THURSDAY, MARCH 29, 1883

THE AMERICAN ASSOCIATION

Proceedings of the American Association for the Advancement of Science. Thirteenth Meeting, held at Cincinnati, Ohio, August, 1881. (Salem: Published by the Permanent Secretary, 1882.)

IN the same year that the British Association for the Advancement of Science was celebrating its jubilee, this, its eldest daughtei, had reached the mature age of thirty years. The volume which embodies the results of the Cincinnati meeting is considerably smaller than the corresponding one published on this side of the Atlantic. The latter, containing the reports and proceedings of the York meeting, is a bulky and closely-printed volume of 824 pages, besides 82 pages of introductory matter and a list of members. The corresponding American volume only contains 416 pages, with about the same amount of introductory matter, in which the list of members is included. The ratio of the one to the other is even less than the above number indicates, for the type used in the American is on the whole larger than in the English volume, the smallness of which, in the Transactions, can only be justified by the necessity for restricting the bulk of the volume.

The American Association appears to be constituted very nearly on the same plan as the British, but there are some minor points of difference. The American consists of Members, Fellows, Patrons, and Honorary Fellows: of which the former two appear to correspond roughly with the Members and the General Committee of the British Association. A donation of one thousand dollars constitutes a Patron—only two persons, however, one of each sex, appear to have availed themselves of that avenue to distinction. The sections, or sub-sections, into which the Association divides itself for purposes of business at the time of meeting, are nine in number, as were those, including departments, at the York meeting of the British Association. But the distribution of the subjects differs. The American Association has a section for Physics separate from Mathematics and Astronomy, rendering permanent the fission which only occasionally takes place with us. Geology and Geography are placed in one section, which certainly would be found impracticable in Britain, as both these departments are in general well supplied with papers. Our Section D (Biology), with its three departments, Zoology and Botany, Anatomy and Physiology, and Anthropology, is divided in America into Biology, Histology and Microscopy, and Anthropology. The remaining sections correspond exactly. The two most noteworthy differences in the American volume are the general absence of the Presidential addresses, so marked and often so valuable a feature of the British, and the small number of Special Committees (and consequently of their Reports). Only in the sub-sections of Entomology and of Anthropology is there any record of addresses by the chairmen, and there does not appear to have been any general address by the President of the whole Association. The number of Special Committees also is smaller than we should have expected. Of these we find but eight, excluding those connected with executive business. They are "On Weights, Measures, and Coinage," "For Obtaining a New Survey of Niagara Falls," "On the Best Method of Science Teaching in the Public Schools," "On Standard Time," "On Stellar Magnitudes," "On State Geological Surveys," and two others, the purpose of which seems a little singular to English readers, one being "On the Registration of Deaths, Births, and Marriages" (the order of sequence seems a little curious), and a "Committee to cooperate with the American Philologica Association in relation to the proper restriction of the degree of Ph.D.," a subject which, we imagine, even if the necessity existed here, the British Association would be a little shy of touching.

It is of course difficult to express an opinion on the requirements of an American institution, but we cannot help thinking that as some of the most useful work of the British Association has been and is being done through its Committees, and that their reports (including those of individuals) are the most valuable part of its volume, the Transatlantic society would do well to develop this feature in its constitution. At the York meeting in 1881 thirty reports were read and forty-eight committees appointed.

There were a considerable number of mathematical and physical papers read before the American Association, but of the majority only the titles are printed. Of the few reported at any length, one, we should have thought, would have been more appropriate placed in the section of Mechanics, as the mathematical reasoning is of the simplest kind. The conclusion, however, is interesting, for it shows, as the result of a number of experiments, that "timber may be injured by a prolonged stress, far within that which leaves the material uninjured when the test is made in the usual way, and occupies a few minutes only." Bars of timber (most of the experiments were made with yellow pine) yielded and broke, generally suddenly, under loads below their average breaking weight under ordinary test. When the load was about three-fifths of the average breaking weight, it was sometimes a full year before they gave way. This suggests pleasant reflections for occupiers of newly-built "jerry" houses in London!

Among the physiological papers there is one on a subject which must, we think, be novel. It is entitled "A Study of Blood during a Long Fast" (by Lester Curtis, of Chicago). In May, 1881, a Mr. John Griscom, of Chicago, commenced a fast of forty-five days. The author was invited by the "managers" to make any investigations that he pleased, and after satisfying himself that the fast was to be conducted honestly, he chose the blood as a subject of study. The first examination made, at the commencement of the fast, shortly after the patient had eaten his last meal, showed the red corpuscles abundant, bright coloured, pure in appearance, regular and smooth in outline. Four days afterwards two kinds were noticed, one pale, almost colourless, large, with a "sticky" aspect, the other deeper in colour than the ordinary corpuscles, smaller and covered with nodules. By the fifth day the colourless corpuscles had disappeared, but they returned in a few days, and continued in greater or less amount to the end. The darker corpuscles assumed various shapes, and many very small ones appeared, apparently by subdivision of the larger. Their aspect was most abnormal on the thirty-ninth day of the fast, when Mr.

Griscom was extremely exhausted; but on the fortieth, after he had been refreshed by a rather long excursion on the lake, the corpuscles returned to a normal condition, except as regards size. This improvement was not lost during the remainder of the fast, though the abnormal appearance to some extent returned.

In the joint section of Geography and Geology are some interesting papers—one, the substance of an evening lecture, describes the Grand Cañon of the Colorado River, and shows that the denudation, of which it is a consequence, commenced in Middle Eocene, and has been continued to the present time, the greater part however having been accomplished by the end of the Miocene. During the whole period there has been a vertical uplift of from 16,000 to 19,000 feet, and a removal of a total thickness of rock equal to about 10,000 feet.

Another interesting paper connected with physiography is by Mr. J. W. Spencer, "Notes on the Origin of the Great Lakes of North America," together with one by Mr. W. Claypole, on "Evidence from the Drift of Ohio, Indiana, and Illinois, in support of the Preglacial Origin of the Basins of Lakes Erie and Ontario." The authors discuss the physiography and geology of the districts in which these lakes are situated, and show the most probable theory of their origin to be that they are fluviatile valleys of preglacial age, which during glacial times were obstructed by the accumulation of drift. This, aided by submergence owing to change of level, has produced the lakes in their present form. These papers are well worth the study of some English geologists, to whom no work seems too small or too great for a glacier, and whose faith at one time seemed quite equal to gulping down Lake Superior itself, sooner than falter in supporting a fascinating theory.

We would venture in conclusion to suggest to the American Association one improvement in detail: this is to imitate the British, and give their volume a cloth binding instead of sending it forth merely stitched in a paper cover, so loosely as to tumble to pieces after a few days' use.

T. G. BONNEY

PRINGSHEIM'S BOTANICAL YEAR-BOOKS

Jahrbücher für wissenschaftliche Botanik. Herausgegeben von Dr. N. Pringsheim. Vol. XII. Part 4, and Vol. XIII. Part 3. (Leipzig: W. Engelmann, 1881 and 1882.)

THE two parts now before us include six papers dealing with anatomical and physiological subjects, illustrated by 13 plates, some of them of great beauty. In the concluding part of vol. xii. there are papers by Westermaier, Ambronn, and Zimmermann; while in the third part of vol. xiii. the editor, Dr. Pringsheim, contributes a long controversial paper, and there are two papers —a long one by Godlewski, and a short one by Tschirch.

Westermaier's paper is on the "Intensity of Growth of the Apical Cell and of the Youngest Segments." From an examination of figures of Dictyota, Hypoglossum, Metzgeria, Salvinia, Equisetum, and Selaginella, as given by Naegeli, Goebel, Pringsheim, Cramer, Rees, and Pfeffer, Westermaier concludes that the maximum of the increase in volume in the apical region occurs in general either in the apical cell itself or in the youngest segments, and that taking the region which includes the apical cell itself and the four youngest segments, in none of the plants examined was the increase in volume of the apical cell found to be the minimum for the region. The results are represented graphically and afford very instructive curves.

A paper on the "Development and Mechanical Properties of Collenchyma, a Contribution to the Knowledge of the Mechanical System of Tissues," is contributed by Dr. Ambronn, and is illustrated by six plates of microscopical sections. The Collenchyma with the prosenchymatous fibres of the wood and bast form the mechanical system of Schwendener and Haberland. When the mechanical elements form separate plates, or bundles, or individual isolated cells, the cells are known as *Stereides*, and the whole tissue as *Stereome*. When on the other hand the mechanical cells are united with others which are non-mechanical, as in wood and bast bundles, then Schwendener has distinguished them as *Mestome*. The investigation of the structure of a number of plants shows that the Collenchyma may be arranged in bundles or in the form of a ring, and that in both the arrangement of Collenchyma and Mestome may follow a uniform plan, or the arrangement of the Collenchyma may be quite independent of the Mestome. Ambronn confirms the statement of Haberland that Collenchyma does not originate from any special morphological series of cells, but has the most variable origin: and further confirms the statement of Schwendener that the grouping and arranging of the cells depends entirely upon mechanical and not upon morphological causes. In *Fœniculum vulgare* the bast and Collenchyma of the external bundles are connected together and lie in the same radii, while in *Clematis vitalba* the bast and Collenchyma lie in the same radii but are not connected. In *Philodendron eximium* the Collenchyma forms a ring and is connected with the separate peripheral fibro-vascular bundles, both developing from a zone of secondary meristem. In *Peperomia latifolia* a ring of Collenchyma is formed, but it is independent of the bast. These plants afford examples of the four great types of structure. The Collenchyma cells are always prosenchymatous, often two millimetres in length, or even longer, and they frequently contain secondary partitions, being chambered by numerous fine transverse walls. They always contain fluid very rarely with any chlorophyll. The walls when viewed in a longitudinal section present elongated slit-like pores. Other collenchymatous cells are more parenchymatous in character, and originate by secondary collenchymatous thickening of parenchymatous cells. The wall always colours blue with Schultz's iodochloride of zinc, but is not coloured by the combined action of phoroglucin and hydrochloric acid, Wiesner's exceedingly delicate test for lignin, which is coloured a fine and intense rose-red by the reagents. Collenchyma swells up but little in water, contrary to the usual opinion, and only contracts about ½ per cent. when deprived of water. Collenchyma may originate from Cambium, from Meristem, or from Parenchyma, but the origin is found to be unimportant. The strength of collenchymatous cells is very little inferior to that of bast fibres, which have been shown by Schwendener to equal that of wrought iron wire.

The last paper is by Albrecht Zimmermann, "On the

Mechanism of the Scattering of Seeds and Fruits, with Special Reference to Torsion." The paper deals with the torsion in the awn of grasses, such as *Avena sterilis* and *Stipa pennata*, torsion of the legume of Orobus and Caragana, the curving and torsion of the awn or beak of the fruits of Geraniaceæ, and the scattering of the seeds of Oxalis, and is illustrated by three plates. The author points out the relation of the different phenomena observed to the mechanical cells in the part, as demonstrated by a microscopical examination of the different structures. Sometimes the cells of the part contract, at other times they swell up, and one or other or a combination of both these causes, gives rise to the effects noticed in the different plants under examination. Thus swelling of the cell-walls causes the remarkable ejection of the seeds of Oxalis. Unequal contraction of the mechanical cells causes the movements in the beaks of Geraniaceæ, and combined contraction and swelling in different layers of cells may be observed in the awns of Stipe and Avena.

In the second part under consideration, namely, vol. xiii. part 3, there is a paper by E. Godlewski, with the title "Contributions to the Knowledge of Vegetable Respiration." The details of a large number of experiments are given which were made, with an ingeniously contrived and simple apparatus, upon the respiration of germinating seeds with both fatty and starchy endosperm, and a smaller series of experiments made on the respiration of the flower buds of *Papaver somniferum* and on the ripening fruits with oily seeds of the same poppy and the castor oil plant. Some of the more important results as set forth by Godlewski himself may here be alluded to. During the early stage of germination in which the seeds swell up by imbibing water, the volume of CO_2 given off equals or is only a little less than the volume of oxygen taken up, both in fatty and in starchy seeds. When the swelling takes place under water or when air is excluded, *intramolecular* respiration takes place. When air is admitted the intramolecular respiration does not immediately cease, but is gradually replaced by normal respiration. As the rootlets of the seedlings are developed the volume of carbonic acid gas evolved gradually diminishes in proportion to the quantity of oxygen taken up, so that at the period of most active respiration only from 55–65 volumes of CO_2 are given off for every 100 volumes of O taken up. The formation of transitory starch during the germination of fatty seeds probably depends upon the action of atmospheric oxygen in each molecule of fat, converting it into CO_2, water, a certain quantity of an undetermined substance, and three molecules of starch. In the later stages of germination of fatty seeds the transitory starch is used as well as the fat, so that the difference between the volume of CO_2 given off and O taken up became gradually smaller, until at last the volumes are equal.

In the germination of starchy seeds the volume of CO_2 given off in all stages nearly equals that of O taken up, in peas sometimes a little more or a little less, but in wheat maintaining a seemingly constant relation of 1 to 1·05, the CO_2 being a little in excess of the O taken up.

In the buds of *Papaver somniferum* the CO_2 given off practically equals the O taken up (100·9 CO_2 for every 100 vols. O). In ripening fruits with oily seeds more CO_2 is given off than O absorbed; in *Papaver somniferum* 150 CO_2 for every 100 vols. of oxygen.

When oxygen is supplied under diminished pressure, respiration is variously influenced in different parts of the plant, but respiration is more affected in fatty than in starchy seeds. When the pressure of the oxygen is very slight *normal* respiration is reduced to a minimum, and *intramolecular* respiration commences. Intramolecular respiration is, under normal conditions, not a primary phenomenon as Pfeffer and Wortmann assert. *Normal* respiration consists in the immediate action of atmospheric oxygen upon the molecules of living protoplasm. Intramolecular respiration only begins when the normal respiration is rendered difficult by the want of atmospheric oxygen. Under ordinary conditions intramolecular respiration only begins when processes of reduction are going on in the plant as when fat is formed from carbohydrates.

The concluding paper in this part is "Contributions to the Anatomy and Mechanism of the Rolling up of the Leaves of certain Grasses," by Dr. A. Tschirch, with three plates. In this paper the author fully describes the mechanism by which such grasses as *Macrochloa tenacissima* (Esparto), *Lygeum spartum*, *Aristida pungens*, and others, which he groups as Steppe grasses, roll up their leaves in dry weather to protect the upper surface which bears the stomata, and prevent too great evaporation.

The first paper in the part and the longest is by the editor, Dr. N. Pringsheim, himself, "On the Function of Chlorophyll and the Action of Light in the Plant." This paper is a controversial one, issued in the form of an open letter to the Philosophical Faculty of the University of Würzburg. The first part of the paper includes a "personal defence," in which the statements contained in a paper by Dr. A. Hansen, with the title "History of Assimilation and the Function of Chlorophyll," published separately as a "Habilitationsschrift," and also reprinted in Sachs' "Arbeiten," vol. ii. p. 557, are minutely criticised. The second part of the paper is an historical discussion of the theory of assimilation, of the function of chlorophyll, and of the action of light on the plant. In this part Pringsheim does not seem to bring forward any new experiments, but gives a careful *résumé* of the whole subject under three heads. These are (1) Problem of the primary action of light on the cell; (2) the function of the colouring matter of chlorophyll in the exchange of gases in the plant; and (3) the function of the chlorophyll bodies and the primary product of assimilation of carbon. Into the merits of the controversy we cannot enter.

W. R. McNab

OUR BOOK SHELF

Mexico To-day. By Thomas Unett Brocklehurst. (London: Murray, 1883.)

During a recent tour round the world Mr. Brocklehurst turned from the beaten track in the United States southwards to Mexico, where he spent seven profitable months in the capital and neighbourhood in the year 1881. Since the suspension of our diplomatic relations with that country in 1860, great difficulties have been felt in procuring accurate information regarding its internal relations. All the more welcome will be this pleasantly written volume, which gives a far brighter picture of the Republic and its prospects than its most sanguine sympathisers may have anticipated. Since the expulsion of the French in 1867, profound peace has prevailed both at home and abroad, interrupted only by a few feeble and aimless pronunciamientos in the years 1868 and 1869; signs of moral and material progress are everywhere perceptible; security for life and property is being extended from the capitals to the remotest districts of the several states; the whole country is already covered with a network of railways connected in the north with the United States system, and affording several alternative routes between the Atlantic and Pacific Oceans; lastly, the Liberal party, which has guided the destinies of the Republic for over twenty years, has succeeded in establishing free institutions on a firm basis. "I have every confidence," writes our author, "that the favourable terms in which I have spoken of the country will not hereafter be found to be exaggerations; that my ideas as to the future prosperity of Mexico being early realised are true, and that such ideas are held by most of its leading men." And he adds that the time has come for England to bring about "a reconciliation with a country, in whose aid her influence and power could be so beneficially exerted" (p. 259).

The contents of this work, which is sumptuously illustrated by no fewer than fifty-six coloured and other plates from sketches by the author, are extremely varied, special chapters being devoted to the present state of the capital and surrounding districts, to the public institutions, the Roman Church, Protestant missions, trade, manufactures, farm life, the Pachuca silver mines, antiquities, the ruins of Teotihuacan, the remarkable limestone caves of Cacahuampila, Popocatapetl, and many other topics of general interest. During the ascent of Popocatapetl, the traveller ascertained that, according to the latest survey, the edge of the crater was 19,000 feet above sea-level, the usual estimates being 17,850 to 17,880, and that the peak still rose 1000 feet higher. Should these calculations be confirmed, Popocatapetl will again take its place as the culminating point of North America, a position from which it had recently been deposed by Mount St. Elias on the Alaska coast.[1] On the same occasion another curious discovery was made. General Uchoa, present owner of the crater and its rich sulphur deposits, told our author that the eruption of 1521, as described by Diego Ordaz, one of Cortes's captains, must have been due to some misapprehension. All geologists who have lately visited the crater, or who have examined specimens of its minerals, are now convinced that no eruption can have taken place for the last 10,000 years. This is a great confirmation of the opinion now generally entertained that the underground energies diminish steadily in vigour as we proceed from the Southern Cordilleras, through Central America, northwards to the Anahuac tableland. The financial condition of Mexico is described, contrary to the current impressions, as far from hopeless.

Of the numerous illustrations a large number are occupied with curious little clay heads, obsidian knives, stone pestles, arrowheads, and other objects found amongst the debris of the Teotihuacan ruins and elsewhere. There are also excellent reproductions of the famous Aztec Calendar and sacrificial stones, of a beautiful vase from Teotihuacan, of Teoyamiqui, the goddess of death, and of an exquisite vase of Centeotl, or the Mexican Ceres, a perfect gem of Aztec art. Many of the objects brought home by the traveller have been placed in the hands of Mr. Franks of the British Museum, and are no doubt ultimately destined to enrich the Christy collection.

A. H. K.

[1] On the British Admiralty charts this mountain is marked 14,800 feet, but by the late United States Survey it was raised to 19,500 feet.

LETTERS TO THE EDITOR

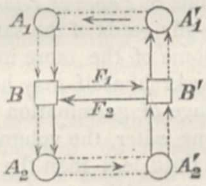
[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

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

The Matter of Space[1]

II.

IN the aggregations of points which form ponderable bodies, other means exist of suppressing the effects of the points' attractions for each other than the simple counteracting forces of the above figure. Clausius's equation of stationary motion in fact informs us that this will take place when there is no exertion of tractive moment, or no total instantaneous sum of motor-couple actions in the system. This simply appears to imply that the pair of orbs A_1 A_2 and the pair A_1' A_2' are in that case no longer independent of each other in their transference and counter transference of motor energy, but that the twofold action of such energy is then a self-neutralising one; or in other words that the energy given off at A_2 passes on to A_2'; and that discharged at A_1' is taken up by A_1; so that in the case where B B' are in stationary motion, or combine to form a "sphere" of two gravitating points, or again where many such points collected together form a permanent ponderable body, orb-couples intervene between the otherwise free extremities, $A_1'A_1$ and A_2A_2' of the two ether systems (in the directions shown by arrows in the figure), and bind them together conservatively by an endless circuit of motor energy through the ether-orbs, while a similar endless flow of ordinary momentum through the ponderable channels of the system in the meantime constitute also the usually recognised internal, gometrical, or



"lost" forces of such a permanent aggregation, "sphere" or "body" of ponderable matter.

This subjection of two or more baric points B B' &c. to the condition of stationary motion, as the bond of neutrality of "lost" geometrical or "internal" forces between them differs therefore from the case before supposed of absolute suppression of all interforce between them in this, that when (in the latter case) the motions of the points B B' &c. are absolutely free and entirely exempted from disturbing force action, the motor-vigours of the couplets A_1A_2, $A_1'A_2'$&c. of the ether-orbs in permanently bound binary attendance upon the baric points B B', &c., respectively, will then also be equally exempt and free from disturbing actions of any other orb-couples upon them, than those only by which they are dually and counter-equally bound to each other through the channels of their respective baric centres B B', &c.

Throughout the whole of a baric point B or B_1's state of undisturbed rest or motion, the ether-couplet attached to it is constantly transmitting from one of its ether-orbs to the other a ceaseless flow of undirected energy, or it is etherially exercising a ceaseless undirected horse-power, whose supply of energy is drawn from and is returned again without mal-destination to the universal ether's general stock of energy, if the meaning of the principle of conservation of energy in this case may be said to be that, for the entire sum of all its parts, the universal ether's whole stock of energy never undergoes any alteration. We may next consider also the case where the interforces between baric points are not entirely absent, but may present us with a resultant algebraic sum of any number of interforces, instead of with a neutral sum only of two equal and opposite ones. Although in that case there is no counter-equality between the motor-couples which act on the ether cortege A_1 A_2 &c. of each baric point B or B' &c. yet if the motions of these latter points are subjected to no condition of stationariness under the influence of the forces acting on them we may yet recognise the universal ether's whole

[1] Continued from p. 460.

stock of energy as being the source and destination of all the flows of undirected energy exerted by the collective cortége's couples, if we assume for the whole of the ether together the same obedience to the law of conservation of energy as before, because, for each one of the interforces between B and some other baric point B′, and therefore in the sum of all such mutual forces and points paired with B to produce them, the orb-couples at A_1 A_1' which yield the force F_1 are exactly counter-equivalent to each other, and so will abstract from such a general stock of energy just as much at one of their points of action A_1 or A_1' as they restore to the same general stock of their energy requirements at the other one.

The presumption here used that the undirected energy funded and effunded by the motor-couples acting on the ether-retinues of the reacting baric points, belongs to an invariable stock of that description of energy residing in the universal ether as a whole, and that it is not extracted from and rendered up to any other imaginable sources, or in other words the theory of the conservation of motor energy in the universal ether by all the motor orb-couples together which are in action in it, acquires an important meaning, when we recur again to the nature, as above explained, of the condition to which these orb-couples are subjected when they act upon the ether-retinue of a collection of baric points which compose a "sphere" or body, or which are together in stationary motion. The description already given of this case informs us that when the state subsists, the simple sum of all the motor actions or tractive couples on the body's retinue of aërilians[1] is either nil at all times instantaneously, or, when it is a periodic sum, its average value for a time-period or recurring time-cycle of its changes is so. No instantaneous resultant can be formed at all, if the sum's value is perceptibly periodic, and it is not in our power to say whether ether orbs of aërilian points originally differentiated from weighty material points (or whether those points themselves) yield sums which have periodic or instantaneous resultants; it belongs to a strict examination of the subject to pronounce and illustrate the rules by which stationary or periodic resultant sums can, in combinations of orbs or aërilian parts, afford by proper means either periodic or stationary resultant actions on a collective aërilian assemblage. The mode of combination of such actions on subordinate parts into a resultant action of one or both kinds on a united group which they compose is certainly not a hopeless problem, when its character is once regarded as the essential problem of etherial mechanics. What free or unbound ether may exist besides the ether enrolled in the retinues of ponderable matter, and what actions these free and enrolled portions of the ether may have upon each other, and separately or together upon the originally sundered multitudes of matter composing the ponderable parts of gravitating bodies, so as (with time as another element of the reactions) to explain the gradual process of condensation which appears to be a perfectly regulated progressive principle of material economy, are all questions which, by a closer discussion of the surmises here explained and indicated, may without doubt be certainly expected to follow from their careful consideration, in due course. But as the phenomenon of stationary motion is shown by Clausius's equation (which states its condition) to be at least a rigidly true absence of average total tractive moment in a system which presents it, when the average is a time-average taken over a sufficiently long fixed or over a proper repeatedly recurring term or movable interval of time, and since, to senses incapable of discriminating exceedingly minute quantities, this time-average becomes an instantaneous quantity when the time-term for which it is reckoned diminishes without limit, a conclusion may be readily drawn from this which will fairly justify us in accepting the presumption used above, that the instantaneous effects of individual motor-couple actions are conserved in the universal ether as a whole. For we are unable to discriminate *what* periodic variations the sum of these effects may or *may not have* in their total value for the universal ether; and we have therefore exactly the same grounds for regarding the instantaneous effects of all motor-couples as being instantaneously conserved by the occult fluctuating terms or periods of the universal ether, as we have for viewing them as instantaneously conserved (so as to give a sensibly stationary zero resultant sum) throughout the parts of a ponderable body's mass in which we cannot detect any periodic motion, or any perceptible vibration.

[1] Those entering into the baric body's actual composition may be left out of the enumeration, since this body's baric motions being themselves (all taken together) stationary, they satisfy the equation of condition identically; and in general instantaneously, unless a common periodic motion is given to the baric points.

A bent bow, when its string is released, a soap-bubble or an air-gun's charge, when they give way and burst, or a bubble of hydrogen and chlorine gas mixture when an active light-ray strikes it, ignition of a train of gunpowder by hot iron, or of fire-damp in a safety lamp, of gases and gold leaf by the electric spark, are instances, if we could penetrate the process, of suddenly infringing by a forced vibration the gradually attained subsidence of all perceptible periodicity in a system's inner motions, with instant disintegration for its consequence of the stationariness of the motor-actions of its parts. A little universe in effigy has collapsed, leaving to the universal ether the task of saving and storing up, by means of individual free motor-couples, the vibrations let loose, and of so modelling into something else the scattered fragments.

But on the other hand the resisted jet, as well as the shutting of a water-pipe or steam-boiler valve, the swing of a hammer as well as its stroke on a rock or bell, directed radiations of all kinds as well as their radiometer-like interceptions, the steadily resisted flow as well as the breaking or making of an electric current, conduction between bodies of a steady flow of heat, sound, and all perceptible horse-power exercises of motor-vigour's effective, or unreversible operations, can only be conducted (as the ether does conduct such effective works there conservatively) by the individual periodic actions of unbalanced motor-couples acting on some free-coursing ether-orbs or orb-clouds forming equally free-coursing heavy bodies' retinues. These all rely directly on the universal ether's store of motor energy to maintain in their isolated severance (and in that of the free-coursing bodies also) from other works' and matters' motions a constant conservation of their unreversible motor-activities' effects.

This view of the ether's function as a whole to conserve the individual effects, both of primordial and of resultant motor-couples on ether aërilians and orbs and clouds, whether those couples' intensities are stationary, or fluctuate and vary in any periodical or unperiodical manner, is the second maxim above noted, to be kept in view along with that of description of couples' intensities as a time-rate of a certain kind of energy, in discussing the properties, or the etherial mechanics, of motor-couples' balanced and unbalanced actions. The maxim, as thus laid down, also cautions us against confusing the kind of *instantaneous* energy effects of motor-couples, which the ether conserves as a whole, with any periodically *term-averaged* semi-mean square of a collection of particles' rhythmically fluctuating velocities, or with any temporary or enduring "peræval sum," as it may be called, of the collection's total undirected energy, since the instantaneous undirected sum thus obtained, is not really instantaneous as long as the length of the term or period over which the average is taken is a perceptible and measurable one. The resultant quantity whose effects the ether conserves at every instant, on any individual aërilian assemblage, by a total sum of counter-equivalent quantities acting on other aërilian assemblages or aërilians is the sum (treating every aërilian as of the same inertia $m = 1$)

$$\Sigma \frac{d}{dt}\left(r\frac{dr}{dt}\right) = \Sigma \left(Rr \right) + \Sigma \left(v^2 \right);$$

where, for a single aërilian, r is a vanishingly small distance between at least two parts of which it must consist, and for groups of aërilians the sum also includes, under the general symbol r, the distance between centres of every pair of aërilians possessing, relatively to the assemblage's centre of inertia (just as the aërilian parts do relatively to their aërilian centres), counter equal accelerations, $R, -R$. We are not at liberty in applying the equation to include in its sum any other distances and accelerations, nor any other velocities v, of the aërilians' parts and centres than these barocentric ones, relative to centres of inertia included in the given system, because as an equation of couples having no truth or meaning, except in virtue of its composition of pairs of quantities (so furnished by pairs of inert points contained in the system as to be independent in its sum of the origin of reference used in its formation), all distances, velocities, and accelerations of the given system's centre of inertia cannot form part of the equation conformably to its physical use and applications, but must form part of physical actions in some other system, of which the given assemblage and its centre of inertia forms one individual member.

It is this necessary view of the above equation of stationary motion drawn from such views as those here offered of its physical interpretation, which obliges us to regard the simplest aërilian point of the ether as consisting of at least two parts; and this assumption agrees with the dual view of the ether's nature taken by Professor O. Lodge in his address on the "Functions of the Ether" (NATURE, vol. xxvii. p. 328), while this system also explains the kind of conservation which has been noticed independently by Dr. G. Lippmann and Professor S. P. Thompson[1] as characterising the phenomena of electricity, and the close resemblance which not only exists between the processes of conduction of heat and of electricity, but also, as noticed by the former writer, between the laws of electrical potential and the thermal principle of Carnot's law.

It seems scarcely probable that so many converging views can be all fallacious, and ingenuity may without doubt be spent with profit and advantage in further attempts to adapt and reconcile some comprehensive theory of the ether's properties, of a mechanical description, to embrace in a common review all the multiplicity of remarkably analogous laws, which physics in its various branches at present offers to our contemplations.

If the description which precedes of a connected outline of such a system of synoptic views has extended to a much greater length than I was originally prepared to offer as comments on Mr. C. Morris' communication, it is because the logical developments which I have repeatedly found them to admit of induced me to try to establish them on a satisfactory foundation. In many trials, moreover, of their applications, I have met with such frequent proofs of the validity of some such general principles as those here indicated, that the results to which they have easily conducted me in numerous directions, are in general so accordant with those which Mr. Morris has skilfully reviewed, that, save in the small divergence between us, upon which I have dilated, in the main principles adopted for explaining them, Mr. Charles Morris's and my views of the properties and laws of motion, of the distribution of the "Matter of Space," and of the mechanical behaviours of "motor-vigour," are for the most part only *variæ lectiones* of each other. A. S. HERSCHEL

Newcastle-on-Tyne, February 10

P.S.—It will perhaps serve to correct some misconceptions which, although they were not intended to be produced, may yet not impossibly have arisen from the form of defective reasoning, which at some few points of this letter's descriptions it has been unavoidably necessary to introduce, to notice in recapitulation that it formed at the outset no part of its main object to define and represent exactly the extremely complicated part which (at least in combinations of its periods) it is evident that time discharges in determining the operative efficacies and strengths of motor-couples, in exerting "vigour" of undirected motion. With a well-grounded geometrical substructure, there need be no occasion to entertain a doubt that the first principles at least of time's use in definitions of the actions and effects of wrests or motor couples will be easily identified and laid down with all the precision and accuracy needed for purposes of their mathematical applications.

The principal object, however, here aimed at and sought to be attained has not been to offer such an exact description of time's relations of form and economy to the different states of action and repose of undirected motion (which do not actually admit of successful discussion without much more abstract elementary conceptions than those ordinarily recognised of geometrical principles), but simply as a preliminary step towards this question's future surer treatment, to point out clearly and plainly the distinctive and peculiar character of undirected motion's space-relations.

This kind of motion, it has been endeavoured to explain, consists in change of magnitude of a certain ratio-index, ϕ, of tractional configuration between collocated points. In the capacity of a ratio-index ϕ very closely simulates, in its algebraical and geometrical properties, all the analogous properties of angles. But it differs from them in this important particular, that it possesses no directional qualification. For a crank-arm's description of angle at once assigns the plane of the crank's revolution, and this plane has direction; but extension of a connecting-rod is a ratio which affects the rod's length equally in all positions, without giving rise in so doing to any new direction.

On the other hand, neither motion in angle nor in traction-index can by their unaided to-and-fro presence in a crank or connecting-rod give backward and forward motion to a piston or piston-rod, but only by virtue of certain constraints involving the properties in one case of trigonometrical, and in the other case of hyperbolic, sines and cosines. It is probably because changes of angle are, like the changes of the angle's sine which result from them, directed quantities, that the relations of angle-variations to changes of coordinate lines by means of trigonometrical ratios is a familiarly applied and well-established theory. But no such theory having the same scope and extent of application connecting changes of coordinate lines with variations of the ratio-index ϕ, by means of hyperbolic sines and cosines, and showing what necessary conditions directed geometrical quantities (including angle) *must satisfy* to make a fixed law of hyperbolic connection with the undirected quantity ϕ have any possible existence, has yet been brought into general notice and acceptance.

But that the directed and undirected geometrical quantities do satisfy and fulfil such a condition, and that the fixed law of connection between them does actually exist, there is sufficient evidence to assure us in the consistency with which such reasonings as those which Mr. Morris has produced, and which I have tried to base on that geometrical assumption, represent correctly a very large array of physical phenomena. Forming therefore, as the undirected quantity ϕ does, a position-scale in space, of whose possession of certain distinctive and special geometrical and physical properties no theoretical employment has yet been made, and no sufficient proof of satisfactory evidence has, in fact, heretofore been produced, no excuse, it is opined, for hyperbole or figurative use of speech need be presented, for describing the new quantity, as it was termed in a former part of this letter, as a new position-scale of interspheral, ethereal, or aërilian motions foreign to and independent of our ordinary graphic field of space.

[1] NATURE, vol. xxiv. p. 140; and pp. 78, 164.

Mr. Stevenson's Observations on the Increase of the Velocity of the Wind with the Altitude

I AM sorry if I took Mr. Stevenson too literally when I understood his remark, "great heights above sea-level," to mean *absolutely* great heights; but I certainly think the phrase is extremely liable to such interpretation, and as no superior limit was assigned, I naturally inferred that the author deemed the formula $\frac{v}{V} = \frac{h}{H}$ applicable to such heights as those considered in my paper.

On his own showing, however, this formula succeeds no better than mine on Arthur's Seat; while mine possesses the unquestionable advantage of approximating to the truth throughout the higher levels, where all Mr. Stevenson's formulæ fail according to Vettin's data. If the data furnished from Arthur's Seat correctly represent the conditions in a free atmosphere up to the same level, which I very much doubt; we must infer that the velocities increase in a more rapid ratio with the heights than that given by the formula $\frac{v}{V} = \left(\frac{h}{H}\right)^{\frac{1}{2}}$, which is preferred by Mr. Stevenson, but in not so rapid a one as that given by $\frac{v}{V} = \frac{h}{H}$; and in fact, if we make the index $\frac{2}{3}$ instead of $\frac{1}{2}$, we get a formula which gives far better results, as far as the Arthur's Seat observations are concerned, than that preferred by Mr. Stevenson. The agreement is so close for nearly all the velocities, that I give below a comparison of the results afforded by both formulæ:—

Velocity recorded at high elevation, 775 feet above sea-level.	Velocities computed for lower station: By Mr. Stevenson's formula $\frac{v}{V} = \left(\frac{h}{H}\right)^{\frac{1}{2}}$	Velocities computed for lower station: By the formula $\frac{v}{V} = \left(\frac{h}{H}\right)^{\frac{2}{3}}$	Velocity recorded at lower station, 550 feet above sea-level.
885	703[1]	704	720
1,698	1,430	1,351	1,364
2,620	2,206	2,084	2,133
3,416	2,876	2,718	2,718
4,328	3,646	3,443	3,465
5,575	4,697	4,435	4,592
6,763	5,698	5,381	5,640
8,035	6,765	6,393	6,782
9,368	7,893	7,453	7,862
10,820	9,115	8,609	8,765
12,410	10,455	9,874	9 789
13,700	11,542	10,900	10,639
15,058	12,687	11,980	11,680
Sums	79,713	76,325	76,149
Means	6,132	5,871	5,857

[1] This value is wrong as given by Mr. Stevenson. It should be 745

From the above table it is seen that in ten cases out of thirteen, the formula I have proposed gives results clo er than Mr. Stevenson's, while the means differ by a quite insignificant amount.

If then, as seems probable on all grounds, the higher we ascend, the slower the increase of the velocities with the heights, Mr. Stevenson's formula, $\frac{v}{V}=\left(\frac{h}{H}\right)^{\frac{1}{2}}$, should hold for a level somewhat higher than 775 feet, and not below it. Above that, again, a formula, $\frac{v}{V}=\left(\frac{h}{H}\right)^{\frac{1}{3}}$ should apply; and finally, the formula, $\frac{v}{V}=\left(\frac{h}{H}\right)^{\frac{1}{4}}$, recommended in my paper.

I cannot believe, however, that the formula $\frac{v}{V}=\left(\frac{h}{H}\right)^{\frac{1}{2}}$ holds up to such a comparatively large height as this inference would postulate, since it gives such an excessive value at 1600 feet with Vettin's data (more than twice that observed), and I can only conclude, therefore, until experiments in a free atmosphere corroborate Mr. Stevenson's data from Arthur's Seat, that these latter do not correctly represent the actual rate of increase in the velocity between such levels in the atmosphere, away from the disturbing influences of mountains and valleys.

In any case, however, I must enter a distinct protest against having my name prefixed to the pressure formula $\frac{f}{F}=\sqrt[4]{\frac{h}{H}}$. If Mr. Stevenson carefully examines my paper, he will nowhere find the remotest allusion to such a formula. The formula for the velocity which I there recommended for the higher levels, was in fact shown to be directly deducible from Mr. Stevenson's first formula for the pressure, viz. $\frac{f}{F}=\sqrt{\frac{h}{H}}$, to which it is exactly equivalent on the ordinary assumption that $\frac{f}{F}=\frac{v^2}{V^2}$.

Moreover, the paradoxical result which Mr. Stevenson arrived at in violation of this assumption, viz. that the same formula was practically applicable both to force and velocity, is controverted by the conclusion entertained in his letter, that the formula $\frac{v}{V}=\sqrt{\frac{h}{H}}$ agrees best with the recorded results of velocity, and the formula $\frac{f}{F}=\frac{h}{H}$ with those of pressure.

While these two formulæ can hardly be called the *same*, it is somewhat striking to find that on the assumption force varies as $(\text{velocity})^2$, which is supposed to be annulled by the diminished density as we ascend, they are *identical*.

Finally, Mr. Stevenson has ev dently quite misunderstood my allusion to sea-level. When I spoke of sea-level, I simply meant the approximate equivalent to the level of the sea *on land*, as at Berlin for example, where Vettin's observations were made. When Mr. Stevenson therefore maintains that the velocity of the wind at 100 feet above sea-level over land, is probably not so great as that near the surface over the sea, he entirely misses the point of the argument, which lies in the *relatively* excessive velocity of the wind at 100 feet above, to that near the surface, *over land which lies approximately at sea-level*.

The very fact mentioned by Mr. Stevenson regarding the greater friction encountered by air in passing over land than over water, as well as the results of his experiments, point to a considerable increase in the velocity from the surface to an elevation of 100 feet above it. For the very same reason, I should expect to find a more moderate increase up to the same height over water. E. DOUGLAS ARCHIBALD

On the Formation of Mudballs

THE letter from Mr. Hart in NATURE, vol. xxvii. p. 483, on the natural formation of snowballs, has recalled to my memory the similar formation of balls of mud.

About eight miles south of Bromley in Kent the soil is clayey, and after rain the country lanes are apt to be very muddy. Some five or six years ago there was a very violent storm of rain, whether or not accompanied with melting of snow I cannot now remember. The steep lanes were in many places regularly scoured with water, and it looked afterwards as though the whole surface had in places been a sheet of water, for the soil was quite washed off and the flints were left bare. After this storm my brother and I noticed in the lanes a considerable number of mudballs, usually almost perfectly spherical, but in some cases with a tendency to a cylindrical shape. They varied in size from small pellets up to four or five inches in diameter. On seeing the first one or two, they looked to us like the handiwork of some boy with an enthusiasm for mud pies, but the number of them, and the fact that they were always found on the slopes of hills proved them to be a natural formation. They were formed throughout of soft clayey mud, and I do not remember finding any nucleus in the middle when we cut them open. We concluded that they were formed by accretion to pellets of mud washed down the hillside and rolling as they went. I have only once since seen a similar ball, and that was in a furrow in a ploughed field in the same country; it is possible that this ball may have been made inside an agricultural roller, although there were no marks on the field of recent rolling and there had been heavy rain. The comparative rarity of the appearance of these balls seems to show that they can only be formed with some precise degree of stickiness of the mud. Closely similar are the marvellously spherical balls of matted vegetable fibre to be found on the seabeach in some places. Sir Anthony Musgrave informed me that on the beach in Australia, I think near Adelaide, he had seen tens of thousands of such balls, all perfectly spherical. It seems rather obscure why the fibres should begin to mat together in such a form as to be rolled by the surf, but the perfection in shape is clearly due to incessant rolling. It is probable that, with a flat bath and some cocoanut fibre or oakum, the process of formation might be watched, but I have never tried the experiment. It is very common to see after rain matted lines of such objects as pine-leaves or the flowers of lime-trees, but I have never seen any apparent tendency to rolling, and such lines are left lying flat after the water has drained off. G. H. DARWIN

Cambridge, March 23

Snow Rollers

THE phenomenon described in NATURE, vol. xxvii. p. 483, under the title of "Natural Snowballs," is known to British meteorologists under that of snow rollers, and as the latter agrees more closely with the phenomenon, I venture to plead for its adoption.

I believe that the first person who carefully examined their formation was that excellent and venerable observer, the Rev. Dr. Clouston of Sandwick Manse, Orkney, and I am under the impression that he published a description of their formation in an early number of the *Philosophical Magazine*. He has observed them on the lawn at Sandwick more than once, and has always noticed the hollowness at the ends; in fact, he described them to me as resembling ladies' white muffs.

I remember only one instance of their being reported in England, namely in the following letter from the late Admiral Sir F. W. Grey, which appeared in the *Meteorological Magazine* for May, 1876. G. J. SYMONS

62, Camden Square, N.W.

SIR,—The snowstorm of Thursday night (April 13, 1876) was marked by one circumstance which I have never witnessed before, though it may not be uncommon. It was this :—

On Friday morning I observed that for a considerable distance, and following a regular line, the lawn, to leeward of the house, was strewed with masses of snow like boulders, varying from the size of a snowball to a cubic foot at least, and as the snow melted, a track either straight or curved led up to the large ones, following, apparently, the direction of the wind. I had observed before dusk that the eddies of the wind and the swirls of the snow were very marked, and I have since heard from a friend who observed the same thing, that he saw the snow rolled along by the wind, and forming masses such as I have described.

As I have said, I know not whether this has been observed in other cases, and perhaps it may interest you to have this account of it.—Yours faithfully, F. WM. GREY

Lynwood, Sunningdale, Staines, April 16

Incubation of the Ostrich

IT seems strange that there should have existed an uncertainty in the mind of an ornithologist as to the mode of incubation of the ostrich in confinement at the Cape of Good Hope. The habits of the birds are of course as familiar to the ostrich-farmers as those of barndoor fowls to ourselves. I have stayed at a farm at Cape Point, where a pair of the birds were nesting within fifty yards of the house, in a small paddock, and have seen the hen on the nest.

An interesting subject of inquiry, however, seems to me to be still open in the matter. It is, How far do the habits of nidification of the ostrich vary in the different climates through which it ranges? The nest of the ostrich is commonly described as a heap of sand, and so no doubt it is in warm desert regions; but the nest which I saw at the Cape was carefully built of grass and other warm materials, so as to aid in retaining heat. The birds kept the nest almost constantly covered between them.

In warmer regions, however, the hen appears often to leave the nest in the daytime, and it is just possible that where the temperature is very high the hen may not incubate at all, and the cock alone may do so at night. I merely wish to point out that it should not be assumed that the habits of the ostrich as to incubation are necessarily the same in the various climates of Africa with those to be observed in the Cape region.

I have noticed that at the Zoological Gardens the ostriches at the breeding season are supplied every year with a cartload of silver sand as the traditional nest. It would not be amiss to try them with some more substantial materials as an experiment, and prove whether in our climate they would not build a warm nest as at the Cape.

That birds' eggs can be hatched like those of turtles in mere sand is undoubtedly a fact. The Megapodius inhabiting Cape York, Australia, makes, as is well known, a huge mound of vegetable matter, which by decomposition supplies the necessary warmth to hatch the eggs; but at the Philippine Islands another Megapodius buries its eggs in the perfectly clean calcareous sand near the seashore.

The habits of the emu in nesting have been carefully watched at Blenheim. The head keeper told me not long ago that the cock alone incubates. The hens lay their eggs anywhere about in the grass, the cock builds a nest, and rolls the eggs to it, the hen sometimes endeavouring to prevent him and to break them. I believe an account of observations on the habits of the emu at Blenheim were published by Mr. Frank Buckland.

H. N. MOSELEY

Bonchurch Hotel, Isle of Wight, March 26

Holothurians

MY experience of about three months in Bermuda and Jamaica fully bears out Mr. Guppy and Mr. Kent's view that the Holothurians do not feed on living coral. They were moderately common in both localities close to the shore, where corals are comparatively scarce, and are mainly of the massive kinds, such as the Astræas, against which the tentacles of a Holothurian would be useless. There were a few branching Oculinas here and there, but not enough to support the Holothurians. But further, some of the latter bury their bodies in the mud or sand, leaving only the tentacles exposed; and I have watched these thrusting their tentacles into their stomachs right up to the base in the comical way described by Mr. Kent. It is quite clear that these were not feeding on living coral. I did not, however, see them actually taking up sand and shell and thrusting it down, as Mr. Kent did; in fact I was puzzled as to what they were feeding on. From the way the tentacles were set, standing nearly erect, I fancied they were catching swimming creatures, as other tentacled animals do. This idea is supported, though not proved, by a fine specimen from the Zoological Station at Naples, which has a half-swallowed fish protruding from its mouth. The specimen is in the Bristol Museum. It proves at all events that they do not reject this kind of food. Possibly in default of it they may fall back upon sand and shell, and the minute organisms contained in these. Some of my experiences with these creatures were interesting. At Bermuda two large kinds used to lie quite exposed in shallow water. I might have guessed from this that they would probably be protected in some way. I used to wade along shore carrying a fishing-basket and a landing-net, and one day, as my basket was full, I put a couple into the landing-net to carry home. As their skins were quite hard, I thought they would travel well so. After handling them, I found my hands smarted a little, and the irritation lasted till bedtime. I found that little bits of their skin had got under mine, and this caused the irritation. As I was going home, I found my Holothurians were literally melting away; long streamers of a colourless gelatinous substance were hanging down between the meshes. Of course I threw the nasty things away, and had a dreadful job to get the net clean. I attributed my misfortune to the sun, so another day I packed a couple up comfortably at the bottom of my basket, which is very closely made. After an hour or two I was horrified to find long streamers hanging down from the basket of the same horrible substance. They had literally gone to pieces again, and spoilt everything in the basket. Shortly after, I left for Jamaica, and there I took out a wide-mouthed bottle and brought one home in triumph. Being engaged that evening, I left the Holothurian in the bottle all night. Next morning the creature was all there, but he had cleared out the whole of his inside; his intestinal canal and the beautiful tree-like organ were perfect. The latter was still alive and was waving about in the water in the prettiest way, and looking remarkably like branchiæ. Some accessory organs along the intestinal canal were exhibiting rhythmical pulsations. Altogether it was a most interesting sight. But my poor Holothurian was only a tube. I did not know at the time that he could grow a complete new inside.

Clifton College J. G. GRENFELL

The British Circumpolar Expedition

SUPPLEMENTARY to the very interesting notice in NATURE (p. 484) of the above expedition, permit me to give a brief extract from a letter recently received from Capt. Dawson, as follows:—"I have heard of a large cavern about a day from this (Fort Rae), which I shall try and explore. There are some eyeless fish that live there, that I hope may turn out to be a new species." I do trust Capt. Dawson may be able to carry out his intention, but he must be heavily weighted with work, in which he appears to take a deep interest. I had long ago been told of this cave and its fish, but had no time to visit it, never having been within one or two hundred miles of the place.

March 24 J. RAE

Meteor

MR. MASHEDER'S account in your last number of NATURE (p. 483) of the meteor seen by him at Ashby-de-la-Zouch on March 17, corresponds in some particulars with the inclosed note of one seen by myself on the same evening at Malvern. I am therefore inclined to send it you.

The discrepancies are in the time, which Mr. Masheder states to have been 7.5, while here the meteor passed at 6.56 p.m.; also in his description of "pieces dropping," I noticed no such appearance, but simply the not unusual one of rapidly recurring scintillations in the train.

Great Malvern, March 17, 6.56 p.m.

This evening a bright flame-coloured meteor with a short scintillating train, nucleus the brightness of Jupiter, passed rapidly across the sky. When first seen it was beneath the moon, then shining brightly, and was apparently about the altitude of Betelgeux, at that time nearly 10° past the meridian. It disappeared behind the hills almost due west, but so quickly that it was difficult to determine its course with any exactitude.

Lambert House, Great Malvern, March 25 E. BROWN

Mimicry

SUCH remarkable instances of mimicry as that described by the Duke of Argyll in NATURE, vol. xxvii. p. 125, as occurring in a moth, make heavy demands upon the faith of the non-scientific reasoner, since it seems to him impossible that organic Nature in her "blind groping in the dark" could, under any imaginable combination of circumstances, have succeeded in taking the successive steps requisite to bring her to such a state of perfect adaptation to condition. But the proverbially keen sight of birds, *as at present organised*, is apt to lead to erroneous inferences with regard to the evolution of protective mimicry in their insect prey, seeing that the high development of this faculty now attained by them renders nugatory any disguise that is not almost perfect. The theory of natural selection, however, requires the gradual perfecting of this, no less than of other structural and physiological acquirements; and there is no reason for supposing that the Ornithoscelidan ancestors of the feathered tribes possessed exceptional visual powers, but rather that the reverse was the case; so that it may be concluded that improvement in vision and in rapidity of flight proceeded *pari passu*. This being granted, the initiatory steps of mimicry in the *Lepidoptera* may have been tentative, and well within the competence of ordinary variability.

The above sufficiently trite train of thought has been suggested to me by the consideration of analogous facts known to every angler. Many fishes greedily snap at anything that glistens or is highly coloured, especially if it be rapidly drawn through the water, and the slight additional disguise imparted to artificial bait of this description by a spinning motion renders it very attractive. The highly specialised salmon is easily deceived, and the most killing artificial flies for this fish make no pretence to resemble anything in nature, and are attractive in proportion to their gaudiness. The same is true of his congener the trout, although this fish appears to be somewhat more æsthetic in his tastes; and the most useful artificial flies employed to entice him are mere generalised imitations of his natural food. Indeed, on these grounds no less than on those of anatomy, it cannot be doubted that the *Teleostei*—albeit highly specialised of their kind—have failed to develop that acuteness of vision which their rapid movements would seem to render desirable, and are yet in the stage in which a very imperfect mimicry misleads them; and it is not an unreasonable presumption that birds were once in a very similar condition, from which they have emerged in consequence of the necessity for frequent and abundant supplies of food entailed upon them by their active mode of life. Under these circumstances it must have gone hard with the helpless caterpillar, so toothsome and nutritious, seeing that he could not, like the mature *Phryganidæ* and *Ephemeridæ*, keep out of harm's way by shunning the element inhabited by his natural foe; and hence arose the necessity for his protective modification. How urgent was the need for this is amply shown by the fact that several distinct modes of protection have been enlisted in his defence, viz. cuticular hypertrophy resulting in hairiness, mimicry of the vegetation on which he feeds and lives, and unpalatable flavour; to which has been superadded mimicry of the unpalatable forms by those of good flavour. But even with all this adventitious aid the struggle would probably have proved exterminating to him by reason of the voracity of birds, had not the teeming imago participated in the protective modifications, and thereby been enabled to maintain the balance of supply and demand necessary for the survival of the order.

Wycombe Court, Bucks PAUL HENRY STOKOE

Threatened Extinction of the Elephant

THE threatened extinction of any existing species of plant or animal cannot fail to be matter of real concern to all students of science, who ought to neglect no feasible means for preventing so deplorable an occurrence.

Of the few gigantic mammals still living on the surface of our planet, none possesses more interest and none are more worthy preservation than the elephant. Yet it is an accepted conclusion that the elephant is doomed to extinction, and that within a measurable period of time this majestic quadruped will have suffered the fate of the Dodo. Cannot such a calamity be prevented? Surely the destruction of elephants might be legally controlled (in India, at any rate), and their capture (for domestication) might be limited, as it is well known they never breed in confinement. The continuous rise in the market-price of ivory, and its recent unprecedented scarcity as an article of commerce, are ominous signs, and renders it incumbent on the votaries of science to consider what may be done in the matter. It is no question of mere sentiment—it is of vital importance; and if "ancient monuments, ruins, &c.," are worth protecting, it cannot be denied that so remarkable and interesting a creature as our colossal Pachyderm merits some effort in his behalf.

EDWARD E. PRINCE

United College, University of St. Andrews, March 15

A Curious Case of Ignition

ONE fine morning recently, as two ladies were standing together in the drawing-room of a house in this neighbourhood, smoke was observed to rise from the dress of one of them. This was found to be due to ignition by the solar rays focused on her dress by the lens of a graphoscope which stood on the table. Similar cases of accidental concentration of the sun's rays have, I am aware, been recorded. It would be interesting to know whether any serious fires have thus originated. One can easily imagine circumstances which would favour such results from a simple cause. M.

Finchley, March 26

SINGING, SPEAKING, AND STAMMERING[1]

I.—SINGING

THE voice, essentially a musical instrument, has only of late been scientifically considered. Even now singing is too much dealt with as an art, and its acquirement as an accomplishment. The professional mystery with which it is surrounded serves no good purpose, and favours empiricism. At ladies' schools the old fiction of what are quaintly termed "finishing lessons" still survives; they often succeed in finishing any prospects the pupil may have had of becoming a singer. Most of the current primers and tutors are ludicrously vague and feeble, many methods are absolutely injurious to the voice; for the improvement of which one ingenious inventor has suggested the use of a false palate, and another the fitting of singers' mouths with a sort of bell-shaped snout or proboscis to act as a resonator. A chorus of such proboscidians on the Handel orchestra would be an appalling sight. The real foundation of our knowledge rests on the researches of Helmholtz on the physical, and of Garcia on the physiological, side. The classical discoveries of the former as to the production of vowel-sounds by the superaddition of a varying harmonic in the mouth-cavity, and of the latter by the examination of the larynx in action by means of a mirror, brought before the Royal Society in May, 1855, have formed the substratum of much which has now become the common property of scientific men. Dr. Bristowe, in his Lumleian lectures of 1879, has added some pathological data of considerable value, and Dr. Walshe, in his "Dramatic Singing, Physiologically Estimated," has touched on points connected with the sympathetic and emotional power which this most perfect of instruments can be made to exercise. It owes this in a great measure to the fact that it can combine musical sounds with significant words, and thus interest at once the ear and the intelligence. After a demonstration of the action of the larynx and fauces in phonation, illustrated by some excellent photographs taken from his own larynx by Mr. Emil Behnke, and thrown on the screen, vowel sounds were shown to be thirteen in number in the English language, with six more in French and German, fifteen of these being oral in origin, and four, all French sounds, nasal. Consonants were about sixteen in number, and had been called "noises" by Max Müller, owing to their comparatively unmusical character. They are chiefly caused by some check or obstruction to the laryngeal note. A diagram of Madame Seiler's was, however, shown which indicates that there is an oral resonance-note even for consonants, though it is much more obscure and uncertain than that of the vowels. Melville Bell's division of vocal sounds into vowels, consonants, and glides or semivowels was adverted to, and his ingenious device of visible speech briefly explained, but left for fuller consideration in the second lecture. The contrast was then pointed out between singing, in which the musical notes predominate and are separate or discrete; intoning, which is speech intentionally rendered monotonous for better transmission in large spaces like cathedrals; recitative, which is the converse of the former, being singing partially loosened from the trammels of time, rhythm, and melody, so as to approximate to speaking; speech itself, which uses continuous inflection; declaiming, which is speech with the addition of a histrionic and emotional element; reading, which is a faint and as it were distant reproduction of speaking in a lower key, quieter and less marked in accent than in speaking *vivâ voce;* and whispering, which is purely oral, without a laryngeal ground note, and which may be termed voiceless speech.

The different qualities, compass, and register of voices

[1] Abstract by the Author of three Lectures at the Royal Institution, by W. H. Stone, M.D.F.R.C.P.

were then described. The larynx of the child, like its head, is large relatively to the rest of the body. At the age of fourteen or fifteen, rather earlier in girls than in boys, the vocal apparatus enlarges and strengthens. In boys the vocal chords about double in length ; in girls they increase from five to seven. In the latter case the pitch of the voice is not materially altered ; in the male it usually descends an octave or more.

Garcia adopted the division of Registers into three, namely, the chest, falsetto, and head voice, due originally to Müller. This remains the most practical mode of classification, though the word falsetto is misleading, being liable to confusion with the artificial male voice bearing the same name, and may well be replaced by the phrase Medium. The term register has been enveloped in much professional mystery, and has been far too much refined upon. There has also been a confusion of octaves, from which even Madame Seiler is not free, due mainly to the modern and objectionable method of scoring music for the tenor voice in the soprano clef, and an octave too high. Register evidently marks an alteration of mechanism in the voice-reed and resonator to enable it to obtain the very remarkable compass, amounting to nearly five octaves, of which the human voice is possessed. Single voices run to three octaves or more. Catalani had 3½ ; Bastardella, heard by Mozart in 1770, had the same. Madame Carlotta Patti can reach G♯ in alt. Bennati, a tenor, had three full octaves, and Tamberlik reached the C♯ of 544 double vibrations.

The words Head and Chest obviously only represent subjective sensations which accompany the shifted mechanism. In many parts of the voice similar notes can be reached in two registers, but with different force and quality, on either side of the break.

In using chest-voice the vibration can be seen to involve the whole vocal chord and the arytœnoid cartilages. At about A in the male and C in the female the chords act alone, though the first mechanism can by an effort be continued. The second form of vibration takes the voice up to F, the usual limit of bass voices and of the chest register. Above the F the chords are stated to lengthen, giving by a second elongation the second series of the chest register, which forms the bulk of the tenor compass, the remainder being formed by a variable number of falsetto notes. These seem to be produced by a thinning of the edges of the chords. Czermak lighted the larynx of thin persons strongly from the outside, and found that sufficient light was transmitted to show a decided increase of transparency in the chords at this point. All observers agree in placing this change, both in males and females, between F and F♯. In this region, common to both males and females, an amusing experiment can be made by causing a tenor male and a contralto female singer to execute the same passage behind a screen, or in an adjoining room. It is difficult, and at times impossible, to discover the sex of the singer from the quality of the tone. There still remains among male voices the curious and only partially explained counter-tenor. Sometimes by arrest of development or by accident the boy's compass is retained in after-life. This accident may be quite independent of masculinity, as those who have heard lusty, rubicund Yorkshiremen, with their wives and children round them, trolling out a sweet treble in glees on the terraces of the Crystal Palace after the Handel Festival, can testify. But besides this rare accident, most basses and baritones can cultivate an artificial and peculiar voice which most properly bears the name falsetto. Its production appears to be in great measure a matter of education. It was seemingly commoner in the madrigalian epoch and in the time of Queen Elizabeth than it is now. Dr. Bristowe says truly that the mechanism of its production is still doubtful, though many attempts have been made to determtne it. Such voices are not only artificial, but complex and uneven, being a compound of high chest notes and others of special quality. There is a serious break between the two both in production and in quality, which practised singers disguise by running the one into the other at different places, according as the passage to be sung ascends or descends.

It will have been seen that female voices overlap the compass of the male voice by an octave or more. Many contraltos take the E on the bass stave, which is well in the middle of the bass voice, and a low note for a tenor singer. Hence we sometimes hear of female tenors, though the effect is usually more peculiar than pleasing. Our great English contralto, Madame Patey, however, drops to this note with fine effect in Handel's oratorio of Solomon, which was written for the exceptional and now fortunately obsolete voice of Farinelli.

In females the break is somewhat higher than in males, but the transition to the falsetto takes place at the same note G. The contralto does not use the head-register.

This, otherwise called the Small, begins as just stated. Its upper limit varies, the extremes having been already given. Mozart wrote the fine air *Gli Angui d' Inferno* in the "Magic Flute" for such an exceptional voice reaching to F in alt. A commoner and perhaps pleasanter limit is the C below this.

All authorities agree in describing a curious appearance of the glottis in singing these notes. This is a folding together of its posterior half with vigorous vibration of its anterior part. Such an appearance can only be produced either by some stopping of the chords at the middle by contact with structures lower down, or by overlapping from vigorous approximation of the arytœnoid cartilages. The former supposition lacks anatomical confirmation, and the latter, which is anatomically possible, has the implied, though not the expressed sanction, of Helmholtz. The drawing of this appearance is given by Madame Seiler, who alone of laryngoscopists, possesses a register peculiar to the female.

Dr. Stone was materially assisted in his first lecture not only by Mr. Behnke, but also by his colleague Dr. Felix Semon, who gave admirable demonstrations of the healthy larynx, as seen in Mr. Williams, and some other pupils of St. Thomas's Hospital.

ACCLIMATISATION OF EDIBLE MOLLUSKS

A RECENT and interesting notice by Mr. F. P. Marrat of Liverpool, who is an excellent conchologist, mentions the introduction into the Cheshire coast of what he calls the "wampum clam," or *Venus mercenaria* of Linné ; and he concludes that there is "a fair prospect of the naturalisation, on the extensive shallow shores of Lancashire and Cheshire, of an extremely nutritious and highly esteemed food-product, new to Great Britain." The late Prof. Gould says that this mollusk is known in Massachusetts under the name of "Quahog," given to it by the Indians. According to him and other American writers on the subject, the true "clam" *par excellence* is *Mya arenaria* of Linné. I was present as a guest at one of the fashionable "clam-feasts"; but the muddy flavour derived from the habitat of that mollusk does not agreeably commend itself to my palatable recollection. However, *chacun à son goût! Mya arenaria* inhabits the western coasts of the North Pacific as well as both sides of the North Atlantic.

The American oyster (*Ostrea virginica* of Gmelin = *O. borealis* and *O. canadensis* of Lamarck) is peculiar to North America, and has now found its way into the London market. It differs from the common European oyster (*O. edulis*, L.), and is equally variable as regards size. *O. virginica* has been within the last few years introduced into the mouth of the Tagus, and is called the Portuguese oyster. Our own or "native" oyster was highly esteemed by the Romans, as we know from Juvenal; but there are no grounds for imagining that it was in those times imported into Rome from Britain. The facility of transport was not then so great as it is at present; and a gamy flavour was probably not so much relished by the Romans as it is said to have been by our King George the First, who preferred oysters a week old at Hanover to those which he afterwards got in England.

Within the last few years the "periwinkle" (*Littorina litorea*, L.), which is a favourite delicacy of our poorer classes, has spread with unusual rapidity along the eastern shores of the North American continent. Mr. Arthur F. Gray, in *Science News* for April, 1879, attributed its origin to Europe. It certainly does not seem to have been observed in America by Gould or any other conchologist before 1870.

Preeminent among land shells, as a dainty article of food in France, is *Helix pomatia*, L. We are more fastidious or more conservative in our gastronomic notions. It is a mistake to suppose that the Romans, when they possessed and inhabited Great Britain, brought this snail with them to indulge their luxurious tastes. In all probability it was not even known to them, because another species (*H. lucorum*, Müller) takes its place in Central Italy. *H. pomatia* has not been found at Wroxeter or York, or in any other part of England or Wales where the Romans built cities or had important military stations. Among the debris of an extensive Roman villa discovered in Northamptonshire, in which the shells of cockles, oysters, mussels, and whelks abounded, not one of *H. pomatia* occurred, although at Woodford, a few miles distant, that species is plentiful in a living state.

J. GWYN JEFFREYS

THE ALFIANELLO METEORITE

SIGNOR DENZA, Director-General of the Italian Meteorological Association, sends us an account of the remarkable aerolite which fell in the province of Brescia on February 16, and to which we referred last week. On that date, at 2.43 p.m. local time, a strong detonation was heard in many places of the province of Brescia and even in the neighbouring provinces of Cremona, Verona, Mantua, Placenza, and Parma. The detonation was quite awful in the commune of Alfianello, in the district of Verolanuova, Brescia. This was found to be caused by a meteorite which exploded a few hundred yards above Alfianello. A peasant saw it fall in the direction of N.E. to S.W., or, more exactly, N.N.E. to S.S.W., at a distance of about 150 yards. When the meteoric mass fell to the earth, it produced on the ground, in consequence of the transmission of the shock, a movement similar to that of an earthquake, which was felt in the surrounding districts; the telegraph wires oscillated and window frames shook. Before the meteorite fell a confused commotion was seen in the sky, and immediately after a prolonged noise was heard similar to that of a tram moving rapidly along the rails. No light was seen; but the meteor must have been accompanied, as usual, by a light vapour, produced by the volatilisation of the substance melted at the surface; for some of those who saw it fall compared it to a chimney falling from the sky, and surmounted by a wreath of smoke. The meteorite fell in a field about 300 yards south-west of Alfianello. It penetrated the ground obliquely, nearly in the same direction as it was seen moving in the air, from east to west, sinking to the depth of about a yard, deducting the height of the meteoric mass. The peasants who saw it fall and who were the first to touch it, found it somewhat hot. The meteorite fell entire, but unfortunately was soon broken to pieces and carried away by the crowd who gathered to see the strange sight. The form was ovoid, but a little flattened at the centre; the under part was broad and convex, presenting the form of a cauldron; the upper part was truncated. The surface was covered with the usual blackish crust, and studded with small concavities, partly separate, partly grouped together.

As to the dimensions and weight of the aerolite, the estimates differ. According to the evidence of some, its height was about 75 centimetres, greatest breadth 60 centimetres, and its volume about 25 cubic decimetres. Its weight has been variously estimated at 50, 100, 200, and 250 kilograms. Its real weight was probably not much under 200 kilograms. It is certain that Prof. Bombicci carried more than 25 kilograms to Bologna, to add to the rich collection of meteorites in the Mineralogical Museum of the University; that a specimen weighing 13½ kilograms was taken possession of by MM. Ferrari, the owners of the field in which the meteorite fell; that about 40 kilograms remained in possession of other persons; that the municipality of Alfianello sent a specimen of 5 kilograms to the Athenæum of Brescia; and that two pieces weighing 12 kilograms each were thrown into a stream and lost; without speaking of a considerable quantity of small fragments, distributed here and there, of which Signor Denza possesses four, of a total weight of 39 grammes.

By its structure the Alfianello meteorite belongs, according to Prof. Bombicci, to the sporasiderite-oligosiderite group, being almost identical with the New Concord (Ohio) meteorite. The substance is finely granulated, of an ashy grey; the bright glossy surface has elements showing varied gradations of colour. Metallic particles abound; they are found scattered like small nuclei, in which are iron and perhaps one of its alloys, in brilliant crystalline aggregations, of a yellowish or bronze white. Circles of rust of a yellowish brown rapidly form around the particles of iron. In the places where there are no metalliferous nuclei, the grains of iron are attached to the stony portion in the proportion of 68 per 1000 of weight. The blackish crust is rough, and to some extent rugged in some parts of the surface, and rather smooth and uniform in others; in general it is somewhat lustrous. The total specific weight of the stone is from 3·47 to 3·50. The chemical analysis of the meteorite is being made in two different laboratories at Bologna. Signor Denza's information has been obtained from Prof. Bombicci of Bologna University, and from Professors Briosi, Ragazzoni, and Casali of Brescia.

THE SHAPES OF LEAVES[1]

IV.—*Special Types in Special Environments*

FROM the previous papers it will be clear that degree of subordination to the stem accounts in large measure for the extent to which leaves vary from the primitive ovate-lanceolate type. Where they are still so most subordinated, there will be a strong tendency towards the long pointed ribbon-like form, and also a marked inclination towards decurrence. This combination of peculiarities is well seen in several thistles, and in comfrey, as also to a less extent in many epilobes and stellarias. Compare *Verbascum thapsus*, and other mulleins. From these extreme cases, in which leaf and stem are not fully differentiated from one another, one can trace several gradations, through square stems with sessile leaves (as in certain St. John's worts) up to merely sessile stem-leaves, or leaves that clasp the stem with pointed or rounded auricles. Wherever lines exist along the stem, they may be observed in pairs up to the point where a leaf is given off, and they are undoubtedly surviving marks of the primitive unity of stem and leaf. The same may be said of rows of hairs, like those of *Stellaria media* and of *Veronica chamædrys*. There can be little doubt

[1] Concluded from p. 495.

that special selective causes (protection against creeping insects, &c.) have often come into play in preserving or modifying such decurrent wings, stem-lines, auricles, clasping stipules, and rows of hairs; but as a whole they nevertheless point back distinctly to the origin of dicotyledonous stems from superposition of leaves and midribs upon one another. They are rudimentary forms of stem-lamina.

Sessile leaves are particularly apt to be lanceolate. They approach nearest among dicotyledons to the monocotyledonous type. The botanist will readily fill in examples for himself.

FIG. 34.—White Deadnettle (*Lamium album*).

On the other hand, it is clear that the conditions under which leaves assume the orbicular and peltate types can only occur where there is least subordination to a central stem. And these conditions must have occurred for immense numbers of generations in order to overcome the ancestral tendency towards the lanceolate or ovate form. For a leaf must first pass through a cordate or reniform stage, like that of the coltsfoots, before it can reach an orbicular shape, like that of our common waterlily; and even when it becomes completely circular, like the *Victoria regia*, it may still retain a mark of junction where the

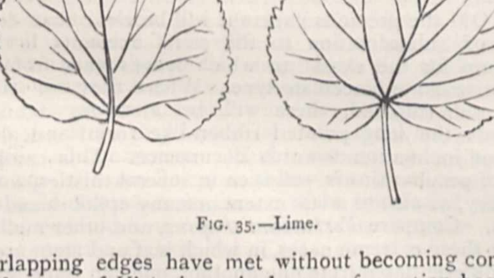
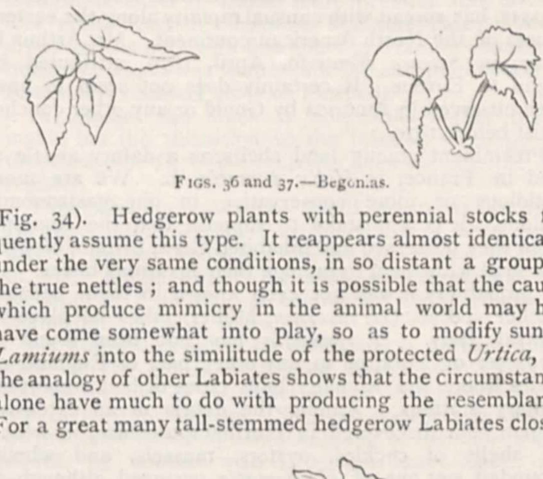


FIG. 35.—Lime.

overlapping edges have met without becoming connate. In the case of *Victoria regia* the transformation has been traced during germination. The first leaves produced by the young plant are linear and submerged; the next are sagittate and hastate; the later ones become rounded, cordate, and orbicular; and even when they assume the peltate form, the line still marks the point of union. This sufficiently accounts for the rarity of perfectly peltate leaves, such as those of *Tropæolum*, *Hydrocotyle*, and *Podophyllum*. Radical leaves growing on long footstalks will be oftenest orbicular cordate; stem-leaves on the same plant may pass from ovate-cordate to ovate, lanceolate, and linear. Large cordate radical leaves will be most frequently produced from perennials with richly-stored rootstocks. The sagittate and pointed leaves of *Arum* and *Sagittaria* show the furthest step attained in the same direction by monocotyledonous foliage, starting from the liliaceous form.

Where the stem, or, what comes practically to the same thing, solitary ascending branches, rise high into the air, especially with opposite leaves, we get a common type which may be well represented by the white deadnettle



FIGS. 36 and 37.—Begonias.

(Fig. 34). Hedgerow plants with perennial stocks frequently assume this type. It reappears almost identically, under the very same conditions, in so distant a group as the true nettles; and though it is possible that the causes which produce mimicry in the animal world may here have come somewhat into play, so as to modify sundry *Lamiums* into the similitude of the protected *Urtica*, yet the analogy of other Labiates shows that the circumstances alone have much to do with producing the resemblance. For a great many tall-stemmed hedgerow Labiates closely

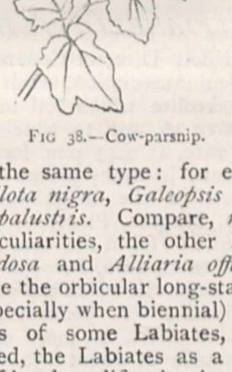


FIG 38.—Cow-parsnip.

approximate to the same type: for example, *Lamium galeobdolon*, *Ballota nigra*, *Galeopsis tetrahit*, *Stachys silvatica*, and *S. palustris*. Compare, *mutatis mutandis* for ancestral peculiarities, the other hedgerow plants, *Scrophularia nodosa* and *Alliaria officinalis*. On the other hand, notice the orbicular long-stalked lower leaves of the latter (especially when biennial) side by side with the lower leaves of some Labiates, such as *Nepeta glechoma*. Indeed, the Labiates as a whole present an excellent study of local modification in an ancestral type,

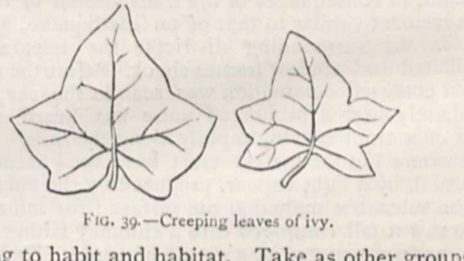


FIG. 39.—Creeping leaves of ivy.

according to habit and habitat. Take as other groups of this family the following: first, *Mentha* and *Lycopus*; then, *Salvia pratensis*, *Prunella*, *Marrubium*, radical leaves of *Ajuga reptans*, and lower leaves of *Nepeta glechoma*; finally, the typical form dwarfed in little prostrate retrograde types, such as *Thymus serpyllum* and *Mentha pulegium*. Compare these last with other prostrate or dwarfed types elsewhere, like *Veronica serpyllifolia*, *Peplis portula*, *Hypericum humifusum*, *Montia fontana*, and *Arenaria serpyllifolia*.

As grassy types, the best familiar examples are those of the flaxes, *Stellaria graminea*, Toadflax, Bastard Toadflax, &c.; all of which have been largely influenced by monocotyledonous competition. Even a pea, *Lathyrus nissolia*, has got rid under such circumstances of its leaflets, and has flattened its petiole into a grass-like blade. Intermediate forms occur in Southern Europe. The peas, indeed, are papilionaceous plants which have largely cast off their ancestral leaf-type, in order to avail themselves of new conditions. *L. aphaca* has lost its leaflets, and flattened and enlarged its stipules so as to resemble simple opposite leaves; and *L. hirsutus* and *pratensis* have reduced the leaflets to one long almost

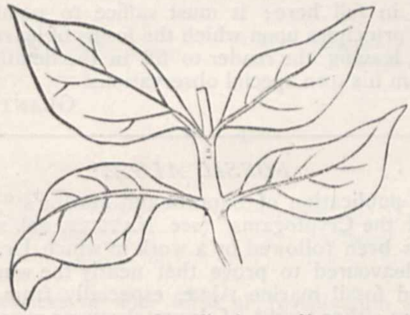


FIG. 40.—Ascending leaves of ivy.

linear pair. Marshy plants have also often been forced into adopting grass-like forms. The great spearwort is a swampy buttercup, whose ancestral leaf has been lengthened out into a long ribbon, with almost parallel ribs; the lesser spearwort shows the same tendency to a less degree, still retaining ovate lower leaves, with lanceolate upper ones; and *Veronica scutellata* is a similar marshy case among the Scrophularineæ.

When the tree-like form is attained, or free access to air is otherwise gained (as by climbers), the supply of carbon, being practically unlimited, becomes relatively little important, and the supply of sunlight assumes the

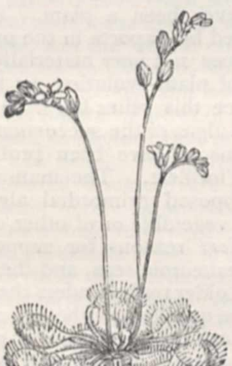


FIG. 41.—Sundew.

first place in the economy of the plant. Under such conditions, the great object must be to prevent the leaves from overshadowing one another. Now this result may be obtained in a great number of ways, and we must not expect that every tree or shrub will solve the problem for itself in exactly the same fashion. It is enough that the shape into which the ancestral form is finally modified should sufficiently answer the purpose in view. As a matter of fact, the suitability of the actual forms and arrangements of tree-leaves to the functions they have to perform can be readily tested by observing any tree in bright sunshine. On the one hand, almost every leaf is in full illumination, no leaf unnecessarily shading its neighbour; and on the other hand, there is hardly any interspace between the leaves, as may be seen by the fact that the shadow thrown by the tree as a whole is almost perfectly continuous. In short, there is no waste of chlorophyll, and there is no waste of sunshine.

Mr. Herbert Spencer has called attention to the results of varying exposure to light in the various parts of the same leaves, which often causes them to become unequally developed. In the lime (Fig. 35) such obliquity is normal. In the various *Begonias* (Figs. 36 and 37) the resulting asymmetry is very noticeable. In the cow-parsnip (Fig. 38) it is the leaflets of the same leaf which are asymmetrically developed, so as not to overshadow one another. In more symmetrical leaves, there is an equal provision for preventing overshadowing, only here it takes the form of indentation of the edge, as in the oak, or of subdivision into leaflets, as in the horse chestnut. In the latter case, indeed, the two outermost leaflets are habitually asymmetrical. On the whole, however, the mass of forest trees in temperate climates have almost entire leaves; and full exposure to sunlight is secured rather by their special specific arrangement at the end of the minor branches. Most often they are more or less ovate, as in the elm, beech, alder, birch, and poplar. Where the

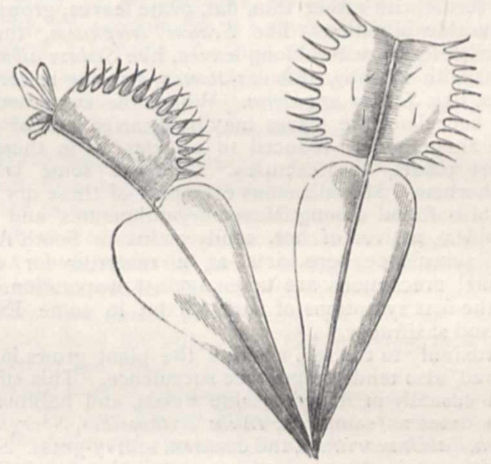


FIG. 42.—Dionæa.

leaves are divided, the separate leaflets assume the appearance of almost entire leaves: compare the leaflet of the horse chestnut with the leaf of the true chestnut; the leaflet of the ash with the leaf of the hornbeam; the leaflet of the walnut with the leaf of the beech; and the leaflet of the mountain ash with the leaf of the blackthorn. In all these cases, almost identical results are practically produced in the end by similar circumstances acting upon wholly unlike original types.

Some minor typical forms exist in certain groups of climbers, which are worth a moment's notice. Take as an example the creeping leaves of ivy. As long as this plant grows close to a wall or the trunk of a tree it assumes the well-known shape shown in Fig. 39. But as soon as it branches out its flowering sprays into the open, acquiring a tree-like habit, which it often does on the top of a wall, it takes a simpler and totally different form of leaf, as shown in Fig. 40, growing on the same plant. This last type is quite comparable to that of the pomegranate. That both types admirably suit their particular situation can easily be seen by noting how well they fit in with one another without overshadowing. It would be difficult to point out the geometrical grounds for this relation, but the relation itself becomes obvious on watching an ivy-plant in broad sunshine. Moreover, the first or truly ivy-like form of leaf tends to recur among many plants which similarly press close to a flat surface. In *Veronica hederæfolia* we get it in a weed that climbs over banks of earth; in *Linaria cymbalaria* we get it in a trailer hanging upon stone walls; in *Campanula hederacea* and *Ranunculus hederaceus* we get it in a creeper along the edge of rills or over soft mud. Compare in each case other forms of the typical generic leaf, as seen in germander speedwell, toadflax, harebell, and meadow buttercup.

Another special climbing type, proper to more open habits of twining round alien stems, is that of the common bindweed. This, the ordinary convolvulus form, reappears exactly in so distant a plant as *Polygonum convolvulus*, whose habits are exactly similar. Even among monocotyledons we get it closely simulated by *Smilax*, with precisely like conditions, and somewhat less closely by *Tamus*. Indeed, this form of leaf may be said to be almost universal among lithe twining creepers.

The hop type belongs rather to mantling than to mere twining climbers. It reappears under identical conditions in the vine, and less closely in true bryony. More subdivided into leaflets, it produces the Virginia creeper, and many forms of clematis.

Among ground plants, it is only possible very briefly to refer to the succulent types which abound in dry situations. A regular gradation may here be traced from rich forms with rather thin, flat, ovate leaves, growing in favourable situations, like *Sedum telephium*, through dwarfish forms, with oblong leaves, like *Sedum album*, to forms with knobby, globular leaves, growing in very dry spots, like *Sedum anglicum*. Where the stem becomes very succulent, the leaves may be dwarfed out of existence altogether, or reduced to prickles, as in those dry desert plants, the cactuses. Compare some tropical Euphorbias. Miscellaneous examples of these dry types are also found among Mesembryanthemums and other Ficoideæ, natives of hot, sandy plains in South Africa. The succulence here acts as a reservoir for water. Special precautions are taken against evaporation. We see the first symptoms of such a habit in some English dry-soil saxifrages.

Proximity to the sea, whether the plant grows in sand or mud, also tends to produce succulence. This effect is seen casually in many seaside weeds, and habitually in such cases as samphire, *Inula crithmoides*, *Spergularia rubra*, *Cakile maritima*, and common scurvy-grass. *Suæda maritima* is in this group the exact analogue of *Sedum anglicum*, while *Salicornia* is similarly the analogue of the leafless cactuses. Compare also *Salsola kali*. There is a somewhat similar tendency to fleshiness in certain freshwater weeds of moist spots, such as *Chrysosplenium*, and many saxifrages.

In such a brief sketch as the present it is impossible to do more than allude in passing to sundry more special developments of leaves, for protective or other purposes. One development of this character is seen in the growth of prickly tips (*Agave*, *Aloe*, *Salsola*, *Juncus acutus*, *Bromelia pinguin*), or of prickly edges (thistles, *Carlina*, holly, *Stratiotes*, *Dipsacus*, *Rubia peregrina*). Such prickles may be purely defensive, or they may assist the plant in clambering (*Stellatæ*, *Smilax*, hop). Again, the leaf as a whole may be reduced to a prickle, as in gorse, where the very young seedling has trefoil leaves like its allies: but these give way gradually to entire lanceolate blades, and finally to mere thornlike spines. Another very different development is that of the insect-eating plants, which grow in very boggy spots, and so require animal matter not yielded them by the roots. Our English sundew (Fig. 41) is an example of the first step in such a process; essentially its leaves belong to the obovate tufted or rosetted type represented by the daisy, only a little exaggerated; but they have been specialised for the insect-eating function by the evolution of the little glandular hairs. Even simpler is the type of the butterwort, which belongs to the same foliar class as the London Pride, *Draba aizoides*, *Samolus Valerandi*, *Sempervivum tectorum*, &c., but with the edges folded over so as to inclose its insect prey. From these simple forms we progress at last to highly specialised types like *Dionæa* (Fig. 42), *Sarracenia*, *Darlingtonia*, *Nepenthes*, and *Cephalotus*. Once more, the connate form in opposite leaves (*Dipsacus*, *Chlora*) or the perfoliate in alternate ones (*Bupleurum*) may be due, as has been suggested, to the facilities these arrangements afford for storing a little reservoir of water, which acts as a moat to protect the flowers from climbing ants. But such minor selective actions are too numerous and too diversified to be noticed in full here; it must suffice to point out the general principles upon which the forms of leaves usually depend, leaving the reader to fill in the details in every case from his own special observations.

GRANT ALLEN

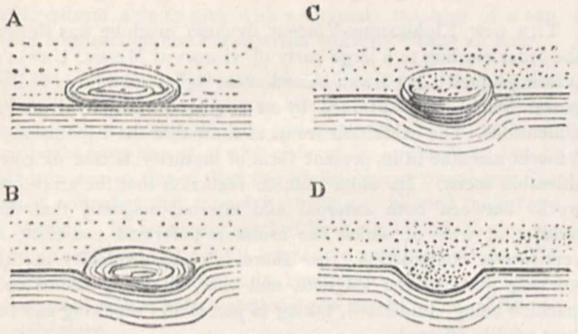
FOSSIL ALGÆ[1]

THE publication of Saporta and Marion's "Evolution of the Cryptogams" (see NATURE, vol. xxiv. p. 75, 558) has been followed by a work in which Dr. Nathorst has endeavoured to prove that nearly the whole of the supposed fossil marine Algæ, especially from the older rocks, are either tracks of Invertebrata or were produced by mechanical agency. "Florideæ, Laminarieæ, Chondriteæ, Alectorurideæ, Arthrophyceæ, Bilobites, and other algæ; comprising among them forms curious and remarkable by the regularity of their branching thallus, their phyllome with raised periphery and striated surface; all had disappeared as if by enchantment, and in their place there remained but tracks of Invertebrata, moving upon the ooze, swimming or creeping, and impressing the extremities of their tentaculary palpæ around them, or of larvæ gliding through the slimy mud." When these are insufficient, the movement of water acting on inert bodies, or waving tufts of sea-weed, are appealed to, for no fossil imprint either sunk or in relief, unless preserving carbonaceous matter, is admitted in Dr. Nathorst's hypothesis to have ever been a plant. This view is energetically combated by Saporta in the present work. The issue however does not very materially affect either the general theory of plant-evolution, as traced by Saporta and Marion, since this relies but little upon the evidence of doubtful fossil algæ, or the succession of marine algæ in time, which seems to have been probably Laminarieæ, Fucaceæ, and Florideæ. The main point in dispute is whether the supposed primordial algæ, Eophyton and Bilobites, are of vegetable or of other origin. There are numerous *a priori* reasons for supposing plant life to have existed in palæozoic seas, and the complexity of life seen in even the older rocks renders their presence almost a necessity. The question is whether certain impressions which are abundant in Silurian rocks reproduce some of these forms, or whether we are still without indications of the primæval algæ.

Dr. Nathorst appears to rely very greatly upon the fact that many of these supposed sea-weeds are marked in relief upon the under-sides of slabs, proving, as he supposes, that they are the filling-in of furrows, and also upon the very general disappearance of all trace of carbon. In denying the plant-origin of certain impressions lately described as algæ by Prof. Walter Keeping in the *Geological Magazine*, he lays particular stress on the former hypothesis. Saporta however devotes two or three pages to clearing up this, as he believes, misconception. The fact that very unmistakable impressions of even terrestrial plants do occur in this condition, is known to most collectors of them, and is explained by the author as follows:—A plant-stem of sufficient sub-

[1] "À propos des Algues Fossiles." Le Marquis de Saporta. (Paris: G. Masson, 1882.)

stance to resist pressure, but destined in the long run to decompose, would, if resting on the sea-bottom, become covered with sand or silt, if such deposit were taking place. (*a.*) As the weight increased above, its under-surface would become pressed into the bed upon which it chanced to be resting. (*b.*) As it decomposed, infiltrated sediment would replace the organic matter (*c.*), until finally the decomposition being complete, the sediment from above entirely fills in the space, leaving on the under-surface a reproduction in semi-relief of the decayed organism, while the upper part is merged in the sand.



(*d.*) Instances of this form of fossilisation are by no means rare, but cases in which all carbonaceous matter has disappeared from vegetable impressions are still more common, especially with sea-weeds, which, as M. Grand 'Eury has remarked, decompose into a semi-fluid gelatinous matter when imbedded in mud. Nor does the destruction of carbon cease when the mass they are buried in becomes consolidated, for percolating water brings oxygen to them, which slowly destroys every remaining vestige of organic matter.

The author is careful in the present work only to select specimens for illustration about which little or no reasonable doubt can exist. Commencing with impressions from the Tertiaries of almost existing species of sea-weed, he compares these with the more doubtful secondary Chondrites. The Chondrites of the Flysch, strongly impregnated as they are with carbonaceous matter, are admitted on all hands to be Algæ, and the author asks how the same origin can be denied to casts of specifically identical Chondrites of the Cretaceous, and so on to the Liassic forms. The algous nature of most of those selected for illustration is indeed so obvious that no shadow of doubt respecting them can exist. The gigantic Liassic Laminarias with reticulated structure are more problematic, but it seems at least highly improbable that any movements of invertebrata could have produced such markings. The Alectoruridæ, an extinct group of algæ which existed from the Silurian into the Tertiaries, and their equally extinct ally Glossophycus, whose vegetable nature is even more apparent, may challenge reasonable criticism on account of their divergence from recent algæ. While the algous nature of these, and many other types, is maintained, the author does not hesitate to acknowledge that many forms which it was previously considered might be algæ, are probably tracks of invertebrates. He simply holds that Dr. Nathorst's generalisations are far too sweeping, and in many cases utterly against the evidence. The true nature of Bilobites, however, is still open to some question. They are always preserved in semi-relief, a process explained above, but the arguments, while abundantly proving that they cannot be due to tracks of invertebrates, fall short of absolute proof that they must be Algæ, and can be nothing else. In like manner the Eophyton of the Lower Cambrian, alleged by Nathorst to be furrows made by moving sea-weed on a muddy bottom, is almost proved by its occasionally cylindrical form and interlacing fragments, and wholly confined as it is to this most ancient formation, to be something more than mere scratches upon ooze, however produced, yet the evidence does not prove conclusively that it is a plant. The discussion has at least produced two most valuable works, the one serving to show how even the most accomplished palæophytologists may be deceived in dealing with so perilous a subject as fossil algæ, and the other proving that in spite of numerous errors, there is a considerable basis of truth in even the most speculative branch of their science. J. S. G.

NOTES

WITH reference to the scheme of the Grocers' Company for the encouragement of sanitary research, it is stated that so far as the administration of the scheme will involve scientific considerations, the Court proposes to act with the advice of a committee of eminent scientific men, and the following gentlemen have consented to form the first committee:—Messrs. John Simon, C.B., F.R.S., John Tyndall, F.R.S., John Burdon Sanderson, M.D., F.R.S., and George Buchanan, M.D., F.R.S.

A PRIVATE test took place on Monday of a telephone between New York and Chicago, a distance of 1000 miles, and the result was a complete success. Previously the longest distance over which a telephonic message had been sent was 700 miles, between New York and Cleveland. The present result is not due solely to the telephone, although that possesses some novelty, but is mainly due to a novelty in the conductor. This consisted, it is stated, of a steel wire core, copper plated, the electrical resistance of which to Chicago was only 1522 ohms. This new achievement is regarded as marking a new era in the development of telephonic communication.

AFTER assuming threatening proportions, the eruption of Mount Etna has almost subsided. Eleven new fissures had opened on the side of the mountain, giving out smoke, scoriæ, and showers of small stones, accompanied by a rumbling sound, and a trembling of the earth. Strong shocks of earthquake were felt at various parts of the surrounding country, and crevices were formed in the earth. A telegram from Prof. Silvestri, dated the 25th, states that the eruption is without importance and seems ceasing. Later news on Monday night states that there is still cause for some uneasiness in respect to Etna. The lava has not flowed, but has formed a new cone. On Monday strong shocks of earthquake were felt at Pedara, and slight ones at Catania. The site of the present eruption is further down the mountain than any previous eruption in modern times, and it is the first eruption which has occurred on the southern side of the mountain for more than a century.

WE regret to record the loss to science of a gifted and energetic young worker through a gun accident. A telegram from Hong Kong informs us that Mr. Frank Hatton, mineralogist and scientific explorer for the British North Borneo Company was killed by the accidental discharge of his gun while hunting in the jungle. The deceased gentleman was the only son of Mr. Joseph Hatton, and gave promise of a brilliant and useful scientific career. He was a student of the Royal School of Mines, South Kensington, where he distinguished himself by the extraordinary rapidity and accuracy with which he worked through the course of studies in that institution. He was especially distinguished in the Chemical Section, in which he made and published some valuable researches on Bacteria, &c., for which he obtained the Frankland prize of the Institute of Chemistry, entitling him to the degree of Associate. Mr. Hatton had great linguistic aptitude, and this, with a considerable amount of natural tact, contributed much to his success in dealing with the natives of Borneo during his exploring expeditions for the Company. During the last eighteen months he has explored the greater part of the Company's dominion, an area about as large as France, without losing a man, and in regions in which in many cases he was the only individual able to speak the Malay and Dusun dialects. A large number of scientific observations and notes on climate, geology, &c., of Borneo made during these expeditions will probably be published. Mr. Hatton, who had scarcely attained his twenty-second year at the time of his death, was a Fellow of the Chemical Societies of London and Berlin and of the Asiatic Society.

THE Gothenburg Museum will be represented at the coming Fisheries Exhibition by a magnificent selection of exhibits from its Zoological Section, the expenses of which will be borne by Dr. Oscar Dickson. This collection will be selected, arranged, and taken care of to London by Dr. A. H. Malm of that Museum. The collection will consist of the choicest gems of the Museum, among which are five rare species of whales, and the ichthyological fauna of the province of Bohus, as well as the well-known collection of herrings of various kinds and from different countries belonging to the Museum. There will also be sent a collection of skeletons of the fishes and birds comprising the fauna of Southern Sweden. The entire selection made by Dr. Malm is remarkable for its scientific accuracy, as well as finish. He will also show privately a splendid collection of Mollusca from the Cattegat.

THE Commission, consisting of Baron Nordenskjöld, Consul Elfwing, and Prof. Gyldén, which the Royal Swedish Geographical Society had appointed to report on the question of an international meridian and a common time, has come to the conclusion that it would undoubtedly be a matter of great difficulty to decide as to the former on account of national jealousies, but it has offered a solution of the latter question which is worthy of notice. If the Greenwich meridian is fixed on as the common one, it would strike a point 180° from Greenwich, east of New Zealand, and if another circle is drawn 90° from Greenwich, its western half would nearly touch New Orleans, and its eastern a point a few minutes east of Calcutta. This system would furnish four cardinal times, viz. one European, one American, one Asiatic, and one Oceanic. As it would however be necessary to find several mean times for Europe, Prof. Gyldén proposes that twelve meridians be drawn from Greenwich, which he numbers at intervals of 2½°, which will make the time of the places falling under each differ from those under the nearest meridian by 10 minutes of actual time. These meridians as numbered would either touch the places mentioned below, or fall so near them that the actual difference would be of no consequence. The difference of time from 10m. is however shown in the parentheses: No. 1, Paris (40s.); No. 2, Utrecht and Marseilles (1m. 29s.); No. 3, Bern (16s.) and Turin (42s.); No. 4, Hamburg (6s.), Altona (14s.), Gottingen (14s.), and Christiania (2m.); No. 5, Rome (50s.), Leipzig (26s.), and Copenhagen (20s.); No. 6, Sweden (15s. from common mean time); No. 7, Brieg (Prussia); No. 8, Königsberg (2m.); No. 9, Abo (1m.) and Mistra (Greece) (5s.); No. 11, no place of importance; No. 12, St. Petersburg (1m. 14s.), and Kiev. Further east it is not suggested to carry the system. Should the various European countries decide on adopting the mean time of the nearest meridian they might be arranged as follows:—No. 1 for France; No. 2 for Holland and Belgium; No. 3 for Switzerland; No. 4 for Norway and Western Germany; No. 5 for Denmark, Central Germany, and Italy; No. 6 for Sweden and Austria; No. 7 for Eastern Germany; No. 8 for Hungary; No. 9 for Poland and Greece; No. 10 for Finland, Roumania, and Bulgaria; No. 11 for Turkey; No. 12 for Eastern Russia. West of Greenwich No. 1 would serve for Spain, and No. 3 for Portugal. By this system Prof. Gyldén thinks it would be a simple matter for every one to remember that the difference between two meridians, as, for instance, between London and Paris, was exactly 10 minutes. Prof. Gyldén also suggests that, for the convenience of travellers and others, all public clocks should be provided with coloured rings showing the differences of time between the various meridians.

THIS winter, at a large number of private and official *soirées* in Paris, the electric light has been used from storage batteries in a very simple manner. The accumulators are carried in a vehicle which is stationed in front of the house, and electric wires are conducted into the building through the windows. Incandescent lamps are placed in the ordinary candelabras, and the fitting of the most complex lighting is an affair of a very few hours.

THE new Elphinstone-Vincent dynamo machine was shown the other evening to a large party of visitors at Messrs. Unwin's printing offices; 411 Swan incandescent lights of twenty candle-power being well sustained by an engine of not at all large dimensions. The exhibition seems to show that the Elphinstone-Vincent machine in its present form of maturity is one of considerable merit. Its most notable feature is that the armature works between both external and internal magnets, that the saddles of wire of which the armature is formed constitute a very simple construction, that there is close proximity in the working parts to the magnets, and that, all the parts of the machine being duplicated, taking to pieces and repairing can be most readily effected.

THE Commissioners on Technical Education—Mr. Woodall, M.P., Mr. Samuelson, M.P., Mr. Wyer Smith, and Mr. Magnus, with Mr. Redgrave, secretary—paid a flying visit to Edinburgh last week. They visited, we understand, the Watt Institute—where they were received by Prof. Fleeming Jenkin and Lord Shand, to whom they expressed themselves highly satisfied with the tuitional and other arrangements of the Institute—the Museum of Science and Art, and Heriot's Hospital. One half of them afterwards inspected the Merchant Company's Schools, and the other half several of the Board Schools.

THE Surveying Expedition, under the direction of M. de Lesseps, has left Hamma, Tunis, and visited the mouth of the Oued Melah, which is to form the outlet of the projected Inland Sea Canal. It is declared that the result of the investigations shows that the cutting of the earth may be accomplished without difficulty.

M. COCHERY, the Minister of Postal Telegraphy, presided over the first monthly dinner of French Electricians, which is to take place on the 21st of every month, at the Café Durand. English electricians wishing to join should communicate with the director of *L'Électricité*, 16, Rue du Croissant, Paris. The president of the meeting for April 21 will be M. Berger, ex-director of the Electrical Exhibition of 1881.

A TELEGRAM from Copenhagen states that "volcanic ashes" have fallen in the neighbourhood of Trondhjem, Norway, and that a serious eruption of Mount Hecla is therefore supposed to have taken place. If these "ashes" are the dust referred to in our note last week (p. 496), then they are not of a volcanic character, according to the examination of Dr. H. Reusch of Christiania University. On this subject a Glasgow correspondent writes:—"My son, who is a passenger by the P. and O. steamer *Deccan* to the East, writes on February 27, when the steamer was in the Red Sea: 'Nothing of note occurred till evening, when G. and myself determined to sleep on deck, on account of the heat. We accordingly did so, and retired to our bunks about 4 a.m. . . . During our sleep on deck we were much annoyed by a quantity of small particles of dust which covered our faces, pillows, &c., and indeed was spread all around. . . . I am convinced it must have been a shower of lava dust, which, it is well known, is often carried hundreds of miles from the crater where it has origin. The dust was of hard particles. I am convinced that lava dust it was, but can get no one to coincide with my opinion.' Can this be a relation to the Norway dust? I see your Norway note says the wind blew strongly from north-north-west, which would bear towards the Red Sea."

M. NAPOLI, electrician to the French Great Eastern Railway, has published in the *Aëronaut* an article showing that electricity supplies a less ponderous motive power than steam for propelling balloons. He supposes that 3230 grammes of material is enough to generate, by means of Bunsen elements, an electric current able to give with a Gramme machine of a convenient construction one horse-power working during an hour.

ON the evening of February 28, at 8·40 p.m., two travellers sledging over the Lesjö, a remote lake in Värmland, in Sweden, saw a meteor of remarkable size and lustre fall about a mile off. Their backs were turned at the time of its appearance, but its luminosity was so strong that the whole country round was illuminated, and when they turned its brilliancy blinded them for a few seconds. Its track was marked by a vivid band, to the eye one foot broad and three yards long, of a yellowish colour. The meteor, after about five seconds, burst with a shower of sparks of the same colour before striking the earth. The night was perfectly clear.

THE Swedish Chamber of Agriculture has granted a Mr. A. Carlsson 50*l.* for the practical study of English agriculture during the coming season.

IT is undoubted that Gramme was the first to construct a dynamo-electric machine with continuous induction, using (independently of Pacinotti) a ring-armature similar to Pacinotti's ring. But regarding the question, who it was that first produced continuous dynamo electric currents, and so was the first to combine experimentally the principles of Siemens and Pacinotti, Prof. von Waltenhofen offers proof (*Wied. Ann.* No. 2) that this priority belongs to Prof. Pfaundler of Innsbruck. In 1867 Herr Kravogl of Innsbruck showed his electromagnetic motor at the Paris Exhibition; this consists of coils forming a hollow ring which rotates round a horizontal axis, while it incloses a bent cylindrical rod tending by weight to take the lowest position, but kept suspended in a certain raised position by currents in the coils, whereby also the ring is rotated. In a letter on this machine in 1867 Prof. Pfaundler proposed to apply Siemens's principle to it, and get electric currents from mechanical work of rotation (the battery being included at first with a shunt, then quite excluded). This he tried and effected about three years later, as a letter dated February 11, 1870, records. Thus Pfaundler seems to have produced continuous dynamo-electric currents before Gramme, and to have indicated the possibility of getting such currents from the Kravogl ring machine in the same year (1867) as Siemens's invention of dynamo-electric machines acquired publicity.

THE Committee of the Annonay Montgolfier celebration have already collected 60,000 francs, and subscriptions are pouring in. They have decided upon the publication of a special organ, of which the first number will be issued in a few days. The celebration will consist in the erection of a statue to the two brothers, several ascents, the sending up of a Montgolfier similar to the original one, and a cavalcade representing the provincial officials, who witnessed the proceedings on June 5, 1783.

IT seems to result from recent researches by A. W. Pehl, brought before the Russian Chemical Society, that the poisonous action of the ergot, the bad effects of which are so often witnessed in Russia, is due to putrefaction poisons called ptomaines, which appear during the decomposition of the albuminoids in flour. The ergot, that is the sclerotium of the small mushroom, *Claviceps purpurea*, has energetic peptic qualities and thus would directly contribute to the formation of ptomaines in the flour.

WE have received the last number of the Caucasian *Izvestia*, which appeared at Tiflis on February 24. It contains several interesting papers; M. Stebnitzky contributes a paper on the measurements by Parrot, in 1829, of the seconds pendulum on the Great Ararat, and, introducing all necessary corrections for rendering them comparable with recent measurements, he arrives at the result that the length of the pendulum at the monastery of St. Jacob on the Ararat is 440·1613 Paris lines. The anomaly would be thus equal to 7·7 swings per day, and corresponds to an elevation of geoide on the normal spheroid of 855 metres. Compared with Tiflis (1343 metres), this diminution of gravity would point out the existence of great cavities in the Ararat. We notice also a paper on the changes of height of the level of the Caspian Sea, by M. Filipoff; measurements of heights in the villayet of Trapezunt; complementary notes to the formerly-published anthropological measurements, by M. Erxert; and a summary of the first part of M. V. Miller's researches on the Osetian language. In the bibliographical part we find an interesting sketch of the climate of the Caucasus, on the ground of the meteorological observations published by Dr. H. Wild in his work, "Die Temperatur-Verhältnisse des Russichen Reichs," and a report, by M. Zagursky, on Baron Uslar's posthumous work on the Tabasatan language; it is a serious work, containing a very elaborate grammar of the language, a list of words, and a chestomathy. The same fascicule contains the necrologies of Dr. Land and Count Sollogoub, and a variety of notes. In the appendix we find a translation of Mr. Palgrave's reports on Anatolia and Lazistan, which are considered as the more reliable with regard to population.

A SERIES of shocks, lasting several seconds, believed at present to be due to earthquake, were felt at Amsterdam at 5 a.m. on March 17. The movement was in a vertical direction, and caused mirrors and other pendent articles of furniture to oscillate.

THE additions to the Zoological Society's Gardens during the past week include a Common Wigeon (*Mareca penelope* ♂), British, presented by Lieut.-Col. C. Birch Reynordson; three Sirens (*Siren lacertina*) from South Carolina, presented by Mr. G. E. Manigault; six Common Squirrels (*Sciurus vulgaris*), British, a Lemur (*Lemur* ——) from Madagascar, two Robben Island Snakes (*Coronella phocarum*) from Robben Island, South Africa, purchased; a Gayal (*Bibos frontalis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE COMET 1883 *a*.—From elements calculated by Dr. Hepperger of Vienna upon observations extending from Feb. 24 to March 4, the following ephemeris for midnight at Berlin results:—

	R.A. h. m. s.	Decl. ° ′	Distance from Earth.	Distance from Sun.
March 30	3 29 24	+21 49·2	1·497	1·073
31	3 33 59	21 19·5		
April 1	3 38 25	20 50·3	1·536	1·098
2	3 42 44	20 21·4		
3	3 46 55	19 52·9	1·576	1·124
4	3 50 58	19 24·8		
5	3 54 55	18 57·0	1·616	1·150
6	3 58 46	18 29·6		
7	4 2 32	18 2·7	1·657	1·177
8	4 6 13	17 36·2		
9	4 9 48	+17 10·2	1·698	1·204

The ascending node of this comet falls at a radius-vector of about 2·36 in the region of the minor planets, the descending node at a radius-vector of 1·12, or 0·14 outside the earth's path; but, for the comet to pass at its least distance from our globe, the perihelion passage must occur about November 16.

THE MINOR PLANET No. 228.—The nearest approach to the earth's orbit made by any one of the 232 small planets so far known appears to occur in the case of No. 228, discovered by Herr Palisa at Vienna on August 19, 1882. At the perihelion point this planet may be distant from us only 0·662 of our mean distance from the sun, and on this account would prove a favourable object for a determination of solar parallax. But unfortunately the brightness of the planet at discovery was only 12·5m., though the mean anomaly was then 1½°, or the perihelion passage took place five days subsequently. Hence it is very questionable if such an object could be utilised for the purpose. No. 132, *Æthra*, has the smallest perihelion distance (1·6038), but in consequence of the large angle between the lines of nodes and apsides, and an inclination of nearly 25°, this planet is much further from the earth's track at perihelion than No. 228. *Andromache*, No. 175, recedes furthest from the sun, the distance at aphelion being 4·7234, or within 0·48 of the mean distance of Jupiter.

BINARY STARS.—According to Dr. Doberck's orbit of γ Coronæ Borealis, this very difficult object should now be measurable with our larger instruments. For 1883·5 the calculated position is 123°, and the distance 0″·34. This object was single, with the great refractor at Washington, from 1875 to 1879. In June, 1881, it was pronounced round, or doubtfully elongated, by Mr. Burnham, who remarks, "It has been apparently single with all apertures since about 1871." Doberck's period of revolution is 95½ years: periastron passage, 1843·7.

The following calculated angles and distances of several other binaries may serve for comparison with observations:—

Epoch.	Star.	Position.	Distance.	Authority for orbit.
1882·5	η Cassiopeiæ	163°·3	5″·52	Doberck.
	,,	161·8	5·38	Duner.
1882·5	ξ Böotis	268·9	3·56	Doberck.
1883·5	,,	267·6	3·20	,,
1882·5	ω Leonis	86·5	0·60	,,
1883·5	,,	88·2	0·61	,,
1882·5	η Coronæ Bor.	140·9	0·51	,,
1882·5	ζ Herculis	105·9	1·43	,,
1882·5	μ^2 Herculis	297·3	0·88	,,
1882·5	70 Ophiuchi	63·5	2·98	Tisserand.

ELECTRICAL TRANSMISSION OF FORCE AND STORAGE OF POWER[1]

DR. SIEMENS, in opening the discourse, reverted to the object the Council had in view in organising these occasional lectures, which were not to be lectures upon general topics, but the outcome of such special study and practical experience as Members of the Institution had exceptional opportunities of acquiring in the course of their professional occupation. The subject to be dealt with during the present session was that of electricity. Already telegraphy had been brought forward by Mr. W. H. Preece, and telephonic communication by Sir Frederick Bramwell.

Thus far electricity had been introduced as the swift and subtle agency by which signals were produced either by mechanical means or by the human voice, and flashed almost instantaneously to distances which were limited, with regard to the former, by restrictions imposed by the globe. To Dr. Siemens had been assigned the task of introducing to their notice electric energy in a different aspect. Although still giving evidence of swiftness and precision, the effects he should dwell upon were no longer such as could be perceived only through the most delicate instruments human ingenuity could contrive, but were capable of rivalling the steam engine, compressed air, and the hydraulic accumulator, in the accomplishment of actual work.

In the early attempts at magneto-electric machines, it was shown that, so long as their effect depended upon the oxidation of zinc in a battery, no commercially useful results could have been anticipitated. The thermo-battery, the discovery of Seebeck in 1822, was alluded to as a means of converting heat into electric energy in the most direct manner; but this conversion could not be an entire one, because the second law of thermodynamics, which prevented the realisation as mechanical force of more than one-seventh part of the heat energy produced in combustion under the boiler, applied equally to the thermo-electric battery, in which the heat, conducted from the hot points of juncture to the cold, constituted a formidable loss. The electromotive force of each thermo-electric element did not exceed 0·036 of a volt, and 1800 elements were therefore necessary to work an incandescence-lamp.

A most useful application of the thermoelectric battery for measuring radiant heat, the thermopile, was exhibited. By means of an ingenious modification of the electrical pyrometer, named the Bolometer, valuable researches in measuring solar radiations had been made by Prof. Langley.

Faraday's great discovery of magneto-induction was next noticed, and the original instrument by which he had elicited the first electric spark before the members of the Royal Institution in 1831, was shown in operation. It was proved that although the individual current produced by magneto-induction was exceedingly small and momentary in action, it was capable of unlimited multiplication by mechanical arrangements of a simple kind, and that by such multiplication, the powerful effects of the dynamo-machine of the present day were built up. One of the means for accomplishing such multiplication was the Siemens armature of 1856. Another step of importance was that involved in the Pacinnoti ring, known in its practical application as the machine of Gramme. A third step, that of the self-exciting principle, was first communicated by Dr. Werner Siemens to the Berlin Academy, on January 17, 1867, and by the lecturer to the Royal Society on the 4th of the following month. This was read on February 14, when the late Sir Charles Wheatstone also brought forward a paper embodying the same principle. The lecturer's machine which was then exhibited, and which might be looked upon as the first of its kind, was shown in operation; it had done useful work for many years as a means of exciting steel magnets. A suggestion, contained in Sir Charles Wheatstone's paper, that "a very remarkable increase of all the effects, accompanied by a diminution in the resistance of the machine, is observed when a cross wire is placed so as to divert a great portion of the current from the electro-magnet," had led the lecturer to an investigation read before the Royal Society on March 4, 1880, in which it was shown that by augmenting the resistance upon the electro-magnets a hundredfold, valuable effects could be realised, as illustrated graphically by means of a diagram. The most important of these results consisted in this, that the electromotive force produced in a "shunt-wound machine," as it was called, increased with the external resistance, whereby the great fluctuations formerly inseparable from electric-arc lighting could be obviated, and that, by the double means of exciting the electro-magnets, still greater uniformity of current was attainable.

The conditions upon which the working of a well-conceived dynamo-machine must depend were next alluded to, and it was demonstrated that when losses by unnecessary wire-resistance, by Foucault-currents, and by induced currents in the rotating armature were avoided, as much as 90 per cent., or even more, of the power communicated to the machine were realised in the form of electric energy, and that *vice versâ* the reconversion of electric into mechanical energy could be accomplished with similarly small loss. Thus, by means of two machines at a moderate distance apart, nearly 80 per cent. of the power imparted to the one machine could be again yielded in the mechanical form by the second, leaving out of consideration frictional losses, which latter need not be great, considering that a dynamo-machine had only one moving part well balanced, and was acted upon along its entire circumference by propelling force. Jacobi had proved many years ago that the maximum efficiency of a magneto-electric engine was obtained when

$$\frac{e}{E} = \frac{w}{W} = \frac{1}{2}$$

which law had been frequently construed by Verdet ("Théorie Mécanique de la Chaleur") and others to mean that one-half was the maximum theoretical efficiency obtainable in electric transmission of power, and that one-half of the current must be necessarily wasted or turned into heat. The lecturer could never be reconciled to a law necessitating such a waste of energy, and had maintained, without disputing the accuracy of Jacobi's law, that it had reference really to the condition of maximum work accomplished with a given machine, whereas its efficiency must be governed by the equation

$$\frac{e}{E} = \frac{w}{W} = \text{nearly } 1.$$

From this it followed that the maximum yield was obtained

[1] Abstract of lecture given at the Institution of Civil Engineers on March 15 by Dr. C. William Siemens, F.R.S., M.Inst.C.E. Revised by the author.

when two dynamo-machines (of similar construction) rotated nearly at the same speed, but that under these conditions the amount of force transmitted was a minimum. Practically the best condition of working consisted in giving to the primary machine such proportions as to produce a current of the same magnitude, but of 50 per cent. greater electromotive force than the secondary; by adopting such an arrangement, as much as 50 per cent. of the power imparted to the primary could be practically received from the secondary machine at a distance of several miles. Prof. Silvanus Thompson, in his recent Cantor Lectures, had shown an ingenious graphical method of proving these important fundamental laws.

The possibility of transmitting power electrically was so obvious that suggestions to that effect had been frequently made since the days of Volta, by Ritchie, Jacobi, Henry, Page, Hjorth, and others; but it was only in recent years that such transmission had been rendered practically feasible.

Just six years ago, when delivering his presidential address to the Iron and Steel Institute, the lecturer had ventured to suggest that "time will probably reveal to us effectual means of carrying power to great distances, but I cannot refrain from alluding to one which is, in my opinion, worthy of consideration, namely, the electrical conductor. Suppose water-power to be employed to give motion to a dynamo-electrical machine, a very powerful electrical current will be the result, which may be carried to a great distance, through a large metallic conductor, and then be made to impart motion to electro-magnetic engines, to ignite the carbon points of electric lamps, or to effect the separation of metals from their combinations. A copper rod 3 inches in diameter would be capable of transmitting 1000 h.p. a distance of say 30 miles, an amount sufficient to supply one quarter of a million candle-power, which would suffice to illuminate a moderately-sized town." This suggestion had been much criticised at the time, when it was still thought that electricity was incapable of being massed so as to deal with many horse power of effect, and the size of conductor he had proposed was also considered wholly inadequate. It would be interesting to test this early calculation by recent experience. Mr. Marcel Deprez had, it was well known, lately succeeded in transmitting as much as 3 h.p. to a distance of 40 kilometres (25 miles) through a pair of ordinary telegraph wires of 4 mm. diameter. The results so obtained had been carefully noted by Mr. Tresca, and had been communicated a fortnight ago to the French Academy of Sciences. Taking the relative conductivity of iron wire employed by Deprez, and the 3-inch rod proposed by the lecturer, the amount of power that could be transmitted through the latter would be about 4000 h.p. But Deprez had employed a motor-dynamo of 2000 volts, and was contented with a yield of 32 per cent. only of the power imparted to the primary machine, whereas he had calculated at the time upon an electromotive force of 200 volts, and upon a return of at least 40 per cent. of the energy imparted. In March, 1878, when delivering one of the Science Lectures at Glasgow, he said that a 2-inch rod could be made to accomplish the object proposed, because he had by that time conceived the possibility of employing a current of at least 500 volts. Sir William Thomson had at once accepted these views, and with the conceptive ingenuity peculiar to himself, had gone far beyond him, in showing before the Parliamentary Electric Light Committee of 1879, that through a copper wire of only ½-inch diameter, 21,000 h.p. might be conveyed to a distance of 300 miles with a current of an intensity of 80,000 volts. The time might come when such a current could be dealt with, having a striking distance of about 1·2 feet in air, but then, probably, a very practical law enunciated by Sir William Thomson would be infringed. This was to the effect that electricity was conveyed at the cheapest rate through a conductor, the cost of which was such that the annual interest upon the money expended equalled the annual expenditure for lost effect in the conductor in producing the power to be conveyed. It appeared that Mr. Deprez had not followed this law in making his recent installations.

Sir William Armstrong was probably first to take practical advantage of these suggestions in lighting his house at Cragside during night-time, and working his lathe and saw-bench during the day, by power transmitted through a wire from a waterfall nearly a mile distant from his mansion. The lecturer had also accomplished the several objects of pumping water, cutting wood, hay, and swedes, of lighting his house, and of carrying on experiments in electro-horticulture from a common centre of steam-power. The results had been most satisfactory; the whole of the management had been in the hands of a gardener and of labourers, who were without previous knowledge of electricity, and the only repairs that had been found necessary were one renewal of the commutators and an occasional change of metallic contact brushes.

An interesting application of electric transmission to cranes, by Dr. Hopkinson, was shown in operation.

Amongst the numerous other applications of the electrical transmission of power, that to electrical railways, first exhibited by Dr. Werner Siemens, at the Berlin Exhibition of 1879, had created more than ordinary public attention. In it the current produced by a dynamo-machine, fixed at a convenient station and driven by a steam-engine or other motor, was conveyed to a dynamo placed upon the moving car, through a central rail supported upon insulating-blocks of wood, the two working-rails serving to convey the return current. The line was 900 yards long, of 2-feet gauge, and the moving car served its purpose of carrying twenty visitors through the Exhibition each trip. The success of this experiment soon led to the laying of the Lichterfelde line, in which both rails were placed upon insulating sleepers, so that the one served for the conveyance of the current from the power station to the moving car, and the other for completing the return circuit. This line had a gauge of 3 feet 3 inches, was 2500 yards in length, and was worked by two dynamo-machines, developing an aggregate current of 9000 Watts, equal to 12 h.p. It had now been in constant operation since May 16, 1881, and had never failed in accomplishing its daily traffic. A line half a kilometer in length, but of 4 feet 8½ inch gauge, was established by the lecturer at Paris in connection with the Electric Exhibition of 1881. In this case two suspended conductors in the form of hollow tubes with a longitudinal slit were adopted, the contact being made by metallic bolts drawn through these slit tubes, and connected with the dynamo-machine on the moving car by copper ropes passing through the roof. On this line 95,000 passengers were conveyed within the short period of seven weeks.

An electric tramway 6 miles in length had just been completed, connecting Portrush with Bush Mills in the north of Ireland, in the installation of which the lecturer was aided by Mr. Traill, as engineer of the Company, by Mr. Alexander Siemens, and by Dr. E. Hopkinson, representing his firm. In this instance the two rails, 3 feet apart, were not insulated from the ground, but were joined electrically by means of copper staples and formed the return circuit, the current being conveyed to the car through a T iron placed upon short standards, and insulated by means of insulite caps. For the present the power was produced by a steam-engine at Portrush, giving motion to a shunt-wound dynamo of 15,000 Watts = 20 h.p., but arrangements were in progress to utilise a waterfall of ample power near Bush Mills, by means of three turbines of 40 h.p. each, now in course of erection. The working-speed of this line was restricted by the Board of Trade to 10 miles an hour, which was readily obtained, although the gradients of the line were decidedly unfavourable, including an incline of 2 miles in length at a gradient of 1 in 38. It was intended to extend the line 6 miles beyond Bush Mills, in order to join it at Dervock station with the north of Ireland narrow-gauge railway system.

The electric system of propulsion was, in the lecturer's opinion, sufficiently advanced to assure practical success under suitable circumstances—such as for suburban tramways, elevated lines, and above all lines through tunnels, such as the Metropolitan and District Railways. The advantages were that the weight of the engine, so destructive of power and of the plant itself in starting and stopping, would be saved, and that perfect immunity from products of combustion would be insured. The limited experience at Lichterfelde, at Paris, and with another electric line of 765 yards in length, and 2 feet 2 inches gauge, worked in connection with the Zaukerode Colliery since October, 1882, were extremely favourable to this mode of propulsion. The lecturer however did not advocate its prospective application in competition with the locomotive engine for main lines of railway. For tramways within populous districts the insulated conductor involved a serious difficulty. It would be more advantageous under these circumstances to resort to secondary batteries, forming a store of electrical energy carried under the seats of the car itself, and working a dynamo-machine connected with the moving wheels by means of belts and chains.

The secondary battery was the only available means of propelling vessels by electrical power, and considering that these batteries might be made to serve the purpose of keel ballast, their weight, which was still considerable, would not be objectionable. The secondary battery was not an entirely new conception. The hydrogen gas battery suggested by Sir Wm. Grove in 1841, and which was shown in operation, realised in the most perfect manner the conception of storage, only that the power obtained from it was exceedingly slight. The lecturer, in working upon Sir William Grove's conception, had twenty-five years ago constructed a battery of considerable power in substituting porous carbon for platinum, impregnating the same with a precipitate of lead peroxidised by a charging current. At that time little practical importance attached, however, to the subject, and even when Planté, in 1860, produced his secondary battery, composed of lead plates peroxidised by a charging current, little more than scientific curiosity was excited. It was only since the dynamo-machine had become an accomplished fact that the importance of this mode of storing energy had become of practical importance, and great credit was due to Faure, to Sellon, and to Volckmar, for putting this valuable addition to practical science into available forms. A question of great interest in connection with the secondary battery had reference to its permanence. A fear had been expressed by many that local action would soon destroy the fabric of which it was composed, and that the active surfaces would become coated with sulphate of lead preventing further action. It had, however, lately been proved in a paper read by Dr. Frankland before the Royal Society, corroborated by simultaneous investigations by Dr. Gladstone and Mr. Tribe, that the action of the secondary battery depended essentially upon the alternative composition and decomposition of sulphate of lead, which was therefore not an enemy, but the best friend to its continued action.

In conclusion, the lecturer referred to electric nomenclature, and to the means for measuring and recording the passage of electric energy. When he addressed the British Association at Southampton, he had ventured to suggest two electrical units additional to those established at the Electrical Congress in 1881, viz., the Watt and the Joule, in order to complete the chain of units connecting electrical with mechanical energy and with the unit-quantity of heat. He was glad to find that this suggestion had met with favourable reception, especially that of the Watt, which was convenient for expressing in an intelligible manner the effective power of a dynamo-machine, and for giving a precise idea of the number of lights or effective power to be realised by its current, as well as of the engine power necessary to drive it: 746 Watts represented 1 h.p.

Finally the Watt-meter, an instrument recently developed by his firm, was shown in operation. This consisted simply of a coil of thick conductor suspended by a torsion wire, and opposed laterally to a fixed coil of wire of high resistance. The current to be measured flowed through both coils in parallel circuit, the one representing its quantity expressible in Ampères, and the other its potential expressible in Volts. Their joint attractive action expressed therefore Volt-Ampères or Watts, which were read off upon a scale of equal divisions.

The lecture was illustrated by experiments, and by numerous diagrams and tables of results. Measuring instruments by Professors Ayrton and Perry, by Mr. Edison and by Mr. Boys were also exhibited.

FAUNA AND FLORA OF THE ALEUTIAN ISLANDS

THE last number of *Naturen* contains an interesting report by Dr. Leonhard Stejneger of the result of his six months' observations of the fauna and flora of the Kamschatkan coast and of the so-called Kommandorski Islands, which form the western group of the Aleutian archipelago between Behring's Sea and the Pacific, in 50°–55° N. lat. The Kommandorski group consists of two islands, one of which is known as Mednoj Ostrov, Copper Island, from the large amount of the pure metal found there; while the other, which was the scene of Behring's shipwreck and death, bears his name. Both islands are geologically allied to Kamschatka, and excepting at the north of Behring's Island, where the gradual subsidence of the sea has left raised beaches, terraces, and tabulated rock-formations, the islands consist generally of deep narrow valleys separated by rocky barriers, which rise precipitously to a height of from 1000 to 2000 feet above the level of the sea. The islands, which were uninhabited before their annexation by Russia, are now occupied by about 700 persons, in the employment of a Russo-American fur company, which has been attracted to the spot by the enormous numbers of sea-bears (*Callorhinus ursinus*) and sea-otters (*Enhydra lutris*) which frequent the coasts. The climate is foggy, and the vegetation stunted and sparse, while in the neighbouring Kamschatkan territory the blue of the summer sky, the stillness of the sea, and the softness of the air, are almost Italian in character. The flora, moreover, is so exuberant that numerous plants, which in Norway never exceed two or three feet, here attain the height of a tall man. Next to the birch (*Betula ermanni*), alders, willows, and roans (*Sorbus Kamschaticus*), are the most frequent trees, the berries of the last-named, and those of *Lonicera cærulea*, possessing a sweetness which brings them into great request among strangers as well as natives. Some flowers also, as the wild, indigenous, dark red rose, several rhododendrons, and native lilies, are equally remarkable for exceptional fragrance. Among wild flowers, some of the geraniums, potentillas, taraxacums, &c., are almost identical with those found in Norway. Besides a large whale, and a specimen of the walrus (*Rosmarus obesus*), which had been killed near Avatscha Bay, Dr. Stejneger could find no trace of any mammal but a small specimen of *Arvicola œconomus*. Of birds there is, however, an enormous variety, some of which, as *Calliope Kamschatica*, *Carpodacus Erythrinus*, and a kind of sedge-warbler, provisionally named by the author "*Acrocephalus dybowskii*," combine an almost tropical brilliancy of colouring with a sweetness of song equal to that of our own nightingale or thrush. Besides these melodious warblers, Kamschatka harbours large numbers of *Locustella lanceolata*, whose grasshopper-like cry is heard when all else is still. *Cuculus canorinus* represents our common cuckoo. Pipits, chats, and wagtails abound; *Larus capistratus* is commoner than any other gull, and the osprey is not unfrequent. Mosquito-like gnats of vindictive nature swarm in such numbers as to make the pursuits of the field naturalist almost impracticable. The fauna, generally, is palæarctic in character, with a scarcity of American forms which is very remarkable when we consider the vicinity of the western continent.

PHYSICAL HISTORY OF THE DEAD SEA, THE JORDAN VALLEY, AND PALESTINE

PROF. E. HULL, LL.D., F.R.S., delivered an interesting lecture on the above subject on March 2, in the Theatre of the Royal Dublin Society's premises, Kildare Street. Prof. Hull said:—"There is no country which possesses for us an interest equal to that which I have to treat of this evening. Its religious and historical associations stand alone amongst those of all nations, and will ever maintain in the history of the world an undying import. But while this is true as regards the religious and social aspects of Palestine, I hope to show that in its physical aspect it possesses points of interest which render it unique amongst all countries, and which have attracted to it the attention of naturalists during a lengthened period down to the present day. Probably no country has been so often described. Its physical features have attracted the attention of observers of natural phenomena from Strabo downwards to the recent admirable work of M. Lartet and the Duc de Luynes, to which I am largely indebted. In more recent times we have the observations of Humboldt, of the late Dr. Hitchcock, of Lieut. Lynch of the United States Navy, who carried out a systematic series of soundings over the bed of the Dead Sea, and more recently of the Rev. Dr. Tristram, of Prof. Roth, Burkhardt, and others, including the Survey made by the officers of the Royal Engineers. It is curious however that the remarkable physical phenomenon which renders the Holy Land unique amongst all countries (regarded in its physical aspect) was not discovered till the year 1836-37, when Heinrich Von Schubert and Prof. Roth determined by barometric observations that the surface of the Dead Sea lies no less than 1300 feet below the level of the Mediterranean, a fact not suspected by previous observers. It is the deep depression of the Jordan Valley, deeper by far than any river valley elsewhere, which is the key to the physical history of the whole country; and in endeavouring to trace out its origin I shall reproduce in as general a manner as I can the successive phases through which the region bordering the Mediterranean, and extending eastwards towards the Euphrates and southwards to the Dead Sea, has passed. The fundamental basis of the geological formation of Palestine is the gneissic granite, of Archæan age and metamorphic origin, which rises into the mountains of Idumea, and is the rock from which the huge monoliths of Egypt have been hewn, such as Cleopatra's Needle' the obelisk of Luxor, and the columns which adorn the Piazza of Venice. This foundation rock formed part of a continental area down to the Carboniferous period, when it was submerged, and a great sandstone formation was spread over it known as "the Nubian sandstone." After another interval of time the sandstone itself was overspread by limestone deposits of Cretaceous and Tertiary age, deposited over the floor of the ancient sea, and down to the close of the Eocene period the waters of the sea overspread the greater portions of Asia Minor, Palestine, and the adjoining districts of the Asiatic and African continents. The first appearance of Palestine and the adjoining districts as a land surface dates from the succeeding Miocene period, when the bed of the sea was upraised into dry land, and at the same period a great fissure corresponding with the line of the Jordan valley was produced. Along this fissure, which has been traced from the Lebanon southwards towards the Gulf of Akaba—the strata on the eastern (or Moabite) side have been relatively elevated: those on the western relatively depressed;—so that the strata on the opposite sides of the Jordan valley and the Dead Sea do not correspond with each other. This great fissure is the key to the physical formation of the whole region, because it gave origin to a river which once flowed down from the mountains of Lebanon—southwards through the Gorge of Arabah (discovered by Burkhardt)—into the Red Sea in a remarkably straight line running north and south for a distance of over 250 miles. This is now the Jordan. The depression of the valley continuing through the succeeding Pliocene epoch, the district of the Ghor and the Jordan valley was conveyed into a lake, which Prof. Hull considered ultimately extended from the southern end of the Dead Sea, northwards nearly to the Lake Merom, and included the Sea of Galilee. This lake would then have had a length of 160 miles and an average breadth of ten miles. During "the Pluvial period," which succeeded "the Glacial," the waters probably reached their maximum elevation, and continued to flow southwards through the Gorge of Arabah and the Gulf of Akaba into the Red Sea; but from the increasing dryness of the climate they gradually decreased, and the surface of the lake became contracted, and ultimately reduced to its existing limits. During this lowering of the surface, the remarkable terraces noticed by most travellers were formed. Dr. Tristram has taken the barometric level of several of these above the Dead Sea. They range up to 750 feet, and even higher. They appear to be undoubtedly old lake margins, and indicate the successive levels at which the lake stood. The 750-foot terrace very closely corresponds to the summit-level of the Gorge of Arabah. When the waters were reduced so low as not to pass through the Gorge of Arabah, they became brackish, and ultimately salt—the salinity increasing as the area became diminished. All lakes not having an outlet become saline; and the contrast of the waters of the Sea of Galilee and those of the Dead Sea form a striking illustration of the law just stated. The saline ingredients in the surface waters of the Dead Sea are 24·57 lbs. in 100 lbs. of the water, while that of the Atlantic only contains 6 lbs. in the same quantity. The Dead Sea water is therefore over four times as strongly impregnated with salts as that of the ocean, and in the deeper waters the salinity amounts to saturation, as saline deposits are forming over the floor of the Dead Sea. This remarkable inland sea had assumed somewhat of its present contracted dimensions, and was known as "the Salt Sea" as far back as the time of the Patriarch Abraham. Near its borders stood the doomed cities of Sodom and Gomorrah—not beneath its waters, as was often supposed—but near its upper margin. With the call of Abraham the political and religious history of Palestine begins, and the narrative of the physical historian ends

SCIENTIFIC SERIALS

American Journal of Science, March.—The selective absorption of solar energy, by S. P. Langley.—New locality of the green turquois known as chalcuite, and on the identity of turquois with the callais or callaina of Pliny, by W. P. Blake.—On portions of the skeleton of a whale from gravel on the line of the Canada Pacific Railway near Smith Falls, Ontario, by J. W. Dawson.—The cobwebs of Uloborus, by J. H. Emerton.—Glacial drift in the Upper Missouri River region, by C. A. White.—Late observations concerning the molluscan fauna and the geographical extent of the Laramie group, by the same.—The Sphingidæ of North America, by A. R. Grote.—"Rotational coefficients" of various metals, by E. H. Hall.—Recent exploration of the volcanic phenomena of the Hawaiian islands, by C. E. Dutton.

Journal of the Russian Chemical and Physical Society, vol. xiv. fasc. 9.—On several ethylenic hydrocarbons, and on their action on water, by M. A. Eltekoff. Of the compounds of the series $C_nH_{2n}O$, the oxides are the least known, and it still remains in doubt as to those described by MM. Bauer, Würtz, Jekyll, and Clermont being true oxides and not ketones; M. Eltekoff studied, therefore, the action on water of seven compounds of this series. He arrives at the conclusion that the characteristic features of oxides do not disappear, as seemed formerly to be the case, in more compound oxides containing even as much as six equivalents of carbon. Their capacity of entering in direct compounds with water diminishes, however, in proportion as the molecule becomes more complicated.—On the oxidation of sulphur used for covering the vineyards, by M. A. Bazaroff.—On the evaporation of liquids, by M. Sreznewsky. Evaporation of benzol, ether, ethyl-alcohol, chloroform, and sulphur of carbon at different temperatures. The paper will be continued.—On the critical temperature and pressure of water, by M. O. Strauss. The average of a series of observations gives for the critical temperature of water 370°, with a probable error of 5°. The critical pressure would be 195·5 atmospheres.—Historical sketch of the work accomplished by the Physical Society during its ten years' existence, by M. N. Hesehus.—On the temperature of the absolute vaporisation of liquids, by M. Nadejdin.—On the spheroidal state of liquids, by M. D. Diakonoff.—Minutes of proceedings.

Rivista Scientifico-Industriale e Giornale del Naturalista, January 15.—The glossograph of S. Gentilli.—Influence of ozone in agriculture, by S. Zinno.—The radiometer and school experiments, by C. Rovelli.—Fossil elephants in the district of Parma.—Simple holohedral forms of the rhombohedral system, by M. de Lupo.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xvi. fasc. i.—Meteorological *résumé* of the year 1882, calculated on observations made at the Royal Observatory of Brera, by E. Pini.—The frost of 1882 considered in its agrarian and meteoric aspect, by E. Ferrario.—Results of observations on the amplitude of diurnal oscillation of the declination-needle made during 1882 at Brera Observatory, by G. Schiaparelli.—On the action of metallic iodide on leucine and other like substances, by G. Körner and E. Menozzi.

Fasc. ii.—Property of a class of functions with more variables than are presented in dynamics in the case of permanent motion, by C. Formenti.—On some plane involutions, by E. Bertini.—Generalisation of a theorem on the analytical representation of substitutions, by A. Grandi.

Schriften der Physicalisch-Ökonomischen Gesellschaft zu Königsberg. 1880, first part; 1881, first and second parts.—Geological investigation of the North German level country, especially East and West Prussia, in the years 1878–80, by A. Jentzsch.—Contributions to a knowledge of the Silurian Cephalopoda found in the East and West Prussian diluvial formations, by H. Schröder.—Rugous corals in the same formation, by G. Meyer.—The scales of our fishes, by B. Benecke.—On some diluvial and alluvial diatom-layers of North Germany, by P. T. Cleve and A. Jentzsch.—The underground portion of the North German level country, by A. Jentzsch.

Verhandlungen der Naturhistorischen Vereines der Preussischen Rheinlande und Westfalens, 1882 (first half).—Further observations on fertilisation of flowers by insects, by H. Müller.—On the various systems of measurement of electric and magnetic quantities, by R. Clausius.—The lower Devonian strata of Olkenbach, by O. Follmann.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 8.—"Notes on the Absorption of Ultra-Violet Rays by various Substances," by Professors Liveing and Dewar.

These notes contain some records of ultra-violet absorptions in addition to those which have been examined by Soret, Hartley, M. de Chardonnet, and other investigators. For these observations the spark of an induction coil, with Leyden jar, between iron electrodes, was generally used as the source of light. The lines of iron are so multitudinous, and so closely set in a large part of the ultra-violet region of the spectrum, that they form almost a continuous spectrum, at the same time there are amongst them a sufficient number of breaks and conspicuous lines to serve as points of reference. The optical train used was wholly of quartz, and the spectra were all photographed.

Chlorine in small quantity shows a single absorption band extending from about N (3580) to T (3020). As the quantity of chlorine is increased this band widens, expanding on both sides, but rather more rapidly on the less refrangible side. Different quantities of chlorine produced absorption from about H (3968) to wave-length 2755, from wave-length 4415 to 2665, and from wave-length 4650 to 2630. With the greatest quantity of chlorine tried, the absorption did not extend above wave-length 2550.

Bromine vapour in small quantity absorbs light up to about L (3820), and is quite transparent above that. With larger quantity the absorption increases, gradually extending with increase of bromine vapour from L to P (3360); and at the same time there is a gradually increasing general absorption at the most refrangible end of the spectrum beginning at about wave-length 2500; so that the denser bromine vapour is transparent for a band between wave-length 2500 and 3350.

Liquid bromine in very thin film between two quartz plates is transparent for a band between wave-length about 3650 and 3400, shading away on both sides, so that below M on one side and above P on the other the absorption seems complete. The transparency of the liquid film ends on the more refrangible side just where that of the vapour begins.

Iodine vapour tolerably dense cuts off all within the range of our photographs below wave-length 4300, and its absorption gradually diminishes from that point up to about wave-length 4080; from that point it is transparent. Denser vapour produces complete absorption up to 4080 and partial absorption above that point.

Comparing the absorptions of the three haloid elements, the principal band shifts towards the less refrangible side with increasing atomic weight, as Lecoq de Boisbaudran has noticed in the case of lines corresponding to one another in the spectra of groups of similar metals.

Iodine dissolved in carbon disulphide is transparent for a band between G and H, cutting off all above and below. It is not possible to tell how much of the light above M (3727) is absorbed by iodine in such a solution, inasmuch as carbon disulphide is opaque for rays more refrangible than M.

Iodine dissolved in carbon tetrachloride when the solution is weak shows only the absorption due to the solvent, described below. More iodine increases the absorption until it is complete above P (3360), with shading edge as far down as about wave-length 3400.

Sulphurous acid gas produces an absorption band which is very marked between R (3179) and wave-length 2630, and a fainter absorption extending on the less refrangible side to O (3440), and on the other side to the end of the range photographed, wave-length 2300.

Sulphuretted hydrogen produces complete absorption above wave length 2580. Below that a partial general absorption.

Vapour of carbon disulphide in very small quantity produces an absorption band extending from P to T, shading away at each end; no absorption in the higher region. With more vapour the absorption band widens, extending from about wave-length 3400 to 3000, and a second absorption occurs beginning at about wave-length 2580, and extending to the end of the range photographed.

Carbon tetrachloride liquid produces an absorption band with a maximum about R, extending, but with decreasing intensity, up to Q (3285) on one side, and to *s* (3045) on the other. In the higher region there is a second absorption sensible about wave-length 2600, and increasing in intensity up to about wave-length 2580, beyond which point it is complete.

Chlorine peroxide gives a succession of nine shaded bands, at nearly equal intervals, between M and S, with faint indications of others beyond. In the highest region this gas seems quite transparent.

A slice of chrome-alum a quarter of an inch thick is transparent between wave-lengths 3270 and 2830; its absorption gradually increases on both sides of those limits, but rather more rapidly on the more refrangible side than on the other, and becomes complete below about wave-length 3360 and above wave-length 2730.

A very thin plate of mica shows absorption beginning about S (3100), rapidly increasing above U (2947), and complete above wave-length 2840.

A thin film of silver precipitated chemically on a plate of quartz transmits well a band of light between wave-length about 3350 and 3070, but is quite opaque beyond those limits on both sides.[1]

A thin film of gold similarly precipitated merely produces a slight general absorption all along the spectrum.

The difference between the limits of transparency of Iceland spar for the ordinary and extraordinary rays, inferred from theory, was found to be very small, and hardly to be detected without using a considerable thickness, three inches or more, of the spar.

The authors had expected to be able to apply the well-known photometric method by means of polarised light to the comparison of intensities of ultra violet rays. Ordinary Nicol's prisms are not applicable to ultra-violet rays on account of the opacity of the Canada balsam, with which they are cemented, so Foucault's prisms were used. Upon taking photographs of the spectrum of the iron spark through this pair of prisms at various inclinations between the planes of polarisation of the two prisms, it was found that for the whole range between the position of parallelism and the inclination of 80° there was no sensible difference of effect upon the photographic plate, though the length of exposure was in all cases the same. For inclinations between 80° and 90° there was a sensible and increasing diminution in the photographic effect as the planes of polarisation of the polariser and analyser were more nearly at right angles to one another. It seems to follow from this that the full photographic effect on the dry gelatine plates used ensues when the intensity of the light reaches a certain limit, but that for intensities of light beyond that limit there is no sensible increase in the effect until the stage of solarisation is reached.

Chemical Society, March 15.—Dr. Gilbert, president, in the chair.—Dr. Gilbert will resign the presidential chair at the end of the session.—The Council have proposed Dr. W. H. Perkin to fill the vacancy, and Mr. J. Millar Thomson to be Secretary.—The following papers were read:—On some condensation-products of aldehydes with aceto-acetic ether and with substituted aceto-acetic ethers, by F. E. Matthews. The author has studied the following reactions: condensations of aceto-acetic ether with isobutylic aldehyde, valeric aldehyde, chloral furfurol, acrolein; of benzoic aldehyde with aceto-diethylacetic ether, aceto-dichloracetic ether, and aceto-benzilidene-acetic ether, and of benzoic aldehyde with aceto-mono-ethylacetic either.—Contribution to the chemistry of "Fairy Rings," by Sir J. B. Lawes, Dr. Gilbert, and Mr. Warington. The authors have analysed samples of the soil inside the ring, on the ring, and outside the ring. The soil inside is much poorer in organic carbon and nitrogen than the soil outside the ring; the soil at the ring itself is intermediate in character as to carbon and nitrogen, but contains a larger quantity of nitrates. The fairy ring fungi seem to derive and assimilate nitrogen from the soil; this nitrogen is eventually deposited as manure at the ring, and becomes available to the associated herbage, which thereby acquires the characteristic dark-green colour.—On lines of no chemical change, by Dr. Mills and Mr. D. Mackey. The authors have investigated the strength at which sulphuric acid ceases to attack zinc at certain temperatures.—On homologous spectra, by W. N. Hartley. The author has photographed and mapped the spectra of various elements belonging to the same homologous series, *e.g.* magnesium, zinc and cadmium, calcium, strontium and barium, &c., especially with a view to finding out whether the striking similarity in such spectra was due to harmonic vibrations of a common fundamental vibration. The author concludes that the data contained in the paper support the view that elements whose atomic weights differ by a constant quantity, and whose chemical character is similar, are truly homologous, or in other words, are the same kind of matter in different states of condensation.

[1] Cornu ("Spectre Normal du Soleil," p. 23, *note*) mentions that such films of silver are transparent for rays about $\lambda = 270$, which is a good deal too high. Chardonnet (*Comptes Rendus*, February, 1883) states that the band extends from O to S. W. A. Miller (*Phil. Trans.* 1863) noticed that a silver reflector failed to reflect a band in the ultra-violet.

Linnean Society, March 1.—Sir John Lubbock, Bart., president, in the chair.—The following gentlemen were elected Fellows of the Society:—W. B. Barrett, L. J. K. Brace, J. B. Bridgman, W. O. Chambers, W. E. Clarke, W. Godden, F. H. H. Guillemard, J. C. Havers, T. M. Hocken, C. H. Middleton Wake, James Stirling, and Rev. P. W. Wyatt.—Two pieces of North American yellow pine were exhibited for Mr. R. M. Middleton, which displayed on their surface a great number of depressions like fine shot holes. These were doubtfully supposed to be produced by insect depredations.—Mr. W. T. Thiselton Dyer called attention to and made remarks on the dried leaves and rind of the fruit of oranges from the Bahamas, partially destroyed by the *Mytilaspis citricola*, Packard.—Mr. R. F. Towndrow showed examples of a new variety of *Rosa stytosa*, obtained at Madresfield, near Malvern, by Mr. A. D. Melin. This variety is evergreen, and its fruits ripen in the second year.—Mr. Alfred W. Bennett read a paper on the constancy of insects in their visits to flowers.—Then followed a communication on the methodic habits of insects when visiting flowers, by Mr. R. M. Christy, see notice (p. 498).—The Secretary, Mr. G J. Romanes, read some observations on living Echinodermata. He stated that star-fish possess a sense of smell which is not localised in any particular organs, such as the ocelli, but is distributed over the whole of the ventral surface. The function of the Pedicellariæ was shown by some further experiments, corroborative of those already published by him in the *Philosophical Transactions*, to be that of seizing upon and arresting the movements of fronds of seaweed in order to give the pedicels time to establish their adhesions. It was also shown that the righting movements of echinus, when inverted on its aboral pole (which are performed by means of the pedicels) are due to central coordination proceeding in part from the pentagonal nerve-ring surrounding the mouth, and in part from central nerve-matter distributed along the course of the radial nerve-trunks. One of the experiments whereby the fact of such central coordination (depending on a sense of gravity) was proved consisted in rotating an inverted echinus upon a wheel moving in a vertical plane. It was found that whatever phase in the righting manœuvre the echinus might have attained at the moment when the rotation commenced was maintained so long as the rotation continued, but the manœuvre was resumed so soon as the rotation was allowed to cease. The paper concluded with an account of the effects of the various nerve poisons on the Echinodermata.—There followed in abstract the 17th part of the Rev. R. Boog Watson's memoir on the mollusca of the *Challenger* expedition; therein he deals with the family Pyramidellidæ, describing twenty-three new species of the genus *Eulima*, and one of the genus *Stylifer*.

Geologists' Association, March 2.—Mr. W. F. Stanley read a paper upon the possible causes of the elevation and subsidence of the earth's surface. In this he offered an hypothesis that both the rising and sinking of land was entirely due directly or indirectly to the action of our great common motor, the sun. But most particularly for the greatest effects to the elevation of aqueous vapour, and to its after deposition as snow about the poles of the earth. The deposition of snow was assumed at the present time to reach a considerable altitude at the south pole, and in this position by its gravity to react as a pressure upon the interior mass of the earth, which was assumed to be in a highly heated viscous or semi-liquid state, and to be surrounded by a somewhat rigid crust of 200 miles or so in thickness. The crust was assumed to offer a certain amount of resistance to internal and external pressures, beyond which it was deflectable upon or from the viscous interior. The pressures from continued accumulation of snow at the poles acting as an hydraulic pressure upon the interior mass were assumed to be distributed in such a manner as was evident by elevation of land in volcanic and plutonic action, so that the earth could remain approximately under the conditions present, a symmetrical spheroid whose outward figure would constantly represent a natural resultant of the action of gravitation upon all its parts, and of the tangential force of such parts in revolution. It was argued that the stability of the land-surface was entirely due to *permanent elevation* by volcanic and plutonic action, and that if this did not exist the effects of atmospheric denudation would reduce the land surface within moderate geological time to a nearly level swampy plane. It was further discussed that if the interior of the earth is metallic, which has been reasonably inferred from its high specific gravity (about 5·6), then it would consist of a heat-conducting material, so that, beyond the non-conducting coating, which we term the crust, a certain degree of heat would be reached which might henceforth remain uniform throughout the interior mass. The crust would therefore be that portion of the exterior which was oxidised into a non-conducting coating in which the interior heated mass would conserve its heat with little loss. It was further argued that if the interior were a *viscous* mass the reaction of hydraulic pressure upon it, as from great accumulation of ice at either pole, would be made most evident about the most deflectable parts of the crust, so that the central mass might remain static, and if this was assumed by the presence of enormous pressure to form a practically incompressible semi-liquid, it would in this state possess enormous rigidity. Mr. Stanley further discussed the conditions of continuity of volcanic action throughout all time that the earth has existed as a cooling globe with a solid crust accumulating ice at either of its poles, and that the periods of greatest glaciation at either pole would be the periods of greatest volcanic eruption and elevation. Dr. Croll's theory of displacement of the earth's centre by polar glaciation was shown not entirely to coincide with observation, in that the coast of Greenland was sinking, and the coast of Norway, in the same latitude, was rising whereas by this theory of displacement of the earth's centre, the present accumulation of ice at the south pole should cause both of these parts to be rising equally. Mr. Stanley held that the cause of the coast of Greenland sinking was the weight of the present accumulation of ice upon that continent, which represented on a small scale a polar pressure system such as he had discussed.

Royal Horticultural Society, March 13.—Sir J. D. Hooker, K.C.S.I., in the chair.—*Potato-disease*: Dr. Masters read a portion of a paper on this subject forwarded to him by Mr. A. Stephen Wilson, and having especial reference to the "sclerotia" which Mr. Wilson has discovered in nearly all the organs of the adult plant, as well as in the seedlings and tubers. The sclerotia are supposed to germinate and lie in a state of incubation in the haulm. Ultimately they give rise to the conidial threads. The conidia form, according to circumstances, either (1) zoospores, (2) plasm granules, or (3) secondary conidia. These are succeeded by oospores and a non-parasitic mycelium, from which latter, as it creeps through the soil, are thrown out "floats" and specks of the seminal plasm. The seed-tuber comes into contact with the plasm in the soil, which is absorbed and becomes developed in the shape of sclerotia, and thus the life-cycle is completed. From the tuber or seed to the conidia is the parasitic arc. From the conidia to the tuber is the non-parasitic arc. The author illustrated his position by what happens in the case of cereals, wherein the plasm, say, of smut or rust, is absorbed by the cells of the scutellum or cotyledon, passes through a period of gestation and then germinates. Mr. G. Murray observed that a microscopical examination did not clearly reveal any organic connection between the sclerotia and the peronospora mycelium, and thought that possibly they might prove to be glandular bodies of some kind, and belonging to the potato itself. Moreover they could not be true sclerotia in the fungoid sense, as the latter are a compact mycelium.—*Retinospora pisifera* and *R. plumosa*: Mr. Noble sent a specimen exhibiting sprays of both of these supposed species on the same plant. Dr. Masters remarked that the latter is the young form, while the former is the adult, and that a microscopical examination showed a correspondingly different distribution of the stomata, being more numerous in *R. plumosa*.—*Juniperus Chinensis*: He also sent a male spray taken from a female plant; the sexes in this species being normally quite distinct.—*Garrya elliptica grafted on Aucuba Japonica*: Mr. Noble forwarded a specimen showing the stock and the graft united. Mr. Henslow observed that this was an instance where physiological affinity corroborated the morphological; in that while Endlicher had placed Garrya between the hop and the plane, Bentham and Hooker assigned its position in the "Gen. Plantarum" next to Aucuba; but the discovery of its power of grafting on Aucuba was purely accidental, having been made by a gardener in Mr. Veitch's nurseries.—*Carica*, hybrid: Mr. Green, gardener to Sir G. Macleay, sent ripe fruits and foliage of a plant grown from seed furnished by M. Van Volxem of Brussels. It is a hybrid of the second generation, the first being raised from *C. erythrocarpa*, impregnated with the pollen of *C. cundinamarcensis* (from Colombia). From the fruit of this cross seedlings were raised, which were impregnated with pollen from the last named species, or from the hybrid itself. Some of the fruits supplied by Mr. Green contained apparently good seed. Mr. Henslow has tried the effect of the foliage on meat, that of the "Papaw," *C. papaya*, having the well known property of rendering it tender. He wrapped a piece of steak in a leaf for twenty-four hours, and it was quite effectual in softening it, and when cooked was pronounced excellent, though some thought there was a somewhat peculiar flavour as compared with a similar piece not wrapped up.

MANCHESTER

Literary and Philosophical Society, January 9.—H. E. Roscoe, F.R.S., &c., president, in the chair.—Dr. Joule said that he had, in December, 1882, made a fresh determination of the freezing-point in a sensitive thermometer constructed thirty-nine years ago. During that time the point had risen about 1° Fahrenheit, and although now rising very slowly, was not even yet quite stationary, having risen 1/40 of a degree Fahrenheit since November, 1879.

January 23.—J. P. Joule, F.R.S., vice-president, in the chair.—Remarks on the simultaneous variations of the barometer recorded by the late John Allan Broun, by Prof. Balfour Stewart, F.R.S.—A paper was read entitled "Jeremiah Horrox and William Crabtree, the Observers of the Transit of Venus in 1639," by Mr. John E. Bailey, F.S.A.

February 6.—Prof. Balfour Stewart, F.R.S., in the chair.—Note on the vapours of incandescent solids, by Henry Wilde.—Remarks on Prof. Osborne Reynolds' paper on isochronous vibrations, by Robert Rawson, Hon. Member. Assoc. I.N.A., Mem. of the London Mathematical Society.

February 20.—H. E. Roscoe, F.R.S., &c., president, in the chair.—Mr. R. D. Darbishire, F.G.S., read a note upon the Mammoth Cave, by Mr. G. Darbishire.

BERLIN

Physiological Society, February 23.—Prof. Du Bois Reymond in the chair.—Prof. Lucae, induced by the perception of a low noise when, in the open country, a strong wind blew against his ear, has long experimentally studied this phenomenon, investigating sounds and noises which arise on blowing into the external auditory meatus. He observed in normal ears which were closed with a sound tympanic membrane a moderately high noise, the pitch of which could not exactly be determined. When the tympanic membrane was stretched, the noise was somewhat higher and piping; when, on the other hand, the tympanic membrane was broken through or was absent, so that in the experiment the large air-space formed by the middle ear with the large cellular air-spaces beyond was blown into, he then heard a very deep noise. This great difference between the proper tone of the external auditory meatus and that of the large irregularly-formed air-space behind the membrane Prof. Lucae has verified both in all suitable patients and in dead bodies. An estimate of the relation of resonance of the ear cavities was obtained when, upon a spherical resonator which gives the tone $c_{\prime}$ on blowing, a short open cylinder was placed, which, blown into separately, gives the tone $c_{\prime\prime}$; when this combination was jointly blown into, the considerably deeper tone *H* was heard. When, however, between sphere and cylinder, a stretched membrane of caoutchouc was introduced, and the system blown into, there was heard again a higher tone, $f_{\prime}$. The influence here exercised by the degree of tension of the membrane could not be determined. To bring this schema of the air-spaces of the ear still nearer to the natural conditions, dry sponge was placed in the spherical resonator, the cavities of this material corresponding to the bone cells communicating with the middle ear; the pitch of the tone on blowing was not thereby much altered. The determination of the proper tone of the tympanum and the influence of these conditions on audition are further engaging the author's attention.—Dr. Pohl Pincus had explained at a previous meeting of the Society that in the non-vascular frog heart two groups of muscular fibres with different action must be distinguished. The one class of fibres surrounds the fissures of the heart-wall, which perform the function of the vessels and admit the nutritive liquid to the tissue (vessel-muscles); the others, by their regular contractions and dilatations, act in the way of moving the blood (proper heart-muscles). The contraction of the first kind of muscles closes the fissures and produces paleness of the heart-wall, and their dilatation opens the fissures, lets the blood penetrate into the substance of the heart, and reddens the heart-wall; while the action of the second group of muscles produces systole and diastole of the heart. Now the actions of these two kinds of muscles—the heart-vessel muscles and the proper heart-muscles—are not simultaneous and similar under the influence of local stimuli, removal of the brain, section of the spinal cord in different places, and poisons; sometimes the heart-walls were observed to be pale in diastole and deep red in systole, and there were various other local differences of behaviour. This led the author to seek also an anatomical difference of the two groups of muscles, and he found one such on microscopical examination, for the proper heart-muscle fibres were cross-striped throughout and had long cell nuclei, whereas in the others the cross-striping did not comprise the whole width of fibres, and the nuclei were oval. With this anatomical difference the different mode of reaction of the two kinds of muscles and their different function is intelligible.

VIENNA

Imperial Academy of Sciences, January 4.—The following papers were read:—G. Haberlandt, on the physiological anatomy of milk-tubes.—T. Wiesner, on the entering of the winter-buds of creeping blackberry-shoots into the soil, and on the mechanical cause of this process.—F. Rathay and B. Haas, on Phallus and Caprinus.—A. v. Obermayer, on diffusion of gases (third paper).

January 11.—F. Enrich, on the action of bile acids on albumen and peptones, and on their antiseptic effects.—T. Haubner, on the logarithmic potential of an uninsulated elliptic plate.—A. Lieben and S. Zeisel, on the products of condensation of propionaldehyde and its derivatives.—F. Anton, determination of the orbit of the Cassandra planet (114).—T. Ehrmann, on the formation of adipose tissue by the fat-organs, named winter-sleep-glands.

January 18.—C. Rabl, contribution to the history of development of Prosobranchiata.—F. Brauer, systematic studies based on the Diptera-larvæ, with a description of new species (third part).—R. Andreasch, on the oxidation of bases obtained by the action of halogen-compounds on thio-urea.—T. Freydl, note on the dry distillation of tartaric and citric acid with an excess of lime.—C. Pelz, on the determination of the outlines of warped screw-planes.—G. Goldschmidt, on the products of decomposition of the anhydrides of salicylic acid by distillation.—F. N. Dafert, on amylbenzol.

February 1.—W. Biedermann, contributions to general nerve and muscle physiology (tenth communication); to the knowledge of secondary contraction.—A. Belohoubek, on crystallised potassium hydroxides.—T. Blaas, contributions to the knowledge of natural water containing double sulphates.—T. Hepperger, determination of the orbit of Schmidt's nebulæ.—M. Kretschy, on the oxidation of kynurine and kinurenic acid.

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