Von Dr. C. G. Giebel. Erster und Zweiter Halbbänder. (Leipzig: Brockhaus, 1872.)

IN this work, we regret to say, the performance does not equal the promise. Nothing would be more acceptable to the many students of the class of Birds than such a "Repertorium" as Prof. Giebel's title seems to indicate. Nor is there anything objectionable in the manner in which he proposes to treat his somewhat extensive subject, although other plans would be equally or more convenient. But when we come to look into details and to consider the mode of execution, we must condemn the work as almost useless to ornithologists from its errors and imperfections.

The first portion of the "Repertorium" professes to give us a complete list of the literature relating to ornithology, arranged under certain heads. But numerous volumes and papers of the greatest importance to the ornithologist are either altogether omitted, or are inserted under wrong headings. For example, Cabanis and Heine's "Museum Heineanum" is not alluded to at all, nor can we find Finsch and Hartlaub's "Ornithologie Ost-Afrika's," Fraser's "Zoologia Typica," or Gilliss's "Astronomical Expedition" (Birds by Cassin) entered under the proper heads. These are all works which a working ornithologist would have occasion to consult frequently. A long list might easily be made of similar omissions. In the section of this part of the "Repertorium" which treats of local faunas, many ridiculous blunders are made. Memoirs referring to Africa and South America are entered under Asia, and a number of South American papers are attributed either to *America Septentrionalis*, or *America Centralis*.

In the second part of the "Repertorium," called "Nomenclator Ornithologicus," it is pretended to give a list of all the described genera and species of the class of birds in alphabetical order, with references to authorities, synonymy, and other points. Nothing could be of greater use to the ornithologist, if such a task were well or even fairly well performed. But this, we regret to say, is not the case, as anyone with previous knowledge of the subject will very quickly discover, on turning over Prof. Giebel's pages. It is, in fact, quite evident that the "Repertorium" is a mere compilation, upon which, no doubt, long and weary labour has been bestowed; but which, as is often the case with compilations, will be of very little value to the student, owing to the compiler having had insufficient previous knowledge of his subject.

OUR BOOK SHELF

Palæontographica. Beiträge zur Naturgeschichte der Vorwelt, herausgegeben von Dr. W. Dunker and Dr. K. A. Zittel. Band XX. Lief. 5. September 1872. (London: Williams and Norgate.)

THIS part of the "Palæontographica" contains a continuation of Dr. Geinitz's description of the fossils of the Lower Quader Sandstone of the Valley of the Elbe in Saxony, and includes an account of the Brachiopoda and the early families (Hippuritidæ, Ostracidæ, Spondylidæ, and Pectinidæ) of the Pelecypoda. The species are carefully described and beautifully figured, and the synonymy and distribution of them are discussed at some length, so that the work must be regarded as indispensable for the student of the Cretaceous rocks.

In some general remarks prefixed to his descriptions Dr. Geinitz calls attention to the interest attaching to these Saxon fossils, in some cases owing to their wide geographical range, in others to their long range in time during the Cretaceous period. Thus of the species here noticed, *Ostrea carinata*, *diluviana*, and *hippopodium*, *Exogyra lateralis*, *columba*, and *haliotoidea*, *Pecten membranaceus*, and *curvatus*, *Vola phaseola*, *quinquecostata*, and *quadricostata*, and *Lima tecta*, are common to the Cretaceous rocks of the Elbe Valley in Saxony and of Southern India, in both which localities the lower members of the Cretaceous series (Neocomian and Gault) are wanting. *Inoceramus labiatus* and *Ammonites peramplus* are also referred to as fossils common to the two localities. On the other hand a collection of Cretaceous fossils from the neighbourhood of Colorado city and the north of New Mexico also included examples of *Inoceramus labiatus*, *Ammonites peramplus*, *Baculites baculoides*, *Inoceramus Brongniarti*, and a species resembling *I. striatus*, evidently representing the Middle Planer of the Elbe Valley, and derived from similar beds of Chalk-marl, over which lie beds with *Inoc. Goldfussianus*, Baculites, and Scaphites, evidently belonging to the age of the White Chalk. These facts, as Dr. Geinitz remarks, furnish support to the assumption of migrations of species from India to Europe, or from Europe to America, long before the human race took the same road.

The most interesting cases of the long-continued existence of species are those relating to the occurrence thus low down in the Cretaceous series of species common to these deposits and to the latest beds of this formation in the province of Schonen in Sweden. Dr. Geinitz also calls attention to the variations occurring in the species here noticed, and to the apparent interdependence of many of those in older and newer parts of the formation, so that, as he says, "it is not difficult to sketch a regular genealogical tree for various series."

Theoretische Maschinenlehre. Von Dr. F. Grashof. In vier Banden. Erster Band. Erste Lieferung. (London: Williams and Norgate.)

THE first number of this work has been issued during the present year. From the preface we learn that the object of the work is the theoretical investigation of the problems involved in the theory of machinery. In the first volume will be discussed the mechanical theory of heat, the theory of hydraulics, and certain other parts of theoretical physics and of applied mechanics, which will be useful in the subsequent portions. The second volume will contain the elements of machines, of mechanical movements, and of governors, and also of mechanical instruments—*i.e.*, instruments for measuring time, velocity, mass, force, and energy.

The third volume discusses the machines which serve for the application of natural agents to technical purposes, machines for employing the power of animals, hydraulic wheels, windmills, steam engines, and especially heat engines in the widest sense. Finally, the fourth volume will be occupied with machines for doing work (*Arbeitmaschinen*)—that is, machines for moving about and hoisting solid, liquid, and gaseous bodies (locomotives, screw-propellers, winding machines, rams, pumps, blowing machines), also machines for the working and manipulation of rigid bodies, such as hammering and rolling machines, sawing machines, &c.

The number which lies before us principally discusses the mechanical theory of heat. This subject is entered into with great thoroughness and profundity, and includes an elaborate discussion upon radiant heat and many other collateral matters. It need hardly be added that for the perusal of this work a sound knowledge of mathematics is indispensable.

LETTERS TO THE EDITOR

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

Kew Gardens and the National Herbarium

PROF. OWEN has very imperfectly stated the facts respecting the cultivation of the ipecacuanha plant at Kew and in India.

My friend Mr. McNab says of the ipecacuanha (Trans. Bot. Soc., vol. x. 319): "It is a plant of remarkably slow growth; the largest plant in the Botanic Garden at Edinburgh is scarcely one foot in height, although more than thirty years of age, and has three leading shoots, each four inches in length. The method hitherto adopted of propagating the *Cephaëlis* (as far as I am aware) is by cuttings, but of these not more than one or two can be got at a time, and at long intervals."

It was the possession in the Edinburgh Botanic Garden of old long-established plants, with well-developed, rhizome-like rootlets, and the difficulty experienced there in obtaining cuttings, which suggested to Mr. McNab a method of propagation which has since been found exceedingly successful, and for which he deserves every possible credit. In a printed report to the Secretary of State for India (11695) Dr. Anderson states: "It was when examining the old plants in order that the best method of propagating might be determined on, that it occurred to Mr. McNab that the numerous root-like tubers might be taken advantage of as a means of rapidly increasing the plant."

At Kew no such great difficulty has been experienced in increasing the ipecacuanha by ordinary cuttings, the original specimen having during the last six years been by this means increased manifold. On the other hand, the constant demand for cuttings from the Kew plant has prevented the formation of the tuberous rhizomes which in the case of the Edinburgh one were the result of thirty years' growth.

As far as the resources of Kew Gardens would allow, all three presidencies of India were supplied with ipecacuanha plants, not once only, but at various times. Most of these perished in India, some from being planted in unsuitable sites, others from accident; and it was not till 1868 that its cultivation promised success, upon which its propagation on an extensive scale was ordered by the Government of India.

Of the plants sent to Calcutta from Kew, one which arrived in 1866 had in 1869 produced twenty plants (Anderson, l.c. p. 3): of these twelve were sent to Sikkim, where seven were "killed by a coolie falling on them and completely smashing them" (Report of the Calcutta Botanic Garden, April 25, 1871). The further history of the remainder is detailed in Dr. King's report, which is quoted by Prof. Owen, but in a very unfair manner. The passage which he has extracted proceeds as follows beyond the point where he stops: "The five plants in Sikkim were, early in the current year, submitted by Messrs. Gammie, Bierman, and Jaffrey, of the Cinchona plantations, to a most successful experiment in artificial propagation, by which four hundred cuttings were obtained, the greater proportion of which have formed good roots, and are now fine healthy little plants."

That the cultivation of ipecacuanha should be taken up at Edinburgh is nothing more than might reasonably be demanded of a garden maintained at the national expense. It was indeed an arrangement which the residence at Edinburgh of Dr. Anderson, the then Superintendent of the Calcutta Botanic Garden, who was home on sick leave, rendered eminently desirable, and one upon which I was fully consulted by the Government, as appears in Dr. Anderson's report already quoted. Nor, in reference to the subject, should it in fairness be suppressed, that not only has the successful introduction of the ipecacuanha into India been due to the establishment at Kew, but that Kew has at the same time supplied living plants to Ceylon, the Mauritius, Jamaica, Trinidad, Barbadoes, Queensland, and various home and continental gardens.

Prof. Owen again appears to have been completely misinformed in respect to *Welwitschia*, which, he implies, had been sent to Kew in a state fit for cultivation. A very large and old specimen with the tap-root chopped off before its arrival, was placed for convenience in a pot of earth, and exhibited in the succulent house, where it would be likely to attract much attention, and would also be in contiguity to other plants from the same region. This was done without the slightest expectation of its showing any disposition to grow, and solely to gratify the public curiosity. On the appearance of symptoms of decay from the dampness incidental to a greenhouse, it was at once transferred to the museum, where it now remains. Prof. Owen, apparently quoting a statement in my memoir on *Welwitschia*, pointedly alludes to the fact that "cones with ripe seeds" had been received at Kew, but he omits to give the following words, "the albumen of which was perfectly rotten;" and when alluding to my acknowledgment of the receipt of "fine young plants," he does not add that these were Dr. Welwitsch's specimens gathered years before.

Prof. Owen refers to my answer to Q. 6,661 in the evidence given before the Royal Commission, as having by groundless insinuation "inflicted pain on fellow-servants of the State and collaborators in science, on men at least his (my) equals, and one of whom in a recondite botanical problem has shown himself his (my) superior." As Prof. Owen does not quote this question and answer, I shall do so. They are as follows:—*Q.* 6,661.—"Has there been insufficient space in the British Museum for the reception of specimens for the enlargement of its herbaria, or has any other obstacle interfered?"—*A.* "With regard to the British Museum I do not think any person can answer that except the officers of the establishment. I do not think that the nature and extent of its botanical collections or their condition is well known except to its officers."

I leave it to the reader to say whether any possible insinuation could be conveyed in such an answer, and, being unconscious of any, shall conclude with expressing my conviction that here again Prof. Owen has been misinformed. J. D. HOOKER

Royal Gardens, Kew, Nov. 15

The Diathermacy of Flame

I HAVE to thank Lord Rosse for pointing out an omission in my communication on this subject. It was not, however, an "oversight," as Lord Rosse supposes, the source of error in question having been duly considered, and its amount calculated, when the experiments were made. It was neglected on account of its smallness. As its theoretical importance is unquestionable, and the amount of experimental error is likely to be much overrated, I gladly supply the following figures, which show that this source of error was fairly negligible.

As heat, like all other radiant forces, necessarily diffuses with the square of the distance from its source, my method of maintaining a constant mean distance by lighting an equal number of jets equidistant from each side of the middle flame, was liable to an error equal to the difference between the square of the distance of the middle flame from the thermometer and the mean of the squares of the distances of the other flames. The flames were ¼ of an inch apart, and the middle flame was 14 in. distant from the thermometer. Thus, in the first trial, when only three flames were lighted, the distance of the nearest was 13¾ in., of the middle 14 in., and of the farthest 14¼ in. Taking ¼ in. as our unit, the middle flame was 56 distant, the nearest 55, and the farthest 57. $56^2 = 3136$, $55^2 = 3025$, and $57^2 = 3249$ The mean of 3025 and 3249 is 3137, instead of 3136 as experimentally assumed; the error in this case is thus only $\frac{1}{3137}$ of the 4° increase which my thermometer registered, or $\frac{1}{784\cdot25}$ of a degree, a quantity far too small for consideration in using a common laboratory thermometer reading only to half degrees.

Proceeding onwards, the error of course continued increasing until it reached its maximum, when the 1st and 17th jet were lighted. The 1st was 48 quarter inches distant from the thermometer, the 17th was 62. $48^2 = 2304$, $62^2 = 3844$. The mean of these is 3074, instead of the experimentally assumed mean of $56^2 = 3136$. The difference is 62, *i.e.* $\frac{1}{50\cdot3}$ of 5°—the last increment of heat. Thus the *maximum* error was less than $\frac{1}{10}$ of a degreee, and the mean error lies between this and $\frac{1}{784\cdot25}$ of a degree.

As regards the last paragraph of Lord Rosse's letter, I would suggest that, with gas passing through a given orifice, the passage of equal quantities neccessarily implies equal pressure; that in turning the micrometer screw of the supply tap so as to cause each additional pair of equal jets to consume an equal additional quantity of gas, I was merely admitting into the space between the tap and the jets a quantity of gas just sufficient to maintain an equal elastic tension or pressure in spite of the varying quantity issuing from the jets.

W. MATTIEU WILLIAMS

Skeletons of Wild Animals

MR. CLARK, of Cambridge, in NATURE of Oct. 31, remarks on the general absence of skeletons, especially those of the *Felidæ*, in museums, and states that, so far as he knows, no European museum possesses more than skulls. It is with pleasure, therefore, that I draw his attention to the fact of the existence of a perfect skeleton of the lion in the Ipswich Museum. Besides this, there is a skeleton of the mole, one of the dog-faced monkey (*Cynocephalus anubis*), one of the dolphin, two very finely prepared skeletons of the boa constrictor, besides others of the ostrich, &c. J. E. TAYLOR

Treble Rainbow

ABOUT the middle of August, whilst standing on platform of the station at Exmouth, I witnessed a phenomenon which I think is rare enough to be worthy of record. The sun was about an hour off the western horizon, and the river, which is to the west of the station, and is in that part about a mile and a-half broad, was perfectly calm; but there must have been a breeze blowing overhead, for a heavy shower of rain came rapidly up from the westward, and when it had passed to leeward displayed the two ordinary rainbows brightly; and not only these, for between them appeared the arcs of a third bow cutting the other two, the inner one on the horizon and the outer about ten degrees or thereabouts above it. This third rainbow appeared to have its centre as much above as that of the ordinary rainbow was below the horizon, and was due to the reflection of the sun from the calm surface of the river. The arcs of the third rainbow extended but a very small distance beyond the secondary bow, but were bright enough at the intersection to show a sort of checkwork of colours, which presented a most curious appearance.

Oxford, Nov. 5 A. MALLOCK

Circular Spraybows

THERE have been several accounts lately in NATURE of circular rainbows, but none of your correspondents have mentioned "circular spraybows;" of course, in themselves they are of no great value, but under certain circumstances they can be seen so near that their brilliancy exceeds that of a rainbow.

The most perfect which I have seen was at the Falls of Foyers, off Loch-ness, at 8 A.M. on September 1, 1868. The previous day had been wet, so that the falls had a greater volume of water than usual. At that time the sun, as seen from the platform for viewing the falls, was ascending just above the ledge of the rock over which the water was precipitated, and on looking away from it an entire rainbow was visible, excepting that part which was caused by the shadow of the lower part of my body; in consequence of the spray being all round me, the proximity of the bow added brilliancy to the colours, which surpassed anything of the kind that could be seen in a rainbow. I took no measurements.

Can any of your correspondents give examples of bows being seen on a cloudless background? Some years ago I saw a rainbow in what seemed a cloudless sky, but the surprising fact that rain was lightly falling from this apparently cloudless sky shows that if there were not clouds there were drops of water-fall over a large area, and which formed a background. I am aware of Mr. Browning's authority for such a phenomenon.

Birkenhead G. H. H.

Elephas Americanus in Canada

CAPTAIN HOWDEN, of Millbrook, Ontario, has lately discovered remains of this species in a field adjoining his residence. They were found in the humus quite near the surface, and with the exception of the molars have been very much broken by the plough. The locality is a deep basin, depressed 100 or 150 feet below the surrounding hills, which may have been the basin of a small lake or pond. The elevation is about 490 feet above Lake Ontario, and 125 feet above Rice Lake, on the northern slope of the drift-ridge which borders Lake Ontario on the north. The discovery is interesting as extending the range of this animal in Canada, eastward, along this drift-ridge. The remains heretofore discovered have been confined to the western peninsula, above the Silurian escarpment, or to positions so nearly adjacent that they may have been washed down from this upper region. The present discovery is at an elevation which precludes this, and seems to indicate the presence of the living animal in this region. Between the ridge and the present lake shore there are at least two ancient lake beaches, one about 100 feet above the present water level, the other a little over 200 feet. Neither of these would bring the waters of the lake up to the level of the escarpment; so that at the time of these higher lake levels, the elephant may have ranged over the western peninsula of Canada, and also eastward over the drift-hills which extend nearly to the lower end of Lake Ontario.

Victoria College, Cobourg, Oct. 4 N. BURWASH

Reason or Instinct?

CONSIDERATIONS on the nature of Instinct will ever engage the attention of the student of Nature, and certainly interest in the subject is not likely to flag at a time when psychological manifestations and relations are being more and more sought amongst the lower animals. Your correspondent of the 10th of October last touches on their power of enumeration, which, even in the case of the sagacious dog, appears to be very limited. Nevertheless, I have been assured by a reliable friend, now deceased, that his wiry terrier would, at his order, run round the table once, twice, or thrice, for a suitable reward.

The idea of alternation, and an example of memory, came under my own observation some time ago at the Grotto del Cani, near Naples, where I witnessed the somewhat unnecessary experiment of the deleterious effects of carbonic acid on the unfortunate dogs kept for that purpose. On walking to the cave, I remarked that one of the dogs gambolled round the guide, whilst the other followed at his heels with slouched tail and hanging ear. The guide assured me that each dog knew when it was his turn to be dropped into the heavy stratum of gas on the floor of the cave, from whence, after partial suffocation, he is thrown into the cool lake close by for resuscitation.

With reference to the *quasi*-reasoning in adaptation of means to an end, under exceptional circumstances, I adduce the following:—

Many caterpillars of *Pieris rapæ* have, during this autumn, fed below my windows. On searching for suitable positions for passing into chrysalides, some eight or ten individuals, in their direct march upwards, encountered the plate-glass panes of my windows; on these they appeared to be unable to stand. Accordingly, in every case they made silken ladders, some of them five feet long, each ladder being formed of a single continuous thread, woven in elegant loops from side to side. The method here adopted is similar in kind to that employed by the glacier climber, who cuts foot-holes with his hatchet to enable him to mount the icy precipices which impede him.

In the case of the above caterpillars, however, reasoning seems to be but narrow, for one ladder was constructed parallel to the window-frame for nearly three feet, on which secure footing could be had by simply diverting the track two inches. Some of these insects have now passed into pupæ, and are curiously supported or slung by their well-known silken band across the thorax, under the drip-stone of the window. Such facts, though simple, should warn us against dogmatically fixing the points in the animal kingdom at which instinct ends and reason begins. Do they not overlap?

Weycombe, Haslemere G. B. BUCKTON

Lunar Calendars

IN a communication addressed to NATURE for 1871, Mr. S. M. Drach writes at p. 204. "The true mean conjunction derived from the 19-year cycle is called the Molad or Moon-birth," and I wish to ascertain how this so-called "mean conjunction" is arrived at.

I have before me the two new Almanacks published by Vallentine and by Abrahams, by which I find the "moon-birth" generally put down at about six hours after the time quoted in the "Nautical Almanack" for 1873. From facts that have reached me, I conclude that the data for these publications are derived from a skeleton almanack printed by German Jews at Altona, containing the necessary particulars for fifty and eighty years in advance; and no doubt correctly calculated for that locality. I ask whether the data there given are to be accepted by Jews in all countries, or whether they are at liberty to calculate the time of new moon for their own meridian?

I may take this opportunity to point out the following discrepancy:—

True New Moon, Thursday, Nov. 20, 1873, 3.36 A.M.
Moeled Kislev, Wednesday, Nov. 19, 1873, 1.14. 1 A.M.,

according to Vallentine, but marked P.M. in Abrahams. Both the latter must be in error, because in *advance* of true time.

MYOPS

Early Eclipses

IN looking through some back numbers of NATURE, I came on a paper by Mr. Hind, in which he examines whether any great eclipse took place at the time of the Crucifixion of Christ. He says that "although a great total eclipse was visible at Jerusalem in A.D. 29, yet, in the year 33 no eclipse of importance took place." * Mr. Hind seems to have forgotten that in the opinion of most divines, Christ was born four years before the vulgar era, so that in the year 29 He would have been 33 years old. Remembering this point, it seems highly probable that the account of how "the sun was turned into darkness, and the moon into blood" may be a correct account, not only of the occurrence of an eclipse, but of an early observation of the now famous red prominences.

Cambridge G.

Water-beetles

I HAVE to thank Mr. Buchanan White (NATURE, Sept. 12) for the statement that "many water-beetles are not only winged but use their wings." My error as to fact, however, has no effect on the argument of my letter (NATURE, Sept. 5), which was, that although it is probable the first insects emerged from the water with their wings formed, yet the existing aquatic insects throw no light on the origin of the class.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, County Antrim

PHOSPHORESCENCE IN FISH

IN two recent numbers of NATURE, Nos. 153 and 154, and more particularly the former one, attention is drawn to the question of phosphoric phenomena connected with living fish; but while it has been proved beyond dispute that certain fish, *Cyclopterus lumpus*, for instance, do possess highly luminous properties, the two cases in point may, I think, be referred rather to the combined effects of the microscopic *Noctilucæ*.

* I quote from memory, and therefore perhaps not quite in Mr. Hind's words.

During my last dredging cruise off the coast of Portugal, I enjoyed many opportunities of witnessing the brilliant and varied aspects under which such phosphorescence exhibits itself, though instances more strictly parallel with those quoted in the two communications referred to, occurred, perhaps, while returning by steamer from Lisbon, after its expiration.

On such favourable nights, as the vessel progressed through the waters, shoals of small fish might be seen darting away in every direction, themselves apparently luminous, and leaving behind them bright tracks of phosphoric light, while now and then a fish of larger size would make its appearance, producing a similar effect, though of proportionately greater brilliancy. The *coup d'œil* produced by their countless numbers was most magnificent, and in miniature vividly recalled to mind the meteoric showers that periodically illumine our summer nights. On all such occasions as the foregoing, the water when closely examined was invariably found to be literally teeming with *Noctiluca miliaris*, its presence being manifest again in the broad track of phosphoric light visible for many hundred yards in the wake of the vessel, while the shaft of the screw was brilliantly illuminated by their countless numbers, excited into active display of their phosphoric properties by the rapid revolutions of its ponderous blades.

Had Mr. Hall examined the "globules of fatty matter" contained in the spray thrown on deck on the night he refers to, with the aid of the microscope, he would no doubt have traced the light to the same source, and discovered that each luminous point represented a single individual of the tiny rhizopod here mentioned. His hypothesis that they were possibly portions of "fatty matter" thrown off by the fish themselves, seems scarcely tenable, and more particularly if we accept, as we are bound to, that the luminous tracks left behind as the fish swims onwards are attributable to a like origin, and which immediately suggests that such rapid desiccation would exercise as ruinous an effect upon the poor animals' organisation as befell the celebrated racing pigeon of American notoriety, reported to have arrived at its destination bereft of every feather, lost one by one through the friction attendant upon the high rate of speed at which the bird had travelled.

In addition to *Noctiluca*, innumerable other forms, such as minute Crustacea, Salpæ, jelly-fish, &c., contribute towards the ocean's nocturnal luminosity; but all these latter, and more especially the Salpæ, for the most part display their light spontaneously, and are restricted to local and comparatively small areas of the ocean's surface; while in *Noctiluca* that luminosity is entirely latent, being dependent upon natural or artificial disturbance and excitement to bring it into action; and though exceedingly minute, the separate individuals rarely measuring the hundredth part of an inch in diameter, occur in such abundance that the whole surface of the sea is equally luminous when disturbed, being frequently so plentiful off our coasts that their aggregated bodies form a superficial crust of considerable thickness. Disturbance of the water at such times is immediately responded to by sheet-like flashes of luminosity, while any object passing through the water appears to be aglow itself, partly from the direct light, and partly from the reflected light produced by these microscopic protozoa. On the same principle the apparent luminosity of living fish is easily explained. Swimming through the water they necessarily disturb countless numbers of these living organisms, whose emitted light, actively scintillating for several seconds after the fish has passed, produces luminous tracks wherever the fish may travel, while its own silvery scales borrow and throw back the earliest coruscations it awakens in its onward course.

W. SAVILLE KENT

THE FLORA OF THE QUANTOCKS *

THE geological formation and the historical associations of the Quantock Hills have been abundantly investigated. Their natural productions, animal or vegetable, have not yet, so far as I know, been described or catalogued, although they contain specimens in both branches of Natural History singularly rare and sought after, and though more than one zoologist or botanist of note gazes on them daily from the windows of his home. A paper whose conditions are that it should be light and popular, and that it should not exceed ten minutes in the delivery, cannot throw much scientific light upon the plants of the most limited region; but it may reveal sources of enjoyment and raise individual enthusiasm, and it may remind this meeting that the time has possibly come, when our association should use the means at its command to encourage the gradual creation of such a flora and fauna of the county as no single naturalist, unassisted by a public body, can in any case trustworthily compile.

In this beautiful valley, fat with the rich red soil that countless millennia have seen washed down from the surrounding hills, the flora is everywhere so unusually rich as to win the envy and delight of strangers. It has been my lot to pilot botanists from all parts of England in search of local rarities; and I have found their chief raptures given not to the uncommon flower they had come to see, but to the profusion of form and colour which includes almost every English genus; manifest in the common turnpike roads which skirt the hills, but revealed in full perfection to those only who penetrate the interior of the range. In the sheltered lanes of the less wooded combes; in the road from Kilve to Parson's farm, the foot path from the Castle of Comfort to Over Stowey, above all in the lane from the Bell inn to Aisholt, the hedge banks and the wide grass margins of the road are scarcely surpassed in beauty by the mosaic of a Swiss meadow or an Alpine slope. From the beginning to the end of June the colours are blue and yellow; the blue represented by the ground ivy, the germander speedwell, the brooklime, the late bugle and the early self-heal, the narrow-leaved flax, the long spikes of milkwort, and the varieties of the violet; the yellow by the birdsfoot trefoil large and small, the St. John's-wort, golden mugweed, and hop trefoil, the agrimony, the yellow vetchling, and the countless kinds of hawkweed. In the hedges above are the mealtree and guelder rose, the madder, white campion and lady's bedstraw, half hidden by the twining tendrils, white blossoms, and tiny cucumbers of the bryony: while here and there, where the hedge gives way to an old stone pit or deserted quarry, the tall foxglove and the great yellow mullein stand up, harmonious sisters, to fill the gap. By the middle of July the colours shift. The flora of early spring is gone: the milkwort shows its pods, the speedwell its bushy leaves; the yellow still remains; but the blue has given way to pink; to the lovely musk mallow, the horehound, doves' foot cranesbill, restharrow, painted cup, and calaminth. With August a third change arrives; the small short clustering flowers are gone: instead of them we have the coarse straggling fleabanes, ragworts, and woodsage: the great blue trusses of the tufted vetch and the pure white trumpets of the bindweed take possession of the hedges; the yellow sagittate leaves of the black bryony and the red berries of the mountain ash warn us that summer is past. Our September visit marks the closing scene. The flowers are few and far between; but the ivy bloom is musical with bees, the hazels put forth clusters ruddy brown as those with which the satyr wooed the Faithful Shepherdess; the arum pushes its poisonous scarlet fruit between the mats of dying grass; and the meadows which slope upwards from the brooks are blue with the flowers of the colchicum.

These are all common flowers, whose names and habits

* Read before the Somerset Archæological and Natural History Society September 12, 1872.

if education did her work, we should learn in childhood from our mother and our nurse: it is their immense profusion, not their rarity, that calls for notice; and they represent but a small part of the hill flora. To exhaust this fairly we must visit four different regions—the hill tops, the bogs, the coppices, and the slopes toward the sea. Of the first it is difficult to speak without a rapturous digression as their familiar sights and sounds occur to us—the breeze that seems half conscious of the joy it brings, the musical hum of bees, the warble of invisible larks, the popping of the dry furze pods in the stillness, the quivering air above the heather, the startled spiders with their appended egg-bags, the grasshoppers, the green hair streaks, the gem-like tigerbeetles on the wing, in the distance the Mendips and the yellow sea, or the long rich valley, closed by Dunkery and Minehead.

Heath, furze, bracken, and whortle berries, are the four tetrarchs of the hill tops, giving endless shades of red, and green, and yellow. The heaths are three, and only three—the heather, the cross-leaved heath, and the bottle heath, the last exhibiting rarely a white variety, which in the language of flowers tells the tenderest of tales. From beneath their shelter peep the eyebright, the spring potentil, the heath bedstraw, and the creeping St. John's-wort; amidst them springs the uncommon bristly bent grass; everywhere the green paths which wind amongst them are carpeted with the mœnchia and the little breakstone, and bordered by the red and yellow sheep's sorrel and the pale yellow mouse-ear. On many of the prickly furze beds grows the wiry leafless dodder; every ditch is filled with masses of lemon-scented oreopteris, and every patch of stones is hidden by the pink blossoms of the mountain stone crop. At 800 feet above the sea we meet with mat grass and the cross-leaved heath. Higher still we find the slender deers' hair, first cousin to the isolepis of our greenhouses; and highest of all grow, for those who know their haunt, two species of the stag's horn club moss.

The bogs are very numerous. They form the summits of the combes; and some of them descend the hill until they join a deep cut stream. All are covered with the turquoise bloom of the forget-me-not and the glossy peltate leaves of the marsh pennywort, and choked with the little water blinks. They all include liverwort with its umbrella-shaped fructification, sphagnum, marshwort, and pearlwort; and on their margins grow the ivy-leaved hair bell, the lesser spearwort, the lousewort, and the bog pimpernel. In a few of them are found the oblong pondweed and the marsh St. John's-wort; in two combes only, as far as I know, grows, alone of its genus, the round-seaved sundew.

Of the coppices Cockercombe and Seven Wells are the best known; but their large trees check the growth of flowers; and the botanist will find more to please to him in Butterfly Combe and Holford Glen, which are smaller and less frequented. Here in early spring masses of the white wild hyacinth rise amid last year's dead leaves; here grow the cowwheat, woodrush, golden rod, sheeps' scabious, wood pimpernel, wild raspberry, sanicle, and twayblade. The helleborine is found in Crowcombe; in Tetton woods the rare pink lily of the valley; in Cothelstone the adders' tongue and mountain speedwell; in Ashleigh Combe, thelypteris; in Aisholt wood the white foxglove, white herb Robert, and white prunella; while under the famous hollies of Alfoxden, sacred to the memory of "Peter Bell" and "We are Seven," grow the graceful millet grass and a rare variety of the bramble.

On the St. Audries slope the changed soil and the influence of the sea give birth to several new plants. The autumn gentian, the tufted centaury, the round-headed garlic, and the sea starwort are abundant near the cliffs; the perfoliate yellow wort is common; fluellen grows in the stubbles, the lady's tresses near the lime-kiln, the sea pimpernell between the stones, the arrow-grass and hard-grass just above the sea, to which we descend between banks covered, as no other banks are covered, by the magnificent large flowered tutsan.

A few rare plants remain, which come under neither of the groups described. The Cornish money-wort abounds in a small nameless combe near Quantockshead; the rare white stonecrop is indigenous or naturalised at Over Stowey; the white climbing corydalis is found close to Mr. Esdaile's lodge; the lady's mantle, goldilocks, and bistort grow in the Aisholt meadows; the stinking groundsel hard by the remains of Coleridge's holly-bower. In the same neighbourhood I have twice found the purple broomrape; and Wilson's filmy-fern, one of the rarest of British ferns, is established in the Poet's Glen.

I venture to hope that there is no one present to whom this catalogue of plants is a catalogue and nothing more. Our English wildflowers are so charming in themselves, they awake in all of us so many associations, they hold so large a place in our poetical literature, their popular names reveal so many an etymological secret and recall so many a striking superstition, that almost every one, whatever be the line of his mental culture, is willing to own their interest and to linger over their recital. To the Shakspearian scholar they bring memories of Perdita at the shearing-feast, of Ophelia in her madness, of Imogen sung to her untimely grave, of the grey discrowned head of Lear, with its chaplet of "rank fumiters and furrow-weeds." The lover of Milton points to the "rathe primrose," the eye-purging euphrasy, and the amaranth, which was twined in the crowns of worshipping archangels. The historian of the long-buried past sees in the Cornish money-wort, the filmy-fern, and the Lusitanian butterwort of our hills evidence distinct and graphic of the time when Scotland, Ireland, and Spain formed with our own peninsula portions of a single continent. The student of folk-lore tells his tales of the ceremonies which surrounded the vervain, the St. John's-wort, and the rowan, and of the strange beliefs which clung to the celandine, the hawkweed, and the fumitory. The etymologist will elevate the names familiar to us all into records of the origin and habits of our remote forefathers; he will disinter the fragments of myth and history which lie embalmed in the centaury, the pæony, the carline thistle, the flower-de-luce, and the herb Robert; he will tell us how the laburnum closes its petals nightly like a tired labourer, how the campion crowned the champions of the tournament, how the foxglove, the troll-flower, and the pixie-stool, bring messages from fairy land; how the scabious, the lungwort, the scrophularia, and the wound-wort, bear witness to the grotesque beliefs of a pre-scientific medical community. Of the botanist I need not speak. Not a flower that blows but will furnish him with the text of an eloquent discourse. Forms that yield to other men artistic and sensuous enjoyment only, lay bare before him secrets of structure and of function as wonderful as those which characterise his own bodily frame; suggesting each its truth of design, and natural selection, and adapted change, and mysterious organic force. In the fructification of the orchid, the stamens of the barberry, the hairs of the nettle, the leaf of the sundew, he reads lessons as profound and similes as graceful, as were taught to Chaucer, and Southey, and Wordsworth, by the daisy, and the holly, and the lesser celandine. Year after year he greets the early spring with an enthusiasm which his neighbours know not, as one by one his friends of many years, the snowdrop, and the violet, and the crimson hazel stigma, and the stitch-wort, and the daffodil, and the coltsfoot, come back to him like swallows from their winter sojourn out of sight. Year after year, as the seasons die away and the earth is once more bare, he looks back delighted on the pleasant months along which he has walked hand in hand with Nature; for he feels that his intelligence has been strengthened, his temper sweetened, and his love of God increased, by fellowship with her changes, study of her secrets, and reverence for her works.]

W. TUCKWELL

INSECT METAMORPHOSIS *

II.

MANY naturalists of eminence have insisted so strongly upon the connection of the growth of wings and metamorphosis, that I shall now proceed to examine into this part of the subject. These beautiful organs of flight, so elegant in their outlines, so exquisite in the artistic blending of their colours, so marvellous in their minute construction, are popularly associated with the perfection of insect life. A suspicion of their existence arises when the curious swathings of a pupa are examined; but it requires the patience of a Landois to trace these future glories of a butterfly within the chest of the caterpillar but lately escaped from the egg.

But in considering the relation of growth to metamorphosis, it must be remembered that some insects have no wings, and yet undergo metamorphosis, and that others possess organs of flight, and yet only submit to skin-shedding.

In describing the general form of the body of the larva, it was noticed that the openings for the passage inwards of the air tubes were visible on either side of each segment. The openings, or stigmata as they are called, of the second and fifth segments of the larva, whose structures have been already described in part, are very distinct, and they lead to large air-tubes which branch off in all directions, and especially send a twig backwards and forwards along the inside of the third and fourth segments respectively.

The openings, or stigmata, of the third and fourth segments, on the contrary, are blind ones, and do not lead to tracheæ or air-tubes; but the delicate offshoots of the second and fifth masses of air tubes pass inside close to them, and it is on these that the wings are developed as new organs, as new structures fashioned out of the protoplasm of the blood. The wings are

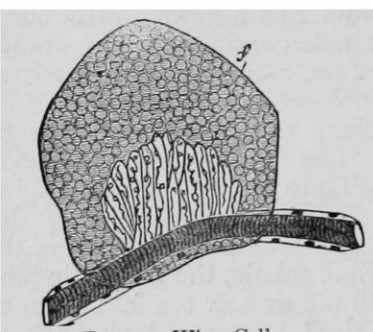

FIG. 7.—Wing-Cells

acquired, and are added to the bulk of the belongings of the larva. They continue to grow and to be perfected during the whole of the life of the insect, until their function is called into action. They originate after the escape from the egg; but the structures, upon the consideration of which so much time has been spent this evening, originated during the embryonic or egg condition, and clearly do not advance through long stages of inutility and imperfection to one of use and perfect adaptation.

The first indication of the wing is observable in a caterpillar four millimetres in length, and one day after birth from the egg. The whole of the air-tubes are at that time as they are at all others covered by a very delicate layer of cells, which separates them, in fact, from the other tissues or blood, as the case may be, and with which they are in contact. Some flat and very small five-sided projections of delicate tissue are seen upon the fine air tubes running along the inside of the third and fourth segments.

There are four of these, two on either side, and the hinder are smaller, but are close to the front pair. In this stage they are composed of simple cells placed side by side to form the expansion of the tissue, and they rest upon and cannot be separated artificially or microscopically from the fine layer of cells which intervenes between their bases and the air-tubes. The tissues and cells of the air tubes remain intact, but these additional structures are fixed upon them, and are destined for a very different series of developments.

When the caterpillar has changed its skin for the first time, the expansions have increased in size and in complexity of structure. Each expansion is found to consist of a structureless, flat, pentagonal bag, which is very thin, and to contain a well-marked layer of globular cells of nearly equal sizes. Moreover, at the base of the expansion, where it rests on the cellular layer of the air-tube, a crowded group of elongated cells is observed resting on this layer, and situated amongst the globular cells and within the structureless expansion.

These elongated club-shaped cells are sometimes fusiform, and contain a structureless liquid, and attached within their equally structureless walls is a nucleus and its contents. They did not exist before the skin-shedding, but are readily observed subsequently to it. The expansions of this tissue consist of the three histological elements just noticed, and out of them the future wings are gradually developed.

After the second skin-shedding of the caterpillar, the expansions are found to have increased slightly in size; and a careful microscopical examination detects an excessively delicate and twisted cylindrical tube within each of the long cells which are situated at the base of the expansion, and which would be in contact with the air-tube, were it not for its investing cellular layer. The nucleus of the elongated cell has been absorbed, and its walls look thinner, and their tissues appear to have been observed to contribute to the twisted-looking thread which floats in the liquid contents. It is evident that this thread-like tube is connected through the cellular layer with the interior of the air-tube, but it is at present a simple tubular expansion of plain structureless membrane, and does not contain air.

Alterations progress in the developing wings during the interval between the third and fourth skin-sheddings, and they be-

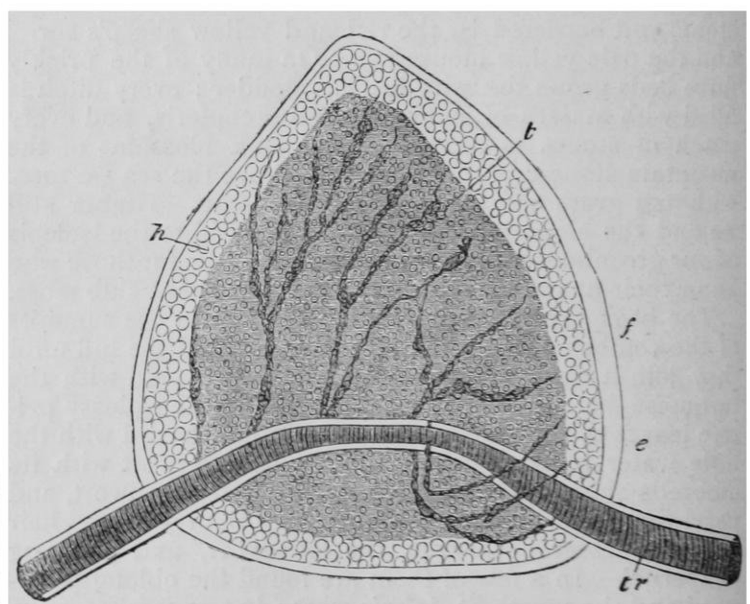

FIG. 8.—Advanced Wing Development.

come sufficiently large as to be seen with the naked eye, for they have attained nearly one-tenth of the length of the whole caterpillar. The globular cells within the structureless membrane are found to have increased in size, and the delicate tubes of the elongated cells to have increased in length and numbers. The cell wall and nucleus are lost to sight in some instances, and the twisted tubular connection of the undermining air-tube may be observed to have passed here and there amongst the globular cells. At this time these tubes take on the appearance of air-tubes, and the delicate circular fibre which is seen in the other air tubes of the caterpillar is to be recognised.

The next stage appears to bring about an increase in the number, length, and size of these coils of air-tubes within the bag-like wing, and in the dimensions of the bag, but not of its contained globular cells.

By the time that the caterpillar leaves off taking food and begins to attach itself by its tail end, preparatory to skin-shedding for the last time, considerable progress has been made in the development of the wings. The cord-like air-tubes have grown sufficiently to reach nearly to the top of the wing, and they branch off in several directions. They contain air, and are surrounded by the layer of globular cells, but they are closer to the under side of the wing bag than to the upper. Moreover, the wing bag, so structureless hitherto, has acquired on its outside a glistening surface of extremely delicate cells, which is called epidermis. Beneath this coating is the main thickness of

* A Lecture delivered before the British Association, 1872, by Prof. Duncan, F.R.S., continued from p. 34.

the bag, and it is now found to be composed of large cells placed side by side. Within it are the globular cells and the cord-like branching air-tubes. By this time the wings which are visible on the 3rd and 4th segments have approached the inside of the skin of the caterpillar, and when this begins to separate before being cast, a glutinous secretion covers them with the whole body.

The structure of the wings immediately before this period recalls that of the membranous expansions with which aquatic insects are furnished, with the aid of which they breathe and move more or less rapidly under water. But the changes on the whole of the wing which occur at this time, and during the four or five early days of pupal life, soon make these organs complicated. The changes are, however, part of a progressive development. The wing veins, or nervures, without which the wings would be flaccid and useless, are formed irrespectively of the structures already described. Their path within the wings has been marked out by the coil-like air-tubes, but they are formed out of the protoplasmic matter which exists amongst the layers of globular cells, and are elastic cords surrounded by a cellular layer. Whilst they are developing, one or two wide air-tubes degenerate, and finally disappear. The veins of the wing are attached to the lower surface of the expansion so frequently alluded to, and they grow with the increasing area of the organs, so that during the early days of the pupa the wing consists of an expanded wing membrane, which is cellular, and which contains wing veins and large air-tubes, intermingled with a great number of globular cells.

The beautiful microscopic scales of the wing begin to be formed as soon as the glutinous case of the pupa is hardened, for air soon passes between it and the delicate skin and members beneath. By the fifth day all the wings are covered with recognisable scales and hair, and then for a certain time, depending upon temperature and the habit of the species, growth is arrested, and things remain *in statu quo*. When the time comes for emergence from the pupa case, the imago within awakens, as it were, from a long hybernation, and after splitting its case it comes forth a moist, weakly thing, with its wings crumpled upon its sides, wet and unable to move. The sunshine, the dry air, and the forcing in of air on the part of the insect into the large air-tubes of the wing, enable those organs to unfold, to increase in area, to become dry, and at last to be of use.

It has, I trust, been made evident that the wings are progressively developed, and that they grow from simple protoplasms into all their beauty and complexity of form during the stages after the escape from the egg.

They are acquired organs; they are given to the insect during its progress of change. Like the metamorphoses, they are superadded to the original condition of the embryo or the young within the egg. They are characteristic, to a great extent, of metamorphosis, and thus the notion that the organs and these states of change were both acquired and superadded is worthy consideration.

It now becomes necessary to inquire into the kinds of changes which insects submit to during their evolution after birth. There are perfect or complete, incomplete and retrograde metamorphoses, and some insects do not change their structures and habits at all

The cabbage butterfly and the false wasp afford examples of perfect or complete metamorphosis, the completeness consisting in the succession of an active larva, an immobile pupa, and an active imago with different habits to the larva. There is a variety of this kind which is of some importance, and it may be termed imperfect-complete metamorphosis. The silkworm is a good example of this variety, and the organs of its mouth are imperfectly developed. Such is also the case in many moths and insects which do not take food of any kind.

Incomplete metamorphoses are observed in those insects which have three stages of activity—active larvæ, pupæ which move and are then called nymphs, and active imagos.

The common gnat undergoes incomplete metamorphosis, and the dragon fly, which belongs to a different class, also. The gnats skim over the surface of stagnant water and collect their eggs together as they are laid one by one in a little boat-shaped mass, the whole being covered with a gummy coating. This floats, and the larva are hatched very soon from the under side. They commence a life of predacious activity, and undergo skin-sheddings. After one of these the insect comes forth, differing in shape from the larvæ. It swims with the aid of two large lamellæ, something like a fish-tail, and when it requires air it presents its back on the top of the water, and not its tail, as the larva did. This is because there has been an alteration in the disposition of the main respiratory tubes. These active pupæ, or nymphs, cannot eat or drink, and after swimming for some days they come permanently to the surface. Then the last stage of metamorphosis succeeds, and the tiny gnat escapes without wetting its delicate wings, and to pursue a life which is well known to you.

The nymph of the dragon-fly greatly resembles the larva, and it seizes prey in the water and devours it. When the time is come for the change into the fly the nymph crawls out of its element on to a leaf, its skin splits on the back, and the sanguinary and active dragon-fly comes forth.

In these instances there is not that distinction in habit and instinct which prevail amongst the insects gifted with perfect and complete metamorphosis.

Retrograde metamorphosis is a doubtful expression of some interesting facts. Sometimes a larva leads an active life, and is elaborately and perfectly formed; it changes into an immobile chrysalis, and then the imago comes forth not only with defective organs of mastication and motion, but also with indifferent legs and scarcely a vestige of wings. Or both wings and legs may be wanting, and there is not much resemblance to an insect left.

Thus the pretty caterpillar, which may still be found about geraniums, and which looks like a harlequin from its curious tufts of different-coloured hair, belongs to the vapourer moth. It is a perfect larva, and very active. The chrysalis, or pupa, is, like those of other moths, immobile and swathed. Two kinds of moths escape—the males, which are pretty and perfect moths, with elegant wings and great powers of fidgetty flight; and the females, which are ugly brown bags with small legs, scarcely a vestige of wing, and incomplete mouths. They are very unlike the male, and really have not the same activity, energy, power of locomotion, or complexity of structure as their larva.

Another species belonging to the genus Psyche has very pretty male moths, but the female has no wings, legs, or feelers, and looks like a helpless egg-bag. She never quits a curious case made up of parts of flowers, in which the caterpillar and the pupa lived.

It is quite clear that in these insects there is no progressive development from first to last in their metamorphosis.

Insects which do not undergo any metamorphosis are by no means uncommon, but they all submit to the skin shedding. Such insects are hatched from the egg, in shape and habit much resembling the adult or full-grown individual. A considerable number of the Orthoptera—insects which fold up their wings longwise, of which the earwig, the cricket, and the grasshopper may be considered as representatives—do not undergo the change in form and habit which is so characteristic of most of the Insecta. What alterations do occur are the progressive development of wings and of the reproductive organs and skin shedding. Most of the Orthoptera moult or change their skins repeatedly, some as many as three times, and still they do not alter in form; a fourth skin shedding finds others with rudimentary wings, which are small, crumpled, and visible. The fifth moult exhibits the insects with perfect wings and full-grown. There is no period of inactivity, and the insect pursues the same habits throughout its lifetime. Its tissues are not subjected to such changes as in those described.

Some few but very important and interesting kinds moult only three times, and never have wings; and others, which only moult four times, never have these organs in perfection.

To conclude this short review of the kinds of and exceptions to metamorphoses, it must be brought before your recollection that the unpleasant louse, the curious fish scale, and the podura, or skiptail, do not undergo metamorphoses, and that their skin sheddings are not attended by the development of wings.

Not only are there these varieties of change of structure and habits, but there are modifications of each of them which relate to the time and season at which metamorphosis takes place, and the duration of its stages.

The next step in the inquiry as to the meaning of all these changes in the philosophy of insect life, is to determine whether insects which resemble each other have the same kind of metamorphosis—in other words, whether identity of metamorphosis accompanies similarity of construction. Are the great groups into which the vast class of Insecta is divided by a natural classification, capable of being equally well and meaningly classified by the similarity or dissimilarity of their particular methods of change of structure and habit. The answer must be that, generally speaking, some of the groups which are widely separated by dissimilarity of structure, possess the same kind of metamorphosis, and that some groups which resemble each other more than others have not the same kind of changes.

It is impossible to classify the groups by their kinds of changes of structure and habit without outraging the first principles of a natural classification.

The next step in this inquiry is to decide whether all the members of any of the great groups are metamorphosed in the same manner, and whether there are any genera or species belonging to one group which are exceptional in their method of change, and which possess that common to the bulk of the insects of another group.

The answers are as follow :—

All the members of any great group are not subject to the same kind of change, but those of some very small families are ; and some genera undergo a metamorphosis totally unlike their closest allies in a group.

There is a very good example of the difference in the mode of metamorphosis in some of the great groups, and of its evident independence of structural affinity or likeness to be gleaned by comparing the Orthoptera, the Coleoptera, and the Lepidoptera —the grasshopper, beetle, and butterfly tribes respectively.

There is a greater resemblance in structure and general arrangement of parts between the Orthoptera and the Coleoptera than between the Coleoptera and the Lepidoptera ; yet the Coleoptera resemble the Lepidoptera in possessing complete metamorphoses, whilst those of the Orthoptera are incomplete or absent altogether. Again, many families of the great groups have genera whose species are influenced by very wide modifications of the same kind of change. Thus amongst a family of the Lepidoptera one kind passes through a perfect change like that already described. A closely-allied moth will pass through the change twice in the year ; and in one the egg will remain unhatched through the winter ; in another the pupa will last through the autumn, winter, and spring ; in a third a perfect insect will hybernate through the water ; in a fourth a caterpillar will be born, will feed and increase in size, but will not turn to a pupa at once. It will hide up and hybernate for months, and will be metamorphosed in the early spring. In a fifth a caterpillar will crawl from the egg in August, and will not eat ; but it hides up and hybernates until the early summer, when it crawls forth and eats and passes through a perfect metamorphosis. All these modifications, so irrespective of seasons, may be noticed in closely-allied genera. The lace-wing family, or the Neuroptera, are a very natural group, and their separation from other forms, on account of the general dissimilarity of construction, is as perfect as any classification will permit. In this family all the kinds of metamorphosis are to be noticed. Some genera, like the dragon-flies, undergo incomplete metamorphoses, and have active nymphs, which do not differ much from the larva ; whilst others, like the scorpion-flies and the caddis-flies, are subjected to changes as perfect as those of a butterfly or moth, although their structures are very diverse.

Seeing, then, that insects which so closely resemble each other as to be placed as allies in every classification that follows the order and system of Nature have to undergo different kinds of change of structure and habit, it becomes necessary to admit that the original structures of a species assumed their form according to a law which did not regulate the metamorphoses. These have no relation with the origin of the species, and are independent of the anatomy of the individual. Like the structures of the wings, the stages of the metamorphosis are acquired and superadded. It is credible enough that these wonderful and various changes are for the benefit of the creatures undergoing them ; and doubtless there has been in every instance a mysterious relation between these and external physical conditions at some period or other. The metamorphoses are for the protection and preservation of the species, and may be esteemed extraordinary aids in the struggle for existence. The fact of there being Insecta which do not undergo metamorphoses, but only the skin sheddings which are common to certain Arachnida, Myriopeda, and Crustacea, - all the Articulata, is very important in studying the philosophy of this knotty subject ; so also is the fact that the orders of Insecta which contain both these non-changing forms, and others which have a very incomplete metamorphosis, are of vast geological age. Probably these Neuroptera and Orthoptera were the first insects- certainly they were amongst the oldest. These considerations must be associated with the method of development of wings—those acquired organs which are, nevertheless, not present in some non-metamorphosing Insecta.

The most convenient hypothesis by which the origin of metamorphosis may be explained, and that which appears to be most consonant with facts, is to be comprehended under the following heads :—1. The insecta have a great geological age. 2. The earliest did not undergo metamorphoses, but simply shed their skins. 3. The first forms were wingless Neuroptera or Orthoptera. 4. That in order to meet the influence of changes in external physical conditions during the evolution of varieties of the original forms, the metamorphoses were acquired. 5. Incomplete metamorphoses preceded the complete. 6. Organs of flight were acquired independently of metamorphosis. 7. The kind of metamorphosis depended upon peculiarities in the external conditions, and its determination was defined by law.

If the phenomena of metamorphosis and the growth of wings have been acquired, and were not implanted in the original species to follow at once and inevitably, there should happen, and there ought to happen—according to the analogy of nature —instances where the part or the whole of the acquisition is absent.

The degraded and almost wingless vapourer moth, the wingless Psyche, the wingless condition of the female of the winter moth, and the useless wings of Climatobid, must have arisen, not by disuse, but by reversion to the ancestral condition. Why should the gall-flies that affect the roots of the oak have no wings, and those which make galls on the branches have them only in the male, whilst the makers of the corresponding structures on the leaf are perfect in their wings and metamorphosis ? The idea of disuse will not apply ; and certainly the wingless would enjoy wings and make them useful. They are reversions to the ancestral type. There is a little false wasp called Metilla : it belongs to a tribe eminently characterised by advanced instincts, and rapidity and power of variation of flight ; yet the female is wingless, and low in its instincts. The wings would be useful to the insect, and the males of an Australian species certainly think so, for they carry their wingless ladies about with them under great difficulties. It is, like the others, an instance of reversion. On the other hand, the acquirement of the gift of imperfect metamorphosis may have been followed by that of the complete kind, and then to that of the elaborate and apparently enigmatical changes undergone by some parasites, may have been superadded.

Habits and instinct which change contemporaneously with the structural metamorphoses were doubtless acquired and are handed down, generation after generation, in obedience to the law of the descent and inheritance of useful gifts. Wonderful as the acquisition is of certain mental powers at certain periods in such humble things as insects, still it must be remembered that man inherits mental peculiarities, which become evident at different successive times of his life. A boy inherits mental peculiarities which characterised the youth of his parents, and others become evident in his adult age, which peculiarised his father or mother at the same period. How, is beyond the question and the fact is enough.

Sometimes, by examining the instincts of a group of closely allied species of insects, and by noticing and comparing slight differences in their habits and metamorphoses, a hint may be obtained how some very recondite peculiarity may have been acquired and been transmitted, provided it were beneficial to the creature. The most interesting instincts of the Odynerus which were mentioned at the commencement of this lecture, were the forming a tubular antechamber and provisioning the chambers with stung grubs for an offspring which it never saw. A considerable group of mining false wasps make or excavate chambers to lay their eggs in, and they, one and all, are in constant terror lest some interloper or parasite should enter their underground workings, during their absence in search of food for the future offspring. On arriving with the stung larva at the mouth of their hole, which is closed up carefully by some before flying off, they enter and run into the chambers in a great state of excitement to see that the nursery is not taken possession of by an intruder who intends to stop. So impressed is this instinct upon them that, if the prey which is left outside during the rapid inspection be removed a little way off, when it is replaced by the insect the process of examination is repeated, and the insect will do this over and over again, senselessly it is true, but in obedience to an inherited and almost automatic impulse.

There is no doubt that a great number of futile egg layings and provisionings occur amongst those tribes on account of the entry of parasitic insects who devour everything. So that an additional instinctive act which could produce any alteration in the shape or arrangement of the tunnel and chamber-making, which would benefit and tend to preserve the future larva, would assuredly be perpetuated by descending to subsequent generations. The ante-chamber of Odynerus meets every difficulty and want. Its fragile nature will not permit the intruder to pass along without breaking it down and covering the hole in the tunnel, and when it is broken down by the dying insect it effectually closes up the scene of its labour and hides the offspring from harm. The only satisfactory hint which can be gleaned respecting the origin of the provisioning of chambers in which an egg is left, is obtained by Fabre's study of the habits of *Bembix vidua*. This mining wasp lays an egg which hatches very shortly, and the little mother visits its living offspring every day and brings it small larvæ, stung to keep them quiet at first, and then larger larvæ as the little cannibal increases in size. All this time the Bembix is a vegetarian, but she is known to sip the honey which may be on some of her victims.

The instinct of a Bembix may have been altered by its eggs not hatching, and a series of victims may have been placed in the chamber automatically, instinctively, and without what is called reason. There is of course the possibility of memory existing during the quiescent stage. Does the butterfly remember its existence as a gormandising caterpillar, and therefore retain some notion of the propriety of laying eggs over cabbages? Does the Odynerus fly remember its underground life, and obey some impulse to provide the unseen offspring with food different to that which she loves? It is possible; and as nothing is too wonderful for psychologists, there may be something in the suggestion.

It is evident that the influence of external conditions which are antagonistic to the comfort and well-being of many insects is often neutralised by a happy and protective contemporaneous change of form and habit. On the contrary, as in the instance of larvæ which hybernate and do not turn into pupæ before severe weather sets in, or in the case of hybernating butterflies, all connection between existing external conditions and the time and nature of the metamorphosis is often indistinguishable. But this apparent anomaly may be explained when it is remembered how long-lived many species and genera of insects are, how persistent some forms have been through considerable geological periods, and to what numerous changes of climate they may have been exposed during forced emigration, or even whilst being on the same area. The commingling of several insect faunas which must have occurred over and over again during the later geological period of the world's history, will quite account for closely allied forms presenting modifications of the general kind of change of structure and habit.

All the relations of the metamorphoses to changes in the inorganic kingdom of nature, *i.e.*, to alterations in the external physical conditions surrounding insect forms, is doubtless within the scope of law. The insect host is innumerable, and the variations in external physical conditions must have been repeated during vast ages; yet the kinds of metamorphoses and their modifications are few in number and are singularly pronounced.

NOTES

A VERY large number of noblemen and gentlemen, members of the Society of Arts, have signed a memorial to Her Majesty's Government, in which, after referring to the great benefit conferred by the opening of the Bethnal Green Museum, and the immense number of people (upwards of 700,000) who have visited it in three months, they "submit that this museum could never have come into useful existence, and have been instrumental in conferring these benefits on the people, without the aid of Parliament; and they desire to press this fact upon the consideration of Her Majesty's Government, with the hope that they will submit to Parliament the policy so essentially national of voting increased means to facilitate the establishment of museums, libraries, and galleries of Science and Art in large centres of population, wherever such localities are willing to bear their share in the cost."

THE list of candidates for the Mathematical School at the University of Oxford numbers 132, against 206 in the Classical. Of these, 14 are candidates in honours. In the Natural Science School there are eight candidates for the Final Examination, all in honours.

AT a meeting of the Arts School at Cambridge this week, a discussion arose on the report of the Museums and Lecture Rooms Syndicate, recommending the erection of additional accommodation for students in physiology and comparative anatomy. Mr. J. W. Clark and Prof. Humphry warmly advocated the adoption of the report, the latter remarking that the sum was small, compared with that expended at Leipsic, Amsterdam, and other parts of Europe. No decision appears to have been arrived at.

AN anonymous friend has just given to the Council of the Midland Institute the large sum of 2,500*l.*, to be expended in scholarships for encouragement of the study of practical physiology, more especially that branch of it which is concerned in the amelioration of the sanitary condition of the poor. This noble gift is prompted by remarks which were made by Canon Kingsley in his opening address to the Midland Institute.

THE *Academy* announces the recent death, at Göttingen, of the great mathematician Klebsch, at the age of forty.

A LARGE number of eminent physicians, chemists, and others belonging to various countries in Europe, have formed themselves into a union for the laudable purpose of constructing a general European Pharmacopœia. At the meeting of the Pharmaceutical Society, on November 6, Dr. Thudichum gave an interesting address on the subject, in which he showed that during the last 200 years many men had tried to realise the idea of a general pharmacopœia; but as these attempts were mostly made by single individuals, each of whom endeavoured to carry out his own idea in his own way, failure was necessarily the result. It is likely that the present co-operative attempt will be more successful.

M. BABINET, of the French Academy, whose death we recently chronicled, was born at Lusignan in 1794, educated at Metz, and entered the Artillery, which he quitted in 1815. After having been Professor of Physics in the College of Fontenay-le-Comte, and afterwards at Poictiers, he went to Paris in 1820, to occupy a chair of Physics in the College St. Louis. Until 1864 he was also Examiner to l'École Polytechnique in Physics, Descriptive Geometry, Applied Analysis, and Geodesy. His lectures at the Athenæum on Meteorology did much to foster a taste for the study of atmospheric phenomena. He was elected to the Academy in 1840 in the section of Physics. Previous to this he had distinguished himself in various ways, having done much to perfect the pneumatic machine, for which the Academy awarded him a prize. Besides this, he invented a goniometer, which bears his name, and in many memoirs recorded his optical experiments and researches, besides doing much to popularise scientific studies. The best of what he has written is collected in his "Études et Lectures sur les Sciences d'Observation."

TWO very interesting letters on Arctic Exploration appear in the *Times* of Tuesday last. Capt. J. C. Wells writes that he met Prof. Nordenskiöld's expedition when returning in Mr. Smith's schooner yacht *Samson* from a cruise to the north of Spitzbergen. The arrangements appeared very perfect, but the vessels were in no way fitted to contend with the ice. Captain Wells is of opinion that the North Pole may be reached during the summer months. The vessel should leave England in April, to enable her to arrive at the edge of the pack beyond Spitzbergen early enough to take advantage of the breaking of the ice from the edge of the main pack. Her return might be looked for in October of the same year. "At the present time," he adds, "Austria, Germany, Sweden, France, Russia, and even Italy, are in the field, striving, either by actual exploration or by tentative efforts, to form expeditions to reach the North Pole, simply for the advancement of science, while England alone remains inactive." Mr. B. Leigh Smith also writes that he met with the expedition inside the Norway Islands near Hakluyt's headland, on August 29. He believes they have made themselves comfortable for the winter months, somewhere on the north coast of Spitzbergen, and that no vessel has any chance of reaching them now.

PROF. CORFIELD has been elected Medical Officer of Health to the parish of St. George, Hanover Square. Dr. Corfield's appointment will make a vacancy in the Officership of Health to the parish of St. Mary, Islington. Mr. Haviland and Dr. Tidy will, we understand, again contest that appointment.

WE learn from the *Medical Times and Gazette* that there will be a vacancy for a Demonstrator of Anatomy in the Charing Cross School of Medicine. A salary of 150*l* is attached to the office. Among the candidates is, we understand, Dr. Murie, late prosector to the Zoological Society.

FROM the same journal we learn that the Chair of Medicine at the Royal College of Surgeons, Ireland, is now vacant through the resignation of Dr. Charles Benson, who had so long and ably discharged the duties connected with it. We learn that several candidates have already entered the field, and that the selection of a professor will take place early in December. Among the candidates are Dr. Samuel Gordon, Dr. James Little, Dr. Henry Kennedy, and Dr. Arthur Wynne Foot. The emoluments are about 150*l*. per annum.

THE French Government has lately struck a medal in commemoration of the discovery in 1868 by Dr. Janssen and Mr. J. N. Lockyer of the method of observing the sun's chromosphere without an eclipse. The medal bears on the obverse the portraits of Dr. Janssen and Mr. Lockyer, and on the reverse the chariot of the Sun, with Phœbus indicating the prominences round an uneclipsed sun.

MR. GLADSTONE and Mr. Darwin having declined the Lord Rectorship of Aberdeen University, about to be vacated by Mr. Grant Duff, M.P., the contest lies between Prof. Huxley and the Marquis of Huntley, the Arts students mostly preferring the latter, and the medical students the former.

PROF. SPALTH has been elected Rector of the University of Vienna.

THE Natural History Mastership at Clifton College is now vacant, through the appointment of Mr. Barrington Ward to an Inspectorship of Schools. The teaching of Botany, Geology, and Physical Geography, and the elementary teaching of Mathematics, are comprised within the duties of the office, as well as the Curatorship of the Museum and Botanical Garden.

IF anyone desires to know how lecturing, and especially scientific lecturing, is managed and rewarded in America, let him (or her) forthwith obtain "The American Literary Magazine and Lecture Season," published at the "American Literary Bureau." Here he will find the names of lecturers willing to lecture on all conceivable subjects, with the fees they are prepared to charge, varying from 50 to 250 dollars per lecture; while one lecturer, Mr. Froude, stands alone in his glory, priceless. The accuracy of this appraisement of talent is however somewhat marred when we read further that "to *some of the above* traveling and hotel expenses are added," while "terms may be modified for weak organisations and deserving charities." The managers of the bureau frankly announce that "a lyceum course must be pushed like any other business," while they give the managers of these institutions the valuable advice to "ignore all party or sectarian bias and choose brains." On the principle of "catching your hare," they therefore furnish the lyceums with eighty pages of choice of lecturers and subjects, advising them to pursue the plan of ranging "from gay to grave, from lively to severe," and give their patrons "at least one concert, one reader, one scientific lecture (not too heavy), and one humorous lecture." Dr. G. P. Quackenbos, in "Words considered humorously, and otherwise," an extensive programme, is undeniably cheap at $100; while Mr. Waterhouse Hawkins nicely values his repertoire of subjects from "The Age of Dragons" to "The Unity of Plan" of the animal kingdom, at from $100 to $112. Dr. Youmans will lecture on "English Institutions as Educational Hindrances" for from $100 to $125. Generals, Reverends, and ladies, are evidently the favourites of American audiences. Who will not go to the bureau where they can have a choice of Prof. Fisk on "Darwinism" for $100, and Miss Kate Stanton on "Whom to Marry" for $50? Although this may appear ludicrous enough to English ears, yet it has its serious and undoubtedly useful side. Some similar plan of providing unity of action and of organisation among English scientific lecturers would be of very great value. Will the scheme now under consideration of the British Association effect this?

THE following is from the *School Board Chronicle*:—"Ten years ago the Federal Polytechnicon of Switzerland received from unknown hands a legacy of 50,000 francs, accompanied by an enclosed envelope, which, according to the testator's injunctions, was not to be opened until ten years afterwards. The time having now elapsed, the envelope was found to contain the name 'Johannes Schoch, citizen of Fischental.' The testator had formerly migrated to Milan, and there, by his judgment and industry, acquired a large fortune. The object of the donation was to secure competent teachers for the Polytechnic School."

THE Royal Institute of Science, Literature, and Arts, in Venice, offers a medal of the value of 3,000 francs (120*l*.), to be awarded in 1874 to the author of the best essay on the following subject:—"The advantages derived by the medical sciences, especially physiology and pathology, from modern discoveries in physics and chemistry; with a retrospective view of the systems which prevailed in medicine in past times." The competition is open to foreigners, and the essays may be written in French.

A PRELIMINARY meeting for the purpose of forming a Medical Microscopical Society, which has been talked of for some time, was held on November 1, at St. Bartholomew's Hospital. A good deal of discussion ensued on the proposed society, and delegates from the various hospitals were appointed as a committee.

THE family of the late Prof. Sir James Y. Simpson have presented a bust of the distinguished physician to the University of Edinburgh. It has been placed in the library hall.

WE understand, says the *British Medical Journal*, that the medical students of the University of Aberdeen propose to issue a medical journal, which shall appear once a fortnight. Three advanced students will act as editors. It bears the name of the *Aberdeen Medical Student*. The undertaking shows very gratifying vigour in the Aberdeen school. We wish the promoters of the journal every success.

THE same journal informs us that the new Professorship of Comparative Anatomy at the University of Dublin will have an endowment of 300*l*. or 400*l*. a year. The first holder will, we believe, undoubtedly be Dr. A. Macalister, Professor of Zoology; and in future the two chairs will go together, with an endowment, jointly, of 600*l*. or 700*l*. a year. Practically, the election may be considered as virtually decided. Trinity College will have in future two Professors of Anatomy—viz.: 1. Pure Anatomy, Human and Comparative; 2. Mixed Anatomy, or Medical and Surgical Anatomy. They will each have an income of 700*l*. Both professors must attend two hours daily in the dissecting-room.

We learn from *Harper's Weekly* that the Hon. James Knox, of Knoxville, Illinois, U.S., now in Berlin, has presented Hamilton College, U.S., with 10,000 dollars for the improvement and endowment of its hall of natural history.

The following is from the *British Medical Journal*:—"Two Russian ladies, Misses Olga Stoff and Sophie Hasse, have employed themselves during the autumn recess in investigating the circulation in the spleen, by means of injection and microscopic examination. Their researches, which were made on the spleens of frogs, pigeons, rabbits, mice, rats, and various other animals, as well as of the human subject, were carried on in Dr. Frey's laboratory. They have published an account of their examination and its results in the *Centralblatt* for Nov. 9."

A memorial portrait of the late Rear-Admiral Sir James Ross, the great explorer, subscribed for by several naval officers and men of science, has recently been placed in the Painted Hall of the Royal Hospital, Greenwich. What Sir James Ross did for North Polar exploration is well known.

The 119th session of the Society of Arts commenced yesterday evening, when the opening address was given by Major-General F. Eardley-Wilmot, F.R.S., Chairman of the Council.

The first course of the Cantor Lectures for the ensuing season will be on "The Practical Application of Optics to the Arts, Manufactures, and to Medicine," by C. Meymott Tidy, M.B., Joint Lecturer in Chemistry and Professor of Medical Jurisprudence at the London Hospital, and will consist of five lectures, to be delivered on the evenings of Nov. 25, Dec. 2, 9, 16, and 23. A second course will be given during the session by the Rev. Arthur Rigg, M.A., "On the Energies of Gravity, Electricity, Vitality, Light, and Heat, especially with reference to their measurement and utilisation."

The winter course of lectures at the Museum of Science and Art, Edinburgh, commenced on the evening of Nov. 18, with the first of a series on "Chemistry," by Prof. Crum Brown. An interesting programme has been arranged, including, among other items, six lectures by Prof. Geikie on the "Superficial Formations of Scotland," and as many on "Sound" by Prof. Tait.

According to the latest bulletin from Regent's Park, young Hippo, whose birth we chronicled a fortnight ago, and who is now sixteen days old, is thriving famously, being plump and well-developed, standing firmly on his legs, trotting briskly about after his stupendous mama, and imitating all her actions. It is to be hoped that the admirable precautions taken by those in charge will be successful in preserving the life of the little stranger till it can take care of itself.

The following is from the *Athenæum*:—"The Maharajah of Cashmere is desirous of having several scientific works translated from the English into the Sanscrit language; and as he understands that there are many able scholars in England and Germany, he has placed the matter in the hands of Col. Nassau Lees, who is to select competent persons for the work. His Highness has had some works already translated in Calcutta. He has requested that, as the first instalment of the European series of translations, Prof. Liebig's work on Chemistry, or some other standard work on the same subject, should be one of the works translated. An undertaking of this sort ought to prove most useful."

It is understood that Dr. Schweinfurth, the eminent German geographer, is about to return to Central Africa with a view of continuing his explorations, especially in the line of botany. His brother, a merchant at Riga, has contributed a large sum of money, the interest of which is to be used by Dr. Schweinfurth in his present undertaking; the principal afterwards to be given to the Polytechnic School at Riga to found a prize to defray the travelling expenses of such explorers in the future as have been students of that establishment.

We hear that a most important desideratum in Biblical Archæology has been supplied by the diligence of Mr. George Smith, of the British Museum, who has discovered among the Assyrian Records an account of a deluge similar to that recorded in Genesis. Mr. Smith will read a paper on the subject next month before the Society of Biblical Archæology.

We learn from *Harper's Weekly* that with commendable enterprise Messrs. Maynard & Dean, of Massachusetts, announce their intention of publishing a periodical entitled *American Ornithology*, to be devoted to the scientific and popular history of birds. It is to appear bi-monthly, at the rate of five dollars a year, and will consist in part of popular articles on birds, and in part of more elaborate and technical memoirs. Each part will consist of about forty pages, and will contain a coloured plate of some new or little-known American species. In view of the difficulty of sustaining special journals, this enterprise is one of no little daring, but will, we trust, be justified by the result. At present there are but two periodicals exclusively devoted to birds; one of them, the London *Ibis*, published quarterly; the other, the *Journal für Ornithologie* of Cabanis, published bi-monthly in Leipsic.

Mr. Worthington Smith records in the *Gardener's Chronicle* some very curious cases of "mimicry" in fungi. He mentions several instances in which a rare fungus so closely imitates another common one belonging to a different sub-genus or even genus in all superficial characters as to be with difficulty distinguished from it, and is always found in company with it. It is difficult to conceive that this "mimicry" is of any value to the "mimicing" fungus except, as Mr. Smith suggests, that it has certainly hitherto prevented the detection and consequent destruction of rare fungi by collectors!

We learn from the *Academy* that Prof. Tschermak has published a new catalogue of the meteorites in the Vienna collection. At the date of issue (October 1, 1872) the mineralogical museum contained specimens representing 182 falls of meteoric stones, and 103 falls of meteoric iron. Letters appended to the name of each aërolite in the list indicate its position in a classification which has been based chiefly on the constituent minerals, certain distinctive physical characters of these minerals also being used in arranging them in subdivisions.

The Haggerstone Entomological Society, which was established in 1868, and is composed of working men, commenced, on Thursday evening last, its Annual Exhibition at No. 10, Brownlow Street, about a hundred yards from the Haggerstone Station on the North London line, and it is well worth a visit. The members are all practical entomologists, meeting one evening a week for the study of the science, with the aid of a good cabinet of Lepidoptera, and other facilities for advancement; and this fifth exhibition shows that they have not worked in vain. Among the specimens, which are at once rare and varied, are some fine ones of the *Vanessa antiopa*. This is one of the rarest butterflies found in this country, but during the last season it was (as we announced some time ago) far more abundant than it had been for many years before, and the Haggerstone collectors seem to have bestirred themselves accordingly.

We have just received the winter programme of the Chester Society of Natural Science (President, the Rev. Canon Kingsley), and a hopeful one it is, showing that the members are no mere *dilettanti*, but are anxious for work likely to produce results of high value in all the three sections into which it is divided—Botany, Zoology, and Geology. Their district is the four squares on the old Ordnance map of which Chester is the centre, and much has already been done by the members to elucidate the natural history of that district, although the Society has existed only 18 months. It numbers over 300 members. Dr. Stolterfoth and Mr. Liddell are energetically working the Diatomaceæ and Foraminifera of the Dee, and lists of these, we believe, will shortly be published. Several other members are actively at work in all three departments; the results of this work we hope to see in a permanent form. On the 27th inst., the President, Canon Kingsley, will read a paper on "Deep Sea Dredging," and on January 30, Professor Boyd Dawkins one on his favourite subject—"Cave Exploratious."

WE learn from the *Athenæum* that the Government of Colombia, or New Granada, has extended for five years the grant to Mr. José Triana to enable him to publish in London, in Spanish, "La Flora Colombiana," and the Botanical Geography of Colombia.

WE are glad to learn that a good deal of attention is being given to the systematic study of science in Glasgow by members of the teaching profession actual and prospective. Mr. E. M. Dixon, B.Sc. (London), one of the lecturers in the Established Church Normal Training College, has for several sessions regularly given a very comprehensive course of instruction in physiology to the male students in training; and this year the female students have been introduced to the study of botany by Mr. Robertson, another of the lecturers in the Glasgow Training College. It is understood that the Free Church Normal College is also about to do something in science teaching. Mr. John Mayer, F.C.S., has, during the last few years, had large classes of pupil teachers in physiology, and of schoolmasters and assistant-schoolmasters in physiology, chemistry, and metallurgy, the class for teachers being held on Saturdays, so as to be suitable alike for town and country students. It is evident that Scotland is becoming more alive to the value of science as a means of intellectual discipline and culture. In many little towns and villages north of the Tweed, special science classes are now in course of establishment for the first time.

WE learn from the *Journal of Botany* that a Flora of Portugal is announced as in preparation by Señor Baroo de Castello de Paiva. It will include all the additions made since 1804, the date of Brotero's excellent Flora Lusitanica.

*AMERICAN SCIENTIFIC INTELLIGENCE**

THE arrangements for an extended exploration of the Pacific Ocean by the Navy Department of the United States, have been brought almost to a conclusion, and it is understood that the *Portsmouth*, under Captain Skenett, will leave New York about the middle of November for the scene of operations. The vessel will proceed, with only the necessary stops, by way of Cape Horn, to the west coast, and will commence her work in the Gulf of California. Two years will probably be spent in the investigation of the hydrography of the peninsula, including the entire gulf region, as also in the exploration of the Revillagigedo group of islands. A subsidiary object, to receive a due share of attention, will be a general investigation into the physics and natural history of the deep seas and of the adjacent islands. Dr. Street, the surgeon of the expedition, has already distinguished himself as a naturalist and a collector in the Darien expedition, and will doubtless win new laurels on the present occasion. The astronomical department will be in charge of Paymaster Tuttle, well known as the discoverer of an asteroid and of a telescopic comet. The *Narragansett*, now on the Pacific station, has also been detailed for the same service, and will probably refit at Callao for the purpose. There are few portions of America more interesting in a natural history point of view than that to be immediately explored by this expedition, the Galapagos themselves being scarcely more noteworthy. This is shown by the researches of Mr. Xantus and of Colonel Grayson. The former gentleman spent several years at Cape St. Lucas, in the service of the United States Coast Survey and of the Smithsonian Institution, and obtained large numbers of specimens in all branches of natural history, many of which were entirely new to science. Colonel Grayson, in his explorations of Socorro Island, one of the Revillagigedo group, found that, as at Cape St. Lucas, there were many animals peculiar, or unknown elsewhere, most of them being then undescribed. They have, however, lately been published by Mr. George N. Lawrence, in a memoir of the collections of Colonel Grayson.—Professor Marsh announces the very important discovery of fossil quadrumana in the eocene deposits of the Rocky Mountains. The genera *Limnotherium*, *Thinolestes*, and *Telmatolestes* are, in his opinion, closely related to the lemurs, especially in the correspondence of the larger bones. The teeth are more numerous than in any known quadrumana, some species having apparently forty—namely two incisors, one canine, and seven premolars and molars on each side of each jaw. The professor also describes a new genus of large carnivora, under the name of *Limnofelis latidens*, in which the canines and premolars of the lower jaw resemble those of the hyena, but with only two incisors on either side. The single species, *Oreocyon latidens*, is supposed to have been as large as a lion. Another novelty consists in a cretaceous reptilian, allied to *Mososaurus*, and possessing peculiar characteristics. The animal has been called *Colonosaurus mudgei*, after the discoverer, Professor Mudge, who obtained the remains in Western Kansas.—Mr. J. F. Whiteaves, of Montreal, has completed his investigations into the deep-sea fauna of the Gulf of St. Lawrence, already mentioned as undertaken in continuance of those of last year; and he is now engaged in preparing his report for presentation to the Minister of Marine and Fisheries, at Ottawa. The greatest depth reached by him was 310 fathoms, off the south-western end of Anticosti, where he obtained a *Virgularia*, and specimens of *Pennatula* additional to those secured last year. He also found an interesting cup-shaped coral about an inch across the disc. — Recent advices from Mr. Stevenson, director of the Snake River division of the United States Geographical Survey, under command of Professor Hayden, announce the arrival of the entire party at Fort Hall on the 11th of October, the Snake River Basin having been carefully explored by them. The party reached the Geyser Basin the last of July, having obtained supplies from Virginia City, *viâ* Madison Valley. They followed the Madison River to its source in a small lake, and crossed the "divide" to Madison Lake, which they found to have no connection with Madison River, but with an outlet about one hundred feet wide, flowing in an opposite direction from the one given on the maps. They followed this to its entrance into another lake about five miles wide, and which proved to be the real source of Snake River. They found a geyser basin near the sources of Snake River, with about two hundred springs of all sizes, some of which spouted eighty to one hundred feet in height. Mr. Stevenson divided his party above the Snake River Cañon into two portions, one of which passed through the cañon, and the other explored the Teton Pass, both meeting again at the lower end of the cañon. The division under the immediate direction of Professor Hayden reached Bozeman on the 14th of October, having completed the season's labours. Every step is said to have been a success, and the amount of valuable material of scientific and practical value to far exceed that of any previous year. The Professor and his assistants proceed at once to Washington to prepare the report, to be presented to Congress for publication at an early date. Just before closing his field labours, Professor Hayden's party had explored the Gallatin River to its source, and completed the examination of the Yellow Stone by descending it to Mount Shields River, thence returning to the Three Forks. He expected to visit Helena before proceeding to Washington, for the purpose of determining its latitude and longitude. His astronomers had already fixed the geographical position of Virginia City, Fort Ellis, and Fort Hall.—One of the most striking of the many interesting discoveries of vertebrate fossils made in the wonderfully rich formations of the West is that of a fossil bird obtained by Professor Mudge in the upper cretaceous shale of Kansas, and described by Professor Marsh. The remains indicate an aquatic form about the size of a pigeon, but differing widely from all known birds in having biconcave vertebræ. The rest of the skeleton, however, is quite similar to that of the average type. The species has been named *Icthyornis dispar*.

* Communicated by the Scientific Editor of *Harper's Weekly*.

ON THE ECLIPSE EXPEDITION, 1871*

I UNDERSTAND my duty to-night to be to give an account of the observations made, not by all who observed the eclipse of last December, but by the members of the party which went out under the auspices of the British Association; and it is extremely fortunate that nothing more is required of me—first, because most valuable work was done by the other parties, which of itself would require more time to state than I have at my disposal; and secondly, because the amount of material obtained by the members who were sent out from England, and by the friends who met them at every point, is so great, that it would be impossible in one discourse to give anything like an exhaustive account of it. Here are some of the records in this portfolio. You will see at once that even for one party I can only make a selection, and I am perfectly aware of the extreme responsibility which attaches to anyone who may venture to make a selection out of such an enormous mass of material as we have collected.

Before I proceed to discuss the work done by the different parties, it will be desirable to give an idea of the arrangements, and for this purpose I have prepared several maps which will enable you to see what the British Association parties did.

In the first instance I may remark that the weather conditions were somewhat problematical. Another point of great importance was that much of the ground was fortunately occupied, and it was essential, when placing the parties, to bear these two considerations in mind—the possibility of bad weather, and then the importance of so arranging matters that if some of the observers were clouded out, belonging to our parties, then the story might be continued by other observers.

Here we have a map of India, which gives you a general idea of the path of the shadow during the eclipse. The shadow, you see, strikes India on the western coast, and it runs down in a south-westerly direction, and cuts the northern portion of Ceylon.

When we arrived in India we found that the Indian observers, consisting of those well-known men Tennant, Herschel, Hennessy, Pogson, and others, had determined, from their knowledge of the climatic conditions of India at that time of the year, to occupy the central part of the line, and also a station at a low level; the eminent French physicist M. Janssen taking up his position at the top of the Nielgherries. We were to station ourselves either east or west, or both, of these parties. Whether east or west would depend upon the monsoon, and the great question that was being discussed on our arrival was, Was the monsoon favourable?

I have not time to go into the many interesting points touching the answer to this question; but I may say shortly that what we heard was, that if the weather was likely to be bad on the east side of the hill range, generically called the Ghauts, there was a good chance for anyone occupying a position west of those hills. What happened was that we did occupy the positions marked by blue wafers on the map, namely, Bekul on the west coast, Manantoddy on the western slope of the Ghauts, Poodocottah in the eastern plain, and in the island of Ceylon, first, Jaffna, and secondly, Trincomalee.

Such were our arrangements. The parties were stationed along the line of totality. Very different were the arrangements of the Sicilian party of the former year. In Sicily we were compelled to throw ourselves *across* the line of totality in the direction which I have indicated on this map of Sicily.

Now what was the work we had to do? If you will allow me to refer to two or three results of the former Eclipse Expedition, I will endeavour to put them before you without taking up too much of your time.

One of the most important among the results obtained in the eclipse of 1870 was this: far above the hydrogen which we can see every day without an eclipse—far above the prominences, the spectrum of hydrogen had without doubt been observed by two or three of the American observers, who were more fortunate than we were. Among them Prof. Young stated that the spectrum of hydrogen was observed to a distance of 8 minutes from the sun; he then adds, "far above any possible hydrogen atmosphere." This is point number one.

Another of the points was this: the unknown substance which gives us a line coincident, according to Young, with a line numbered 1474 by Kirchhoff, had been observed by the American observers to a height of 20 minutes above the limb of the dark moon.

Now, it was a very obvious consideration that if we got a spectrum of hydrogen 8 minutes from the dark moon, when we thought we knew that the hydrogen at the sun did not really extend more than 10 seconds beyond the dark moon, there was something at work which had the effect of making it appear very much more extensive than it really was; and it was fair to assume that if this happened in the case of the hydrogen, it might also happen in the case of the unknown stuff which gives us the line 1474.

In support of this view we had one of the few observations which were made in Sicily, in the shape of a drawing of the corona, as seen by Prof. Watson, who observed at Carlentini. He saw the corona magnificently; and being furnished with a powerful telescope, he made a most elaborate drawing of it, a rough copy of which I will throw on the screen. You will see at once that we had in this drawing something which seemed to militate against the idea that the 1474 stuff at the sun did exist to a height of 20 minutes. According to Prof. Watson the boundary of the real corona was clearly defined, its height being far under that stated.

Next, we had another observation of most important bearing on our knowledge of the base of the corona. I refer to the announcement of the observation by Prof. Young of a stratum in which all the Fraunhofer lines were reversed. It was asserted that there was undoubtedly a region some 2 seconds high all round the sun, which reversed for us all the lines which are visible in the solar spectrum. We had, in fact, in a region close to the photosphere the atmosphere of the sun demanded by Kirchhoff at some distance above the photosphere.

Last, not least, we had the photographic evidence. There was in Sicily a photographic station in Syracuse, and the Americans had another in Spain. I now show on the screen a drawing—it is not the photograph itself—but a drawing of a photograph made by the party in Sicily; what we have on this photograph is a bright region round the dark moon, which is, undoubtedly, solar, but stretching out right away from this, here and there are large masses of faint light, with dark spaces between them, which have been called rifts. Now the question is, Is this outer portion solar?

Having thus brought rapidly before you some of the questions which we had principally to bear in mind, and, if possible, settle (though that is too much to hope for in any one Eclipse Expedition) in the work we had to do in India, I will next bring to your notice some new methods of inquiry which had been proposed, with the object of extending former observations.

I may here remark that the Royal Astronomical Society, in the first instance, invited me to take charge of an expedition to India merely to conduct spectroscopic observations; but although this request did me infinite honour, I declined it, because the spectroscope alone, as it had been used before, was, in my opinion, not competent to deal with all the questions then under discussion. I have told you that some of the most eminent American observers had come to the conclusion that the spectrum of hydrogen observed in the last eclipse round the sun, to a height of 8 minutes, was a spectrum of hydrogen "far above any possible hydrogen" at the sun. Hence it was in some way reflected. Now with our ordinary spectroscopic methods it was extremely difficult, and one might say impossible, to determine whether the light which the spectroscope analysed was really reflected or not; and that was the whole question.

It became necessary, therefore, in order to give any approach to hopefulness, to proceed in a somewhat different way in the 1871 expedition; and, in order to guard against failure, to supplement such new observations by photographs; and fortunately we were not long in coming to a conclusion that this might be done with some considerable chance of success.

I have here a train of prisms. I will for one moment take one prism out of the train, and we will consider what will happen if we illuminate the slit of the lantern with a monochromatic light, and observe it through the prism. If we render sodium vapour incandescent, we know we get a bright yellow image of the slit, due to the vapour of the metallic sodium only giving us yellow light. But why is it that we get a line? Because we always employ a line for the slit. But suppose we vary the inquiry? If, instead of a straight line we have a crooked line for the slit, then we ought to see a crooked line through the prism.

* A Lecture delivered at the Royal Institution of Great Britain, Monday, March 22, 1872, by J. Norman Lockyer, F.R.S. (The chief results obtained by the expedition have been taken from the *ad interim* Report presented to the British Association Meeting at Brighton. The lecture itself dealt mainly with the methods and instruments employed.—J. N. L.)

Now, allow me to go one step further: suppose that instead of a line, whether straight or crooked, we have a slit in the shape of a ring, shall we see a ring through the prism? You will see that we shall. And then comes this question: If, when we work in the laboratory we examine these various slits, illuminated by these various vapours, why should it not happen that if we observe the corona in the same way, we shall also get a ring built up by each ray of light which the corona gives to us; since we know, from the American observations, that there were bright lines in the spectrum of the corona, as observed by a line slit? In other words, the corona, examined by means of a long train of prisms, should give us an image of itself painted by each ray which the corona is competent to radiate towards us.

Now let us pass to the screen, the screen merely replacing the retina. We will first begin with the straight slit with which you are familiar—we now have our slit fairly focussed on the screen—we then in the path of the beam interpose one of these prisms, and there we get on the screen a bright line.

Now, to continue the argument, we replace the straight slit by a crooked one, and you see we get a crooked image on the screen. We now replace this crooked slit by a ring. We have now a ring-formed image on the screen. So that you see we can use any kind of narrow aperture we choose, and as long as we are dealing with light which is monochromatic, or nearly so, we get an image of the aperture on the screen.

If we consider the matter further, it will be evident that we may employ a mixture of vapours, and extend this result.

We will now, for instance, instead of employing sodium vapour, employ a mixture of various vapours. You see now that each ray given by these substances, instead of building up a line image, is building up for us a ring image—that we have now red, green, yellow, blue, and violet rings.

Now that was the consideration which led to the adoption of one of the new attempts to investigate the nature of the corona used this time. It was, to use a train of prisms, pure and simple, using the corona as the slit, a large number of prisms being necessary to separate the various rings we hoped to see, by reason of their strong dispersion. On the screen the rings to a certain extent intersect each other; and it would have been easier to show you the ring-form of the images if we could have used more prisms than one.

If this is good for a train of prisms such as I have referred to, it is good for a single prism in front of the object-glass of a telescope. Such was the method adopted by Prof. Respighi, the distinguished Director of the Observatory of the Capitol of Rome, who accompanied the expedition.

Now you may ask how would this method, if it succeeded, be superior to the ordinary one? In this way. If we were dealing merely with reflection, then all the rings formed by vapours of equal brilliancy at the base of the chromosphere would be of the same height, while if reflection were not at work, the rings would vary according to the actual height of the vapours in the sun's atmosphere, and the question would be still further advanced if the spectrum did not contain a ring representing the substance which underlies the hydrogen.

Our *new* spectroscopic equipment then was as follows:—

1. A train of five prisms.
2. A large prism of small angle placed before the object-glass of a telescope.
3. Integrating spectroscopes *driven by clockwork*.
4. A self-registering integrating spectroscope, furnished with telescopes and collimators of large aperture, and large prisms. (This instrument was lent by Lord Lindsay.)

Now a word about the polariscopic instruments, referring you to my lecture given last year for a general notion of the basis of this class of observation.

A new idea was that observations to determine the polarisation of the corona might be made with the same telescope and eye, both with the Biquartz and the Savart.

By the kindness of Mr. Spottiswoode, who has placed his magnificent polarising apparatus at our service, I hope to be able to show you on the screen the mode of examining the corona by means of those two instruments, so as to enable you pretty well to follow what was actually done.

Let me begin with the Biquartz polariscope. In the first instance I will throw on the screen a representation of the corona itself, and we will then insert a Biquartz, and see its effect when I flood the screen with polarised light. You now see an indication of what would be observed supposing the polarisation was due to polarised light diffused in the region between us and the dark moon and eclipsed sun, in which case the polariscopic effect would be observed generally over the dark moon, the corona and the region of the sky outside the corona. But this is not all; not only does this arrangement enable us to determine the existence of such a general polarisation, but the vertical line in the Biquartz called the line of junction indicates the plane of polarisation, when the colours on both sides of it are the same; so that we have two colours strongly contrasted in either half of the field when we are away from the plane of polarisation, and a uniform colouring of the whole field when in or at right angles to that plane. By turning this prism through 90 degrees, you see I entirely change the colours.

But we are not limited to the Biquartz in this inquiry. We can apply the Savart polariscope. Having still our image of the corona on the screen, I now replace the Biquartz by a Savart.

We now no longer see a line of junction with the similar or different colours on either side of it, but lines of colour running across the image. I turn the prism. We first see the lines with a white centre, then with a dark one; while at times they are altogether absent. And as a departure from the plane, when we use the Biquartz, gives us the strongest contrasts of colour, so you observe that with the Savart under these circumstances all indications of polarisation vanish.

Now, if we assume polarisation to be general, and the plane of polarisation vertical, we should get those coloured bands, as you see them there, crossing the corona and dark moon, the lines being vertical and dark-centred. If the plane of polarisation were horizontal, we should find the lines horizontal and the central one white.

But so far as we have gone, we have been dealing with polarisation which is general, and we have not attempted to localise polarisation at the corona itself. But I have here an apparatus, by means of which, quietly, in this theatre one can see as admirable an example as we should desire of polarisation, assumed to be particular to the sun and not general—I mean radial polarisation. We have simply a circular piece of mahogany, or something else which polarises light equally well, with a hole in the middle with sloping sides, cut as you see this cut, and then we place behind it a candle, so that the light of this candle, after falling on oiled tissue paper stretched across the aperture, can be reflected to the eye by the sides, the direct light of the candle being stopped by a central metallic diaphragm. We have now a source of polarised light of a different kind from the last. The next thing we have to do is to introduce into a small telescope exactly the same kind of apparatus we have there, though of course on a much smaller scale, and examine the ring of light seen when we put the candle behind the aperture. On examining the ring of light which is now visible by means of this telescope, which contains a Biquartz and analyser, I see the most exquisite gradations of colour on either side the line of junction which cuts the field of view and the bright ring in the centre into two.

Now, instead of the candle, we will employ the electric lamp; and instead of the eye, the screen; but I must inform you that the great heat of the electric lamp prevents the appearance being perfectly successful on the screen, as the reflecting varnish is melted.

In this experiment we cannot work with an image of the corona. We must make our corona out of the image of the ring we hope to get on the screen; and then, by employing the Biquartz in the same way as before, instead of getting similar colours on either side of the line of junction, as we did when we were working in the plane of polarisation, and getting the greatest contrasts, as we did when we worked 45 degrees away, you observe we get different colours in each part of the ring.

On the screen we now have a highly-magnified image of the hollow cone of iron which I am compelling to reflect the light from the lamp; and by inserting this Biquartz I throw various colours over different portions of that ring, which I beg you to consider for one moment as the solar corona, and the colours change as I rotate this prism. You will at once be able to explain the different actions of this Biquartz in this instance. The reflection, and therefore the plane, of polarisation is no longer general, but varies from point to point of the reflecting surface. It is in fact radial, and hence the delicate radiate arrangement of colour.

Such, then, were some of the new methods and new instruments we used for the first time in our researches. And I hope you will allow me to use this term, although our work was conducted a long way from the Royal Institution, the natural home of research in England.

(*To be continued.*)

SOCIETIES AND ACADEMIES

London

Geological Society, Nov. 6.—Prof. Ramsay, F.R.S., V.P., in the chair. A Report by F. T Gregory, Mining Land Commissioner in Queensland, on the recent discoveries of Tin-ore in that Colony. According to this report, the district in Queensland in which tin-ore has been discovered is situated about the head-waters of the Severn river and its tributaries, comprising an area of about 550 square miles. The district is described as an elevated granitic table-land intersected by ranges of abrupt hills, some attaining an elevation of about 3,000 feet above the sea. The richest deposits are found in the beds of the streams and in alluvial flats on their banks, the payable ground varying from a few yards to five chains in extent. The aggregate length of these alluvial bands is estimated at about 170 miles, the average yield per linear chain of the stream-beds at about ten tons of ore (cassiterite). Numerous small stanniferous lodes have been discovered, but only two of much importance, namely, one near Ballandean Head Station on the Severn; and another in a reef of red granite rising in the midst of metamorphic slates and sandstones at a distance of about six miles. The lodes run in parallel lines bearing about N. 50° E.; and one of them can be traced for a distance of nine or ten miles. The ore, according to Mr. Gregory and Mr. D'Oyly Aplin, is always associated with red granite, *i.e.* "the felspar a pink or red orthoclase, and the mica generally black; but when crystals of tin-ore are found *in situ*, the mica is white." The crystals of tin-ore are generally found in and along the margins of quartz threads or veins in bands of loosely aggregated granitoid rock, but are sometimes imbedded in the micaceous portions. The report concludes with some statements as to the present condition and prospects of the district as regards its population.—Observations on some of the recent Tin-ore discoveries in New England, New South Wales, by G. H. F. Ulrich. The district referred to by the author is in the most northern part of the colony of New South Wales, almost immediately adjoining the tin-region of Queensland described in the preceding report. It forms a hilly elevated plateau, having Ben Lomond for its highest point, nearly 4,000 feet above the sea-level. The predominant rocks are granite and basalt, enclosing subordinate areas composed of metamorphic slates and sandstones; the basalt has generally broken through the highest crests and points of the ranges, and spread in extensive streams over the country at the foot. The workings of the Elsmore Company, situated on the north-west side of the Macintyre river, about twelve miles E. of the township of Inverell, include a granite range of about 250 feet in height, and nearly two miles in length. The granite of the range is micaceous, with crystals of white orthoclase, and is traversed by quartz veins which contain cassiterite in fine druses, seams, and scattered crystals, and by dykes of a softer granite, consisting chiefly of mica, and with scarcely any quartz, in which cassiterite is distributed in crystals, nests, and bunches, and also in irregular veins of several inches in thickness. This granite yields lumps of pure ore up to at least 50 lbs. in weight. The quartz veins contain micaceous portions which resemble the "Greisen" of the Saxon tin mines. The deepest shaft sunk in one of the quartz veins was about 60 feet in depth. The author noticed certain minerals found in association with the tin ore, and the peculiarities of the crystalline forms presented by the latter. In conclusion the author referred to the probability that a deficiency of water may prove a great obstacle to the full development of the tin-making industry in this district, but stated that "it seems not unlikely that the production of tin ore from this part of Australia will reach, if not surpass, that of all the old tin-mining countries combined."—"On the included Rock-fragments of the Cambridge Upper Greensand." By W. Johnson Sollas and A. J. Jukes-Browne. The occurrence of numerous subangular fragments in the Upper Greensand formation was so far remarkable that it had already attracted the notice of two previous observers (Mr. Bonney and Mr. Seeley), who had both briefly hinted at the agency of ice. While ignorant of the suggestions of these gentlemen, the authors of this paper had been forced to the same conclusion. A descriptive list had been prepared of the most remarkable of the included fragments. The infallible signs of the Upper Greensand origin consisted in incrustations of *Plicatula sigillum*, *Ostrea vesiculosa*, and "Coprolite," without which, it was stated, the boulders would be undistinguishable from those of the overlying drift. The following generalisations were then put forward:—1. The stones are mostly subangular; some consist of friable sandstones and shales, which could not have borne even a brief journey over the ocean bed. 2. Many are of large size, especially when compared with the fine silt in which they were imbedded; the stones and silt could not have been borne along by the same marine current. 3. The stones are of various lithological characters, and might be referred to granitic, schistose, volcanic, and sedimentary rocks, probably of Silurian, Old Red Sandstones, and Carboniferous age. Such strata are not found *in situ* in the neighbourhood, and the blocks must have come from Scotland or Wales. Numerous arguments were adduced in favour of their Scottish derivation. The above considerations, that numerous rock fragments, some of which are very friable, have been brought from various localities and yet retain their angularity, were thought sufficient evidence for their transportation by ice; the majority showed no ice scratches, but the small proportion of scratched stones in the moraine matter borne away on an iceberg, and the small percentage of ice-scratched boulders in many deposits of glacial drift, show that the absence of these striæ is not inconsistent with the glacial origin of the included fragments. Besides this the stones of the Greensand consisted of rock, from which ice marks would readily have been removed by the action of water. The authors stated, however, that they had found more positive evidence in a stone which was unmistakably ice-scratched, consisting of a siliceous limestone, and preserved in the Woodwardian Museum. The fauna, so far as it proved anything, suggested a cold climate; though abundant, the species were dwarfed, in striking contrast to those of the Greensand of Southern England and the fauna of the succeeding Chalk. The authors concluded that a tongue of land separated the Upper Greensand sea into two basins, the northern of which received icebergs from the Scottish-Scandinavian chain; the climate of this was cold, that of the southern basin much warmer.

Paris

Academy of Sciences, Nov. 4.—M. Faye, President.—The first paper read was by M. Becquerel, on the solar origin of atmospheric electricity. A large portion of the paper was preliminary, and contains a sketch of modern solar discoveries; the subject is to be continued.—M. Pasteur then read a note on the production of alcohol by fruits. His remarks referred to some experiments by M. Lechartier, who has found that alcohol is developed in fruit on simple keeping.—Another note by the same author followed, replying to some of M. Fremy's late assertions. To this M. Fremy replied, and was immediately answered by M. Pasteur, who demanded the appointment of a commission to examine his experiments, when M. Fremy arose and proposed that he, M. Pasteur, and M. Trécul should work in common. M. Dumas then stated that the Academy should grant the request of M. Pasteur. M. Wurtz supported M. Pasteur's demand, and M. Pasteur then asserted that he would not agree to M. Fremy's proposed joint work, and urged the appointment of a commission to examine the contested experimental evidence. After this the discussion dropped.—Another of MM. Favre and Valson's papers on crystalline dissociation was then read. The authors described a new method for the investigation of the "coercive" action of a salt on water at any temperature.—M. Faye then read a paper on Mr. L. Rutherfurd's lunar photographs.—Next came a report on a memoir by Dr. Dufossé on the noises and sounds which the sea and freshwater fish of Europe can hear. The report recommended that the thanks of the Academy should be awarded to the Doctor for his discoveries. M. Max Marie then presented a paper on the elementary theory of Integrals of any order, and of their periods. M. Becquerel then presented an addendum to M. E. Jannettaz's late note on the coloured rings of gypsum. The note by M. Jannettaz contained some additions to and corrections of his former communication.—M. D. Colladon then presented a note on the effects of lightning on trees, which was referred to the Lightning Conductor Commission. MM. Becquerel and Edm. Becquerel made some remarks on this paper in relation to the change in colour of stricken trees and flowers. M. C. Dareste's third part of his paper on the osteological types of the osseous fishes followed, and was sent to the Anatomical and Zoological section.—M. Sainte-Claire Deville then presented a memoir by M. F. Fouqué on some new processes for the proximate analysis of minerals, and on their application to the lavas of the late eruption of Santorin. The *Phylloxera* Commission next received a proposal from M. de Wissocq, proposing calcic sulphide and hydrosulphuric acid as remedies for the diseased vines.—M.

Yvon Villarceau then presented the elements and ephemerides of the planet 125, calculated by M. G. Leveau. This planet was discovered by M. Henry at the Paris Observatory. Astronomers having powerful instruments are requested to observe it, and communicate their results, as it is exceeding difficult of observation.—M. Maurice Lévy then communicated a paper on the theory of equations of partial differences of the second order of two independent variables.—Next came a continuation of M. Th. du Moncel's paper on the accidental currents which are developed in telegraphic lines, of which one end remains insulated in air.—Next followed a note by M. P. Yvon on a photometer founded on the perception of relief, and a note on the action of a copper and cadmium couple on a solution of cadmic sulphate, by M. F. Raoult, and M. P. Havrez's paper on the formulæ for the laws of colour, and number of "Chevreulian" tints connected with the doses of different generating agents.—This long paper was followed by a note on the paces of horses, studied by the graphic method, by M. E. J. Marey. Several traces of trot and gallop movements accompanied the paper.—Mr. Grace Calvert sent a paper on the power of certain substances in stopping putrefaction and preventing protoplasmic life, which was then read, and followed by a note on the febrifugic and anteperiodic properties of the leaves of *Laurus nobilis* by M. A. Doran, and by a paper on the causes of intermittent fevers, and the means of prevention and cure, by M. E. Ferrière—M. Picot then read a paper on the "antifermentescible" properties of sodic silicate. M. Ch. Robin presented a note by M. E. Dubrueil, on the Capreolus of *Zonites Algirus*. This was followed by a note by M. Carbonnier on the reproduction and development of the telescope fish. This fish is of Chinese origin, its name being Long-tsing-ya in Chinese (*Cyprynus macrophthalmus* Bloch). M. Claude Bernard then presented a note by M. L. Ranvier, on the annular strictures and inter-annular segments of the rays and cramp-fish.—Another communication from M. Thomas on his asserted discovery of fluorine was submitted to the examination of M. Balard.—M. Le Baron Larrey presented an extract from M. Berenger-Féraud, naval surgeon-in-chief at Senegal, on the larvæ and flies (*mouches*) which are developed in the human skin. At the conclusion of the paper M. Émile Blanchard made some remarks on it as regards the Cayor fly, no specimens of which have yet reached Europe. M. Chevreul then presented a copy of M. Paul de Gasparin's work on the "Valuation of Arable Land in the Laboratory;" and after some remarks from him on M. Gasparin's discovery of phosphoric acid in the subsoil waters of the Plain of Orange, the session was adjourned.

Nov. 11.—M. Faye, President.—The first paper was by Capt. Perrier on the determination of a great geodesical base in Algeria.—The President followed with a paper on the triangulation of Algeria for the new military map of the province.—M. Becquerel then read the second part of his paper on the solar origin of atmospheric electricity. He considers that the protuberances come from solar volcanoes, and that they are charged with positive electricity.—A letter from M. Faye to the author on his last paper followed.—M. Le Verrier then read a note on the determination of the secular variations of the elements of the four planets—Jupiter, Saturn, Uranus, and Neptune.—Next came a paper by M. Trécul on the origin of the lactic and alcoholic ferments. The author is very severe on M. Pasteur, who, he states, if 999 experiments are favourable to spontaneous generation and one against it, adopts the one and rejects the 999. This, of course, drew a reply from M. Pasteur, and his reply an answer from M. Trécul.—M. Pasteur then read a note on M. Fremy's paper read at the session of Nov. 4. M Fremy answered M. Pasteur's criticisms, and M. Pasteur in a few words of answer again demanded a commission of inquiry.—M. Dareste then presented the fourth part of his researches on the osseous fishes, after which two papers on aerostation, by M. Hopin and M. Lamole respectively, were sent to the commission on that subject.—MM. Paul and Prosper Henry then announced the discovery at Paris, on the night of November 5 and 6, of two planets 126 and 127 of the 11th and 11·5 magnitude respectively; and M. Yvon Villarceau then read a letter on the two planets by M. Stephan, who had received information and observed them at Marseilles. Next came a paper by M. H. Durande on the acceleration in the displacement of a system of points which remains homographic with itself. At the conclusion of this came a paper on "Chloride of Lime" (bleaching powder), by M. J. Kolb. The author gives a method of valuation of this important commercial product.—M. Balard then presented M. Scheurer-Kestner's note on the loss of sodium in the preparation of soda-ash by Le Blanc's process. The author decides that the loss occurs in the "waste," and augments with the excess of lime compounds.—M. Wurtz presented a note by M. G. Bouchardat on the neutral combinations of Mannite and its hydrates.—M. L. de Saint-Martin presented some researches on Santonin.—This was followed by MM. Legros and Onimus, with experimental researches on the physiology of the pneumogastric nerve; and by an account of "Experimental Researches on the Functions of the Brain," by M. E. Fournie.—M. Brogniart then presented MM. Renault and Grand'Eury's paper on the Fossil Botany of the *Dictyoxylon* and its specific attributes.—M. Béchamp then gave an account of some researches on the function and transformation of mildews.—M. Pasteur presented a note by MM. G. Lechartier and F. Bellamy on the "Fermentation of Fruits."—M. A. Gaudin next read a note on "Some arguments necessary to clear up the fermentation question;" after which came a note by M. A. Leclerc on the Estimation of Manganese in soils and vegetables. After some observations on the geometric markings of microscopic algæ from M. J. Girard the session was adjourned.

DIARY

THURSDAY, NOVEMBER 21.

ROYAL SOCIETY, at 8.30.—On the Mechanical Conditions of the Respiratory Movements in Man: Dr. A. Ransome.—Further Experiments on the more Important Physiological Changes induced in the Human Economy by Change of Climate: Dr. Rattray.—On Linear Differential Equations, VI. and VII: W. H. L. Russell, F.R.S.

LINNEAN SOCIETY, at 8.—On the *Compositæ* of Bengal: C. B. Clarke, F.L.S.—On Diversity of Evolution under one set of External Conditions: Rev. J. T. Gulick.

CHEMICAL SOCIETY, at 8.—On some New Derivations of Anthraflavic Acid: W. H. Perkin.

SUNDAY, NOVEMBER 24.

SUNDAY LECTURE SOCIETY, at 4.—On the Renaissance of Modern Europe; a Review of the Scientific, Artistic, Rationalistic, Revolutionary Revival, dating from the 15th Century: J. Addington Symonds.

MONDAY, NOVEMBER 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, NOVEMBER 26.

LONDON INSTITUTION, at 4.—On Elementary Physiology: Prof. Rutherford.

WEDNESDAY NOVEMBER 27.

ROYAL SOCIETY OF LITERATURE, at 8.30.—On Difficult Words and Phrases occurring in Shakespeare's Works, Part I.: Dr. C. M. Ingleby.

SOCIETY OF ARTS, at 8.—On Technical Education, and the Means of Promoting it: Thomas Webster.

LONDON INSTITUTION, at 7.—On Spontaneous Movements in Plants: A. W. Bennett.

SOCIETY OF TELEGRAPHIC ENGINEERS, at 8.—On Lightning; W. H. Preece.

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ERRATA.—Vol. vii. p. 14: in the article on "Scottish Coal Fields," for "Prof. Geikie" read "Mr. James Geikie."—Vol. vii. p. 15, col. 1: in note on lecture arrangements at Royal Institution, the second announcement should have read thus—"Twelve Lectures on the Forces and Motions of the Body, by Prof. Rutherford, F.R.S.E.; Three Lectures on Oxidation, by Dr. Debus," &c.