THURSDAY, APRIL 29, 1875

THE ISLAND OF ST. HELENA

St. Helena: a Physical, Historical, and Topographical Description of the Island, including its Geology, Fauna, Flora, and Meteorology. By John Charles Melliss, A.I.C.E., F.G.S., F.L.S. (London: L. Reeve.)

"THERE is a change to be introduced into our mode of work as compared with that of former investigators. When less was known of animals and plants, the discovery of new species was the great object. This has been carried too far, and is now almost the lowest kind of scientific work. The discovery of a new species, as such, does not change a feature in the science of natural history any more than the discovery of a new asteroid changes the character of the problems to be investigated by astronomers. It is merely adding to the enumeration of objects. We should look rather for the fundamental relations among animals; the number of species we may find is of importance only so far as they explain the distribution and limitation of different genera and families, their relations to each other and to the physical conditions in which they live. Out of such investigations there looms up a deeper question for scientific men, the solution of which is to be the most important result of their work in the coming generation. The origin of life is the great question of the day. How did the organic world come to be as it is?"

This passage, quoted by Mr. Bentham in his address to the Linnean Society for 1868, from an instructional lecture given by Agassiz on the voyage out to his young companions in his Brazilian expedition, sums up the grounds on which writers of books on systematic natural history must now be prepared to have their work criticised. It is no longer enough to publish, however sumptuously, bare enumerations of the organisms which inhabit some spot of the earth's surface. No treatment can be really considered scientific which does not go a good deal further, and, regarding the fauna and flora of a country as phenomena to be accounted for, endeavour to unravel their causes, history, and relationships. No one has shown with more penetration and success than Mr. Bentham, what important and interesting general results may be educed from the most apparently arid fields of systematic investigation. But it is only the gradual elucidation of such results that really affords anything like a scientific sanction to this kind of study, and it is because this has in many cases been very much lost sight of, that taxonomy—especially on the Continent—has fallen into a disrepute which is just as unscientific and unphilosophical as a morbid appetite for taxonomic studies unqualified by any search for results of general biological interest.

It will now perhaps be apparent why this stately octavo which Mr. Melliss has devoted to the natural history of St. Helena does not yield either the kind or amount of satisfaction which a cursory inspection might lead one to expect. It is quite true that science owes a great debt to Mr. Melliss for carefully collecting the extremely interesting forms of life which St. Helena possesses, and which from one cause or other are rapidly disappearing. But his gatherings have been already worked up by different naturalists, and the results published in various scientific journals. The mere enumeration of genera and species which he gives in these pages, with occasional remarks, is not by any means interesting reading, and is of course but of very small use for any purpose of reference.

The first of the five parts into which the book is divided is occupied with the history of the island. It was discovered in 1502 by John de Nova Castella, commanding a Portuguese fleet on its return from India. The day being the anniversary of Helena the mother of Constantine, the island was named St. Helena in her honour. The Portuguese left on the island a supply of goats, asses, and hogs, and in this way commenced at once the gradual extirpation of the indigenous flora which has since never ceased to proceed. The Portuguese for a time had a settlement, which they appear soon to have deserted. The Dutch next took possession, only in turn to abandon it, after which it was occupied about the middle of the seventeenth century by the East India Company. Twice, however, in the next quarter of a century it was again taken possession of by the Dutch, to be again retaken from them by the English.

St. Helena never appears to have had any internal source of independent income. The population lived by supplying the needs of the garrison, the "Liberated African depot," the West African squadron for the suppression of the slave-trade, and the passing eastward-bound ships. The garrison is now represented by a handful of Engineers and artillerymen, the depot is abolished, the squadron reduced, and the trade to the east is almost entirely diverted through the Suez Canal. No articles for export are produced; the "natives" prefer to live on imported rice; the farmers barely exist on their deeply mortgaged properties. Yet the soil, composed of volcanic débris, is undoubtedly productive, and, were it tilled with even moderate energy, might yield profitable returns. The cultivation of *Cinchona* has been encouraged by the home Government, but has been treated with entire apathy by the colonists. The population, amounting to 6,860 in all, consists of the "yam stalks," or "natives" proper, the descendants of the slave population liberated in 1832; they are of mixed origin, partly European, partly Asiatic. The West African negroes form about a sixth of the whole population; they were introduced from the captured slavers, and form settlements apart from the "natives." The white inhabitants consist of the Government officials, the garrison, and merchants and farmers.

The history of the colony contains little of any interest. The *ennui* of island life was probably the exciting cause of several mutinies. In the first, in 1693, the governor was murdered, but the lieutenant-governor was equal to the occasion, and stamped out the conspiracy which was spreading among the black slaves. Amongst other repressive measures one of the ringleaders "was hanged alive in chains and starved to death." Mr. Melliss apparently approves of this, and compares it with "Governor Eyre's prompt measures." Of course there is a good deal to say about Napoleon—the house in which he lived, and the mode in which he was buried.

Part II. treats of the Geology and Mineralogy. It does not appear to add anything essential (unless we except the stupid story about "the apostate friar") to the admirable account given by Mr. Darwin in his "Volcanic

Islands," which Mr. Melliss does not appear to have seen. The volcanic bombs figured on Plate 14 would seem to be much more probably explained as examples of spheroidal weathering. Nor does the view of the curious dike called the "chimney" (Pl. 17) give any more indication than the text (p. 72) of its very curious structure. This is described and figured in Lyell's "Elements" (p. 610), from Seale's "Geognosy of St. Helena," which also seems to have eluded Mr. Melliss's attention.

Part III. is occupied with the Zoology, beginning with *Homo sapiens*, Linn., and finishing with the *Spongida*. The list is swelled in every possible way, and a variety of information which is, to say the most, hardly more than "curious," is given under the different heads. Under *Mus decumanus*, Linn., we are told "that it is a fact that one of these noxious animals" sprung out of Napoleon's that when he was about to put it on after dinner. *Canis familiaris*, Linn., suggests, on the principle of concomitant variations, that the neglect of their education is the reason of the absence of hydrophobia in St. Helena dogs. *Equus caballus*, Linn., introduces the governor's "modern carriage and pair of Hyde Park." The account of the *Cetacea* is still more trivial. Mr. Harting's account of the endemic land-bird *Ægialitis sanctæ-helenæ* is given, and an enumeration of the other introduced and indigenous species. But Mr. Melliss does not say anything about the fossil eggs found in the beds of limestone by Mr. Darwin and also written upon by Buckland. The fish have been described by Dr. Günther, and the Mollusca by Mr. Gwynn Jeffreys; but only the names are enumerated. Some further confirmation would seem to be needed of the suggestion that the extinct *Bulimus auris-vulpina* bored the holes found in the marl on the upper part of the island. The insects have passed through the hands of various entomologists: Mr. Wollaston has published an account of the Beetles, Mr. Cambridge of the Spiders. Excluding the cosmopolitan species which have been manifestly introduced, the St. Helena list of *Coleoptera* "possesses," according to Mr. Wollaston, "nothing whatever in common with those of the three Sub-African archipelagos which lie further to the north—though the great development of the Curculionideous subfamily *Cossonides* is a remarkable fact which is more or less conspicuous throughout the whole of them." With regard to the other groups there is no summary or comparison of distribution; in fact, little more than a bare enumeration of species.

White ants were introduced into the island in 1840 in some timber from a slave-ship. Mr. M'Lachlan has identified the species as *Termes tenuis*, Hagen, peculiar to South America. The mischief which it has done is almost incredible, and it appears to have simply gradually destroyed the whole of Jamestown. A considerable portion of the books in the Public Library, especially theological literature, was devoured by them, and the whole of the interior would be destroyed without the exterior of the volumes seeming otherwise than intact.

The flora of St. Helena is one of extraordinary interest. When the island was discovered it was covered with arboreous vegetation. Notwithstanding the belief of the botanists of the United States Exploring Expedition under Wilkes to the contrary, there seems no reason to doubt the existence of the forests, or that their destruction during the past 360 years has been almost entirely effected by the goats introduced by the Portuguese. The old trees gradually died, the young ones were barked, and the seedlings were browsed down. In this way all knowledge of a large part of the flora has been completely lost. Even since the beginning of the present century several species have become extinct, while many were more abundant then which are only represented now by single individuals. Fortunately, however, the flora has been examined by several botanists. Burchell spent five years in the island from 1805 to 1810, and although he published no results he made a large number of drawings and collected excellent specimens. Roxburgh subsequently made a list of St. Helena plants, and the island has also been twice visited by Dr. Hooker. Had collections been made during the last century, more of its extinct endemic species would no doubt be known, but the forms that we are acquainted with are extremely interesting.

Mr. Melliss swells the list of flowering plants to 880. But this is accomplished by including every kind of plant introduced into or cultivated in the island. Spring and winter wheat, the sugar-cane, and garden vegetables such as cabbages and turnips, are all enumerated in precisely the same type as the remnants of the peculiar endemic flora. Mr. Melliss quotes freely from Dr. Hooker's interesting address at the Nottingham meeting of the British Association on Insular Floras, but he altogether omits giving any distinct list of the indigenous as apart from the introduced plants. By carefully going over his pages it is possible to frame such a list, and it appears to contain thirty-one flowering plants. Of these, except *Commidendron* (*Aster*) *glutinosum*, which occurs at Ascension, and *Cynodon dactylon*, which is widely diffused in the tropics, the whole appear to be absolutely restricted to this minute speck of the earth's surface. They have, moreover, all the aspect of a very ancient vegetation. Exactly one-third of the species are *Compositæ*, but nine out of the ten are shrubs or trees, a most unusual habit of a growth in an order where the vast proportion of the species are annuals or die down to the ground every year. Mr. Darwin has pointed out the significance of this:—

"Islands often possess trees or bushes belonging to orders which elsewhere include only herbaceous species; now trees, as Alph. De Candolle has shown, generally have, whatever the cause may be, confined ranges. Hence trees would be little likely to reach distant oceanic islands; and an herbaceous plant, though it might have no chance of successfully competing on a continent with many fully developed trees, when established on an island and having to compete with herbaceous plants alone, might readily gain an advantage over them by growing taller and overtopping them."—*Origin of Species*, 4th ed., p. 467.

Not less singular than the testimony to long isolation borne by the habit of the species is the extremely obscure geographical relations of the flora. Any amount of adaptive differentiation would be intelligible. But what is not easily explicable is the want of relationship of the species to those of adjacent continents. The connections are really far more remote. Mr. Bentham has made some remarks upon this in his elaborate paper on the Compositæ (*Journ. Linn. Soc.*, vol. xiii. p. 563):—

"*Commidendron* [to which genus Mr. Bentham refers the three species of *Aster*] and *Melanodendron* are among the woody Asteroid forms exemplified in the Antarctic-American *Chiliotrichium*, in the Andine *Diplostephium*, and in the Australasian *Olearia*. *Petrobium* is one of three genera, remains of a group probably of great antiquity, of which the two others are *Podanthus* in Chili, and *Astemma* in the Andes. The *Psiadia* is an endemic species of a genus otherwise Mascarene or of Eastern Africa, presenting a geographical connection analogous to that of the St. Helena *Melhaniæ* of De Candolle with the Mascarene *Trochetia*."

In many of the other constituents of the flora—*Mesembryanthemum*, *Pelargonium*, *Phylica*, *Lobelia*, *Wahlenbergia*, there is an obvious connection with the South African flora. But the changes in the physical geography of the Old World must have been very considerable, since the Mascarene Archipelago and St. Helena received their vegetation from any common source.

Questions of this kind, which are the real matters of interest about St. Helena from a biological point of view, Mr. Melliss scarcely touches, or quite inadequately. And this is the more tantalising, as so large a body of undigested information has not hitherto been brought together about any oceanic island. Here and there significant facts of the same kind may be gleaned from the lists of the fauna. Thus a beetle, *Stenoscelis hylastoides*, Woll., appears to be peculiar to the Cape and to St. Helena; *Bulimus helena*, Quoy, is a Mascarene and East African type; while the great *B. auris-vulpina*, Chemn. (now, like the last, extinct), belongs to a group peculiar to Tropical America.

Apart from these points, the mere history of the vicissitudes which the animal and vegetable life of the island has gone through since the Portuguese first visited its forest-covered but now denuded hills, forms a striking series of episodes in the general struggle for existence. What the goats forbore to browse, introduced plants like the blackberry strangled. It would seem as if strenuousness died away among assemblages of organisms which had established a *modus vivendi* amongst themselves. Rude impulses from without, when at last the isolation is broken, achieve a comparatively easy victory. One cannot fail noticing the uniformity of language with which this is described, whether the invasion takes the shape of goats, blackberries, white ants, measles, or even dissent, which, "introduced by a Scotch Baptist minister about the year 1847, soon spread" (page 33).

The fifty-six plates with which the volume is illustrated deserve a word of notice. Thirty-one of these are effective illustrations of the plants from the drawings of Mrs. Melliss, with dissections from those by Burchell in the possession of Dr. Hooker. A large proportion of the most curious of the St. Helena plants have been figured by Dr. Hooker in the *Icones Plantarum*, but that is a somewhat inaccessible publication, except to botanists, and the present series of botanical plates really gives the present work its chief interest. W. T. T. D.

HEREDITY

Heredity: a Psychological Study of its Phenomena, Laws, Causes, and Consequences. From the French of Th. Ribot. (Henry S. King and Co., 1875)

IF M. Ribot intended this work to be regarded as an original contribution to the philosophy of evolution, is impossible to consider his efforts successful. He styles the book a "Psychological Study," and he shows therein an intimate acquaintance with the writings of all the principal authors who have created the new philosophy. Darwin, Spencer, Bain, Galton, Lucas, and some others are constantly appealed to, or made to contribute to his pages. M. Ribot has further collected from older writers, and from medical works, a great number of facts, often more curious than authentic, bearing upon the question of heredity. He has composed a very readable and interesting essay on the subject, of a semi-popular character, and no doubt there is plenty of room for such a work, epitomising and presenting in a connected form the great abundance of facts and generalisations already accumulated upon this subject. But it is difficult to regard the work as more than a compilation, and there are several important deficiencies which may be pointed out.

I should have liked to meet in the book some clear and consistent view as to what heredity really means, but M. Ribot's ideas seem to waver. At the outset (p. 1) he says: "Heredity is that biological law by which all beings endowed with life tend to repeat themselves in their descendants. . . . By it nature ever copies and imitates herself. Ideally considered, heredity would simply be the reproduction of like by like." In many other passages he repeats, no doubt correctly, that heredity is the generation of like by like. Any feature in a living being which is not found in any one of its ancestors cannot be called hereditary. From similar conditions follow similar effects. Thus, if heredity had been the sole influence moulding living beings, we must all have had exactly the same features and characters.

In other passages M. Ribot takes an opposite view, and speaks of heredity as the cause of difference. In p. 387 he concludes that "heredity is really, therefore, partial identity," and he adopts a solution of the question "which attributes to heredity a creative part." This view he explains as follows (p. 34):—"In the hypothesis of evolution, heredity is really creative; for since, without it, it is impossible for any acquired modification to be transmitted, the formation of instincts, properly so called, however slightly complex, would be impossible." Again, he says (p. 344): "If with the evolutionists we recognise in heredity a force which not only preserves, but which also creates by accumulation, then not only is the character transmitted, but it is the work of fate, made up bit by bit, by the slow and unconscious but ever accumulating toil of generations." In pp. 302-3 he distinctly speaks of heredity as an indirect cause of decline, acting by way of accumulation. A few pages later (p. 306) we are informed that the first consequence of heredity is to render possible the acquisition of new instincts. Surely there is a confusion of ideas in these statements.

As M. Ribot in other places fully explains, the conditions governing the form and character of a living being may be classed under three heads: (1) Heredity, by which we mean the transmission of like characters from parent to offspring; (2) The influence of surrounding objects—the environment, as Spencer calls it; (3) Spontaneity, by which some writers have denoted the inexplicable variation of the offspring from the type of their ancestors. Two meanings, however, may be attributed to spontaneity: it may mean *causeless* variation, change independent of prior conditions, in which case it is removed from the sphere of law altogether, and becomes miraculous; or it may mean a distinct tendency to variation inherent in the offspring, and impressed upon it by the parent. In the latter case, however, spontaneity is really hereditary; and only appears to be spontaneous because it is the disclosure of a previously hidden power. M. Ribot fails, so far as I can find, to discriminate these meanings. He rejects the notion of spontaneity as wholly unscientific, but does not observe that the original life-germ must have contained inexplicable powers enabling it to develop into many forms. The seven hundred or more crystalline forms in which calcite is said to be found, must be explained partly by the intimate constitution of a molecule of carbonate of lime, partly by the environment in which it became crystallised. So we must attribute the almost infinitely varied forms of animal life partly to environment, but partly to the inexplicable powers of development impressed upon certain particles of protoplasm.

M. Ribot's reasoning is of doubtful soundness, again, when he speaks of heredity as the *cause* of decline in nations, or the cause of the production of new instincts. So far as the child is like its ancestors, there cannot on the average be either progress or decline. If certain individuals have, from unexplained causes, deviated from the previous type, it is impossible that their offspring should resemble completely both the previous and the new type. The contradictory features of different ancestors cannot possibly be made manifest in the same child; therefore the law of heredity must appear to fail in one way or the other. When a superior race intermarries with an inferior one, and becomes degraded, heredity simply perpetuates the inferior type by what Mr. Darwin calls *prepotency;* a term, by the bye, which M. Ribot should have adopted.

It cannot be said that M. Ribot is alone responsible for the want of consistency in his views of heredity. There are still some who believe in spontaneous generation; there are others who would have us believe that ordinary chemical agencies have developed a lifeless particle of protoplasm into a living particle, which became the germ of the animal and vegetable kingdoms. Mr. Darwin, so far as I remember, nowhere goes back to such insoluble questions. Sir W. Thomson suggests that the germ came from other parts of space. How far Mr. Herbert Spencer's philosophy affords a real solution of the question it must probably remain for another generation to decide. All that I wish to point out is, that so highly intelligent and careful a student of all that has been written on the philosophy of evolution as M. Ribot has certainly failed to acquire clear notions concerning the relations of heredity, spontaneity, and the influence of environment.

The most important result of M. Ribot's arguments is perhaps the support which he brings to Mr. Spencer's views of the origin of moral sentiments and rules. The last few chapters in which he treats of the moral consequences of heredity are particularly interesting. It becomes evidently impossible to uphold any longer the views of the older utilitarians, from Locke down to the two Mills and Buckle. As M. Ribot remarks, it is surprising to find a writer such as Buckle attributing little importance to psychological heredity. It is impossible any longer to look upon the mind and moral nature of the child as a *tabula rasa*, which can be marked by education at our will. If so, Mill's views of the philosophy of morals fall to the ground, and the doctrine of the moral sense in a modified form must be again taken in hand.

As a general rule, M. Ribot appears to acknowledge with sufficient candour his indebtedness to various authors. An exception is to be found in the case of Mr. Galton. It is true that Mr. Galton is quoted from time to time, but sometimes in a slighting manner; whereas the extensive obligations under which M. Ribot lies towards Mr. Galton will be apparent to anyone who is acquainted with the work on "Hereditary Genius" of the latter author.

W. STANLEY JEVONS

OUR BOOK SHELF

Animal Physiology. By John Cleland, M.D., F.R.S. Advanced Science Series. (Wm. Collins, Sons, and Co.)

HUMAN Physiology being in a great measure based upon investigations conducted on the lower Vertebrata, all works on the subject may, in a certain sense, be considered to be on "animal" physiology. The small treatise before us agrees, as far as the nature of the points treated of, very much with most works of the same size on human physiology. Incidental mention is no doubt made of the most important peculiarities of the nervous, circulatory, digestive, and other systems in the lower Vertebrata, but these are incomplete, and sometimes inaccurate. As an introduction to physiology, Dr. Cleland's work, however, possesses many advantages. It is written for readers previously unacquainted with anatomical details, and this class of students is daily becoming more numerous, although it is generally felt that no considerable progress can ever be made in the subject except on an anatomical basis. The illustrations are also numerous, whilst many are original and excellent. The manner of expression is particularly simple and clear, all the technical terms employed being carefully explained. In the earlier part of the work, in the chapter on alimentation, there is an argument on which particular stress is laid, which is, that as animals have no power of manufacturing organic matter from the materials found in organic nature, but feed either directly on the vegetable world or on other animals which have fed on vegetables; and as in plants the power of building organic matter is confined to the green parts, "the statement may therefore be ventured on that, so far as observation has yet proceeded, it would appear that the presence of chlorophyll is as necessary for the production of organic matter in organisms as the presence of protoplasm is necessary for growth." The full bearing of this fact is, no doubt, not yet fully understood. On the whole, we think that the author has fully succeeded in producing a work which, from the grouping of its facts, is decidedly more than a mere collection of details.

Fifth Annual Report of the Association for the Improvement of Geometrical Teaching. (January 1875.)

THE Association, it may be remarked, is almost coeval with this journal, for it was in the early numbers of NATURE that a correspondence was started on the subject of Geometrical Teaching. This resulted, as our readers are aware, in the formation of the Association. After four years of continuous work, two of which have been devoted to the difficult subject of Proportion (as we learn from the Report), the Syllabus of Plane Geometry is now complete; and, after a few verbal alterations possibly have been made, it will be forwarded for criticism to the Committee (on Geometrical Teaching) of the British Association and to other mathematical authorities. The object, we further learn, is, if possible, to get the sanction of the British Association ; and this backing the opinion of the large number of mathematical teachers who now form the Association, will, it is hoped, lead the examining bodies of the country to act with perfect impartiality in considering the merits of those pupils who have been trained in accordance with the methods of the Syllabus as contrasted with the favourers of Euclid.

From the Report we gather that the principal work of the Association is expected to be completed in another two years ; it is not attempted to forecast what will be its subsequent work. Perhaps, as has, we believe, been suggested, it may become an Association for the Improvement of Mathematical Teaching.

As the publications of the Association are for private circulation, we cannot go into further detail; we may, however, say that it has done good work in having been the moving cause of five valuable Presidential Addresses.

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.*]

Influence of Pigments on the Photographic Image of the Spectrum

WHEN, some time since, Prof. H. Vogel announced the discovery that the addition of a pigment to a film of bromide of silver made it sensitive to light of the colour which that pigment gave it, though it had not been so previously, many—indeed I might say most—photographic chemists doubted the accuracy of his observations and the existence of any such law. His experiments were rehearsed by most of them, and the reports were, in almost every case, contradictory of his conclusions. There were powerful *à priori* reasons for doubting, amongst which the chief was, in my own opinion, that if a film coloured (say) red were sensitive to red light, it could not be developed under red light, but would fog, and would therefore be unworkable, which was not found to be the case. Another was, that the use of tinted films, well known for a long time, had only resulted in an universal retardation of all colours. It was, moreover, contrary to the known analogies of actinism that a purely mechanical admixture irrespective of any chemical quality should produce changes of so purely chemical a nature as those which are the basis of photographic action.

By the kindness of Mr. Lockyer I was enabled to experiment at his laboratory at South Kensington with the same plates (Col. Wortley's tinted films) that Prof. Vogel had based his discovery on, and, as I expected, found the results quite other than those the professor had announced. Although a protracted exposure (seventeen minutes) was given, and the more refrangible lines were quite buried by halation, no line was shown which did not appear in the ordinary wet collodion film.

That careful and excellent photographic chemist, Mr. Spiller, President of the London Photographic Society, Dr. Van Monckhoven, Mr. Carey Lea, and numerous others, amongst whom I am enabled, by his personal assurance, to name Dr. J. W. Draper, unquestionably the first living authority on spectrum photography, as well as his not less well-known son, Prof. Draper, have also followed Vogel in his experiments without obtaining any confirmation of his law.

Up to this time the only testimony confirmatory of his views offered is that of Becquerel, who, as the most marked instance of success, gives this—that chlorophyl (a green substance) gives great sensitiveness to *red* rays ! That most indefatigable and precise experimentalist, Mr. Carey Lea (of Philadelphia, U. S. A.), in the course of a long series of experiments, unfortunately interrupted by his ill-health, showed that while coralline in a film did add slightly to the length of the spectrum image, other red pigments produced no effect whatever, and that salicine, which has no colour, produced more effect than coralline. But if chlorophyl, a green substance, is sensitive to red light, aniline green, so far as my own experiments go, produces no effect whatever except prolongation of the exposure necessary.

Now, without in the least disputing the prolongation of the spectrum photograph as claimed by Prof. Vogel, or depreciating the importance of his results, it seems to me that we are in a position to assume that he is entirely mistaken in the nature of the law he deduces, and that these results are due to purely chemical causes, in no wise dependent on colour, though in a few cases the colour may coincide with the chemical cause in such a way as to afford apparent confirmation of his hypothesis.

It must be remembered that Dr. Draper has long ago shown that all the rays have chemical activity, and that he has, without any such aid as Vogel has called in, produced complete photographic spectra ; and has also shown that different substances decompose under different rays. Becquerel's experience with chlorophyl gives a clue to the connection between these discoveries and Vogel's results, if collated with a series of phenomena resumed by Dr. Draper (from observations by Dr. Gardner) in the interesting papers by him on the "Distribution of Chemical Force in the Spectrum" * :—"In Dr. Gardner's paper there are also some interesting facts respecting the bleaching or decolorisation of chlorophyl by light. He used an ethereal solution of that substance :—'The first action of light is perceived in the mean red rays. and it attains a maximum incomparably greater at that point than elsewhere. The next part affected is the indigo, and accompanying it there is an action from + 10·5 to + 36·0 of the same scale (Herschel's), beginning abruptly in Fraunhofer's blue. So striking is this whole result, that some of my earlier spectra contained a perfectly neutral space from − 5·0 to + 20·5, in which the chlorophyl was in no way changed, whilst the solar picture in the red was sharp and of a dazzling white. The maximum in the indigo was also bleached, producing a linear spectrum as follows :—

in which the orange, yellow, and green rays are neutral. These, it will be remembered, are active in forming chlorophyl.' . . . I have quoted these results in detail, because they illustrate in a striking manner the law that *vegetable colours are destroyed by rays complementary to those that have produced them*, and furnish proof that rays of every refrangibility may be chemically active." (P. 7, "Researches in Actinic Chemistry.")

Dr. Draper goes on in this memoir to establish a second proposition to this effect : "That the ray effective in producing chemical or molecular changes in any special substance is determined by the absorptive property of that substance." This proposition, laid down in 1841, seems to me to contain the explanation of all the phenomena of chemical or molecular change in photographic films ; and if I might be permitted to offer an hypothesis supplementary to the proposition, serving, *if demonstrable*, as corollary to it, it would be that if two substances having different absorptive properties are simultaneously (or nearly so) subjected to the action of white light, in molecular contact the change in one of them may be communicated to the other mechanically. Thus, bromide of silver, which is not sensitive to the red ray, being placed in contact with chlorophyl, which *is* sensitive to that colour, the action of the red ray is communicated from the latter to the former substance, producing what may be designated as a sympathetic molecular effect. But in order that this may obtain, it is necessary that the auxiliary substance applied to influence the sensitive photographic film should be in itself sensitive to other rays than those which decompose the silver bromide. This would account for the effect of chlorophyl and perhaps for the original experiment which attracted the attention of Prof. Vogel, as the dry plates of Col. Wortley with which it was made contain salicine in their preservative as well as an aniline red in their substance, and Mr. Carey Lea has shown that salicine has the effect which Vogel claims for the colour.

If this is tenable, it follows that the object of our researches should be to discover those substances which have an independent susceptibility to actinic action, but for different rays than those which form the basis of the film experimented on. The results so far obtained in this direction, even those of Vogel himself, are, it seems to me, quite as capable of explanation by the hypothesis I have offered as by that of an arbitrary effect of colour; in confirmation of which we have only experiments (thus far made public) by Prof. Vogel himself.

It seems to me incredible that, if such a law existed, such

* "Researches in Actinic Chemistry, Memoir Second," &c. John William Draper, M.D., LL.D., New York.

careful and experienced investigators as the Drapers, Von Monkhoven, Spiller, Carey Lea, and others who have repeated Prof. Vogel's experiments, should utterly fail to obtain any confirmation of his hypotheses; and there is no solution in accordance with known facts and analogies of actinic action except to conclude with Dr. Draper that Prof. Vogel has made a mistake—he has attributed to one of two coincident qualities of certain substances effects which are due to the other.

Dr. Draper records experiments in which he secured a photograph of the entire spectrum on a daguerreotype plate, by availing himself of the singular reversing action of light on the impressed plate (pp. 2 and 3 of memoir), and allowing a diffused daylight to fall on the plate simultaneously with the spectrum image. "If," he says, "a spectrum be received on iodide of silver formed on the metallic tablet of the daguerreotype, and carefully screened from all access of extraneous light, both before and during the exposure, on developing with mercury vapour an impression is evolved in all the more refrangible regions.

"But if the metallic tablet during its exposure to the spectrum be also receiving diffused light of little intensity, as the light of day or of a lamp, it will be found, on developing, that the impression differs strikingly from the preceding. Every ray that the prism can transmit, from below the extreme red to beyond the extreme violet, has been active. The ultra-red heat lines α β γ are present."

The whole of this memoir is of the greatest interest to the spectroscopic photographer, not only as giving the result of all previous experiment in this field, but in clearly marking out what remains yet to do in it. The subsequent success of the younger Draper in obtaining a negative of the spectrum complete by the ordinary collodion process, through the aid of an analogous system of protection by mechanical means for the lines most readily impressed, proves that even with silver, and under any condition of process, we have the power of recording any spectroscopic phenomenon; but if experiment should prove that substances in themselves liable to decomposition by rays which do not attack the salts of silver are capable of communicating an impression by molecular contact *to* the silver, and inducing decomposition in it, it is evident that a complete combination may be arrived at which, without mechanical contrivances, will give us printing negatives of the spectrum throughout.

W. J. Stillman

Dr. A. B. Meyer and his Critics

Not until now have I found leisure to look through the pages of Nature for the years 1873 and 1874, and therefore it was not till now that I became aware of two letters in your correspondence (December 11, 1873, p. 102, vol. ix., and April 23, 1874, p. 482, vol. ix.), which concern me, and in answer to which I beg leave to say a few words.

The first is written by Mr. Wallace, and is about a wrong opinion which I had formed on this author's notion as to the relation of the inhabitants of the Arfak Mountains on New Guinea to the inhabitants of the coast. I am glad to see that Mr. Wallace and I agree in the conviction of the identity of those two groups of Papooas; but nevertheless I am anxious to show that my misunderstanding of Mr. Wallace's opinion was based upon an apparently clear expression in his valuable work on the "Malay Archipelago," which I took, as I believe, not in the restricted sense in which the author perhaps wished it to be understood. Mr. Wallace did not succeed in finding the passage in his work on which I had based my idea; but he just breaks off his quotation where the words begin to which I referred: "Their hair, though always more or less frizzly, was sometimes short and matted," &c.; so far Mr. Wallace cites his own words, but the sentence (page 310, 1st ed.) goes on, "instead of being long, loose, and woolly; *and this seemed to be a constitutional difference, not the effect of care and cultivation.*" These last words then led me to the opinion in question. In a paper in the *Mittheilungen der Anthropologischen Gesellschaft zu Wien* ("Anthropologische Mittheilungen über die Papúas von Neu Guinea; I. Ausserer physischer Habitus"), 1874, page 92, I quoted myself the *whole* passage, and dealt with the object more in particular. That it is still the general opinion that a difference exists between the Arfakis and the Papooas of the coast is proved, *e.g.*, by a notice of that paper in M. Broca's "Revue d'Anthropologie," vol. iii., 1874, page 729: "Notre voyageur n'admet pas non plus qu'il y ait entre les tribus du bord de la mer et celles des montagnes—les Arfakis—les différences constitutionelles *observés cependant par la plupart des voyageurs*," &c.

The other letter contains a protest of Signor D'Albertis against my having "led the public to believe that he had claimed for himself the honour of crossing New Guinea from one coast to the other." Signor D'Albertis cites my paper in Nature, vol. ix. p. 77, where he states he has read an assertion of mine concerning this point. But I look in vain through my whole article to find one single word to the purpose, and therefore I do not understand what induced that intrepid co-operator to publish his protest. I only mentioned (page 79): "I need not say that this journey from one side of New Guinea to the other has never been made before, and I should hardly myself attribute any importance to the fact," &c.

A. B. Meyer

The Chesil Bank

The letter of your correspondent, Col. Greenwood (vol. xi. p. 386), has only now been brought under my notice.

There is one fallacy contained in it which no one would detect more easily than Col. Greenwood, if he were but to visit the Portland end of the Chesil Bank. He would then see for himself that Portland Island *does not* act as a groin in accumulating the pebbles that form the beach.

The Chesil Bank extends from Portland to Bridport Harbour, where it is composed of small pebbles or gravel of the average size of horse-beans. It is there a true beach of considerable breadth and depth, and does not merge into sand until it arrives at a point beyond the mouth of the harbour. Following it towards Portland, it runs along under the cliffs by Burton, Swyre, &c., to Abbotsbury, where it assumes its distinguishing characteristic of a pebble ridge, washed by the sea on one side and by the waters of the Fleet estuary on the other. From thence it proceeds to the Ferry bridge, where it meets the waters of Portland Roads (from which, however, it is separated by a stretch of sand of varying width), and from thence to Portland.

Its direction after leaving Abbotsbury is W.N.W. and E.S E. very nearly. On reaching Portland it takes a sharp curve to the west and forms the little bight called Chesil Cove, and it is here that the ridge begins to decline in height, and the pebbles, that up to this point have been gradually increasing in size, commence to diminish in bulk. A line stretched seawards from this point at right angles with the shore would point W.S.W.

The decline is rapid, so that in a distance of about 250 yards the bank tails out to nothing at the point where it touches, and does but just touch, the Undercliff.

There are probably several causes at work in bringing about this abrupt termination of the Chesil Bank. Among them I should reckon as most effective the curvature of the bank at Chesil Cove, whereby the beach is exposed at such an angle to the waves caused by the prevailing S.W. wind that the progressive action of the W. and W.N.W. winds is neutralised; secondly, the peculiar set of the tides round the Bill at Portland; and thirdly, the progressive action of the W. and W.N.W. winds being diminished or nullified by the curvature.

There cannot be the slightest doubt that the march of the pebbles is from Bridport to Portland, and that any movement in the contrary direction is due to temporary causes only.

That the larger pebbles travel over the heads of the smaller when the waves strike the beach at an angle is not merely probable in theory, but a fact demonstrable by experiment, as was announced by Sir John Coode in his elaborate paper on "Sea-Beaches" (Phil. Trans. 1834).

As to the materials of the beach having been partly derived from the destruction of the ancient raised beach, the remains of which are to be seen at this day in Portland, I would remark that, according to the account given by Leland in his "Itinerary," Portland at the time of his visit was of nearly the same dimensions as now, though tradition reports that the site of the old church was once the centre of the island, the shifting bank of sand and shells called the Shambles being its eastern boundary. Any pebbles derived from the intervening raised beach have in all probability been ground by the continual pounding of the Atlantic billows into sand long before this—probably before the time of Leland. Yet he states, with reference to the Chesil Bank, "that as often the wind blowith strene at south-est (? west) so often the se betith it, and losith the bank, *and breakith through it;*" indicating that the bank was not so strong then as it is now: for such a thing has not occurred within the memory of living man, not even on the occasion of the "Outrage" in Nov. 1823, when the crown of the bank was swept off by a tremendous gale, and spread over the sands on the other side of the ridge; when the fishermen's houses, that for centuries probably had nestled under its eastern declivity, were overwhelmed with their unfortunate occupants, to the number of fifty or sixty, and, to quote the words of an epitaph in St. George's Churchyard descriptive of the event—

> "The wind and sea its fury broke,
> The wondrous works of God bespoke:
> Man's dwellings levelled with the ground,
> When some were killed and some were drowned."

The grandfather of my informant fared worse still, for he, poor man, "was killed fust and drownded aterwards." I mention Leland's report in order to suggest that since his time the inroads of the sea and rivers must have reached flint-bearing strata more prolific than any before attacked.

The supply of flints at the present day is greater than the loss caused by attrition, and so the Chesil Bank is very gradually creeping up to the height it had acquired at the date of the "Outrage," when the ridge was equally steep on either side, and the present eastern expanse of pebbles had no existence.

Weymouth, April 2 THOS. B. GROVES

Flowering of the Hazel

ALTHOUGH in the vast majority of cases the male and female flowers of the hazel, as stated by Mr. Bennett in NATURE, vol. xi. p. 466, mature simultaneously on the same bush, with, I think, rather some tendency to begin the shedding of pollen before the expansion of the neighbouring stigmas; yet I have seen very striking exceptions to this rule, in the same sense as have been formerly recorded in NATURE. Thus, on March 5, 1874, I was astonished to find in a neighbouring copse a row of hazel bushes with beautifully expanded stigmas, their male catkins being still in a very undeveloped condition, and other bushes, very near those, had long lost their stigmas—the buds unfolding—while the male flowers were still shedding their pollen. Probably this exceptional "proterogyny" of the hazel is peculiar to individual bushes, and it is to be desired that such bushes may be observed in succeeding years.

Dr. H. Müller, in his admirable work on fertilisation of flowers by insects, states that he once observed many honey-bees collecting the pollen of the hazel, "but none of them ever sat down on a female flower." However, one can scarcely avoid connecting, in a Darwinian sense, the brilliant red colour of the stigmas with the occasional dichogamy and with the bees, often seen collecting the pollen of this shrub, at a season when there is scarcely any other pollen within their reach.

Frankfort-on-the-Maine, April 26 F. D. WETTERHAN

OUR ASTRONOMICAL COLUMN

THE TOTAL SOLAR ECLIPSE OF 1715, MAY 3.—The circumstances of this eclipse, the last in which totality was witnessed in London, and of which Halley gave so full and interesting an account to the Royal Society, are very closely represented by the following elements, wherein the Greenwich corrections to the principal lunar motions have been incorporated with Leverrier's Tables of the Sun:—

Conjunction in R.A. May 2, at 21h. 52m. 31·7s. G.M.T.

	°	′	″	
R.A.	39	48	22·5	
Moon's hourly motion in R.A.		38	29·8	
Sun's ,, ,, ...		2	23·3	
Moon's declination	16	16	30·4	N.
Sun's ,, ...	15	32	15·7	N.
Moon's hourly motion in Decl.		8	12·3	N.
Sun's ,, ,, ...		0	44·5	N.
Moon's horizontal parallax		61	4·9	
Sun's ,, ...			8·8	
Moon's true semidiameter		16	38·7	
Sun's ,, ...		15	51·3	

The sidereal time at Greenwich mean noon, May 2, was 2h. 39m. 0·7s., and the equation of time 3m. 23s. additive to mean time. Hence the middle of general eclipse occurred at 21h. 36m. 46s.; the central line commenced in long. 46° 54′ W. and lat. 31° 58′ N., and ended in long. 129° 39′ E. and lat 54° 30′ N., and the middle of totality took place with the sun on the meridian in long. 31° 1′ E. and lat. 62° 21′ N., or on Lake Ladoga.

If we calculate directly from the above elements for the position of St. Paul's, we find totality commenced in the metropolis at 9h. 5m. 58s. A.M. on May 3, and ended at 9h. 9m. 19s., so that the computed duration is 3m. 21s. Halley observed the eclipse from the house of the Royal Society in Crane Court, Fleet Street: he made the duration of totality 3m. 23s., and the middle at 9h. 7m. 22s. mean time; and De Louville, of the French Academy of Sciences, who came over to observe the eclipse, and was with Halley at the time, found the duration of total darkness 3m. 22s., or only one second less than was noted by the latter. The calculation is therefore within 2 secs. as regards continuance of total eclipse, and only 17 secs. later than the observed time of middle, an agreement which has not often been exceeded in predictions of recent phenomena. Again, if by equations of reduction founded upon this direct calculation for St. Paul's, we deduce the circumstances for Greenwich, there results 9h. 6m. 27s. mean time for beginning of totality, and 9h. 9m. 39s. for ending, or a duration of 3m. 12s., which is in exact accordance with Flamsteed's observations.

The track of the shadow across this country will be pretty correctly given by the following figures:—

Long.	North Limit. Lat.	Central Line. Lat.	South Limit. Lat.
4° W.	52° 19′ 6	50° 37′·8	48° 59′·7
3	52 48·0	51 6·0	49 27·8
2	53 16·2	51 34·1	49 55·8
1 W.	53 44·2	52 2·1	50 23·7
0	54 12·1	52 29·9	50 51·6
1 E.	54 39.8	52 57·6	51 19·4

Halley concluded that the south limit passed over Cranbrook, in Kent, where "the sun was extinguished but for a moment:" our elements indicate a duration of only seven seconds, and therefore the limits must be assigned with considerable precision as well as the track of central eclipse. At Northampton, close to this track, the error of calculation is again only two seconds. At Plymouth it was supposed that the totality continued 4m. 30s., but it does not appear to have lasted more than about 4m. 6s. in any part of England, and the longest duration would fall on the Norfolk coast, about midway between Cromer and Wells.

Should any reader be desirous of further examining Halley's table of the circumstances of totality, printed in the *Philosophical Transactions*, 1715, the following equations of reduction will assist him:—

$$\text{Cos. } w = 45{\cdot}4600 - [1{\cdot}75533] \text{ sin. } l + [1{\cdot}41097] \text{ cos. } l, \text{ cos. } (L - 91^{\circ}\ 28'{\cdot}9)$$

$$t = 21\text{h. } 33\text{m. } 2\text{s}{\cdot}9 \mp [2{\cdot}08660] \text{ sin. } w + [3{\cdot}36371] \text{ sin. } l - [3{\cdot}86117] \text{ cos. } l, \text{ cos. } (L + 43^{\circ}\ 21'{\cdot}4)$$

Here L, the longitude from Greenwich, is to be taken, *positive* if *east*, *negative* if *west*; l is the geocentric latitude, and t represents *Greenwich* mean time; the quantities within square brackets are logarithms.

In a future column we shall give particulars of the total solar eclipse of 1724, May 22, founded upon elements similarly derived. This phenomenon has an especial interest, as having been the last in which totality was observable in any part of England, and the subject of the description given by Dr. Stukeley in his "Itinerarium Curiosorum."

THE TRANSIT OF VENUS, 1631, DECEMBER 7.—It is known that Gassendi at Paris watched attentively during several days, despite of interruption from stormy weather, for the transit of Venus, which Kepler, on the completion of the Rudolphine Tables, had predicted for the 6th of December, 1631, and that his observations were unsuccessful, the first view of the planet upon the sun's disc being reserved for our illustrious countryman Horrox eight years subsequently. Gassendi was able to watch the sun occasionally on the 6th and during the whole morning of the 7th, and it now appears that he very narrowly missed being the first observer of the rare phenomenon of a transit of Venus. We have before us elements of the transit of 1631, carefully deduced from Leverrier's Tables of Sun and Planet. As regards the centre of the earth, the first external contact occurred on December 6, at 15h. 47·8m. Greenwich mean time, at 35° from the north point of the sun's disc towards E. for direct image, and the last external contact at 18h. 26·8m. about 4° towards W. At Paris the final contact took place at 18h. 50·3m. local mean time, but the sun did not rise till 19h. 39m.; the planet therefore had left his disc less than fifty minutes before he was on the horizon of Paris.

*ARCTIC GEOLOGY**

IV.

Vardö Island,† at the end of a long promontory in the polar basin, is described by Mr. Campbell, of Islay,‡ as consisting of metamorphic slates, dipping at 45°, and striking with the hollows and ridges north and south, ground into shape by ice, but since submerged and wave-worn; drifts packed and rolled by the sea are left in a grass-grown raised beach at 60 feet, a peat-covered beach at 100 feet, and rolled stones occur on the summit level of the island, 220 feet above the sea, resting on red sandstones, with fossil markings in concentric rings. At 30 feet above the sea occurred a "storm beach," with large and sub-angular stones, sweeping in a crescent round the bay, the fortress of Vardö, and the church of Vadsö. He describes it as built on coral sand, and refers to the warm equatorial current affecting the climate in the polar basin to lat. 80° in Spitzbergen, and to long. 66° E. in Novaya Zemlya, which enables a luxuriant vegetation to live on the shore at Yeredik, about 70° N., in spite of the winter's darkness.

The most northern island of Novaya Zemlya has been called Castanjenö by Capt. Mack, from the "Mimosa beans" or chestnuts found there, which tropical brown nuts in Spitzbergen reach 20° E.;§ but Mr. Lamont considers the large quantities of drift wood found on that coast to be derived from pines (*Abies excelsa*) that have grown on the banks of the large Siberian rivers;‖ and states that when wood occurs inland it is associated with bones of whales. He therefore does not agree with Lord Dufferin that it is brought to Spitzbergen by the Gulf Stream,¶ which Mr. Lamont states has no influence north and east of Black Point and the Thousand Isles, even during June, July, and August, while during the winter months ice-laden currents sweep round Spitzbergen on both sides from the north, and bear back the equatorial current, and envelop the entire island with a wall of ice.

These rapid changes of direction of currents, with accompanying marked alteration of climate, appear to bear a close analogy to those which must have obtained in South Britain when the alternating beds of boulder-clay and sands and gravels were being deposited, clay with scratched stones during the colder intervals, and sands during the warmer episodes, when the waves were fretting coasts unprotected by ice.

Icebergs appear to have ground the surface of the rudely columnar trap-rocks of the Thousand Islands, which are covered with countless smoothed and rounded boulders of the local trap, and of red granite derived from the centre of Spitzbergen, forty miles distant.

In one of the cluster of islands off the coast at Black Point is a channel 100 yards long, three or four feet wide, and four deep, running N.E. and S.W., excavated in the boulders, which Mr. Lamont believes to have been produced by the passage of an iceberg, when the land stood lower than at present. The power of bergs to groove and scoop out hollows has been denied, and it is to be hoped that the officers of the Arctic Expedition will have opportunities of ascertaining what the usual character of the bottom portion of a berg is, how far it is capable of grooving rocks and excavating hollows in soft sea beds, with or without coming to rest.

* Continued from p. 494.
† In the following notes on Spitzbergen and other neighbouring islands, only those points have been touched on as have a direct bearing on the geology of the area already described.
‡ Quar. Jour. Geol Soc., vol. xxx. p. 455; 1874.
§ "Frost and Fire," by J. F. Campbell, vol. i. p. 483.
‖ "Seasons with the Sea Horses." London, 1861.
¶ "Letters from High Latitudes." (London.)

Separated from the great glacier of Deeva Bay by two miles of sea covered with fast ice, is a terminal moraine of mud, 3½ miles long, 200 to 400 yards broad, and 20 to 30 feet high, on the top of which grow Arctic plants. Observations as to what extent glaciers can extend into the sea, and push moraines before them without breaking off into bergs, would have great interest, for in this instance the sea must have been deeper during the maximum size of the glacier than now, as bones of whales occur at heights of more than forty feet above the present sea level.

One of the three large glaciers that protrude into the sea between Black Point and Ryk-Yse Islands has a sea front of thirty miles, sweeping in three great arcs, five miles beyond the coast line, terminating in a precipitous wall from 20 to 100 feet in height, from which bergs are constantly tumbling into the sea, carrying stone and large quantities of clay and stones seawards. The position of the melting area of such bergs as these, and consequent deposition of erratic material, is a point of great interest in attempting to unravel the British glacial phenomena.

Prof. Wyville Thomson, dredging on the edge of the southern ice pack, brought up fine sand and greyish mud, with small pebbles of quartz, felspar, and small fragments of mica-slate, gneiss, and granite, derived from the melting of icebergs found in lat. 65° or 64° S., which represents their melting area, while further south in 200 to 250 fathoms of water, in which they first commence to float, land débris is much rarer; at the surface of the water in the melting area, *Globigerina* and diatoms are numerous, but do not form a deposit at the bottom, owing to the deposition of silt obliterating them.

Recent Elevation of Spitzbergen.—From the observations of Mr. Lamont it may be inferred that during the past 400 years Spitzbergen has been rising at the rate of thirteen feet per century.

Bear Island (lat. 74° 30′ N.)—From the plants and specimens collected by Professors Nordenskjöld and Malmgren, the following classification of the rocks of the island has been established*:—

MILLSTONE GRIT.—Siliceous schists.

MOUNTAIN LIMESTONE STAGE.—*Productus* limestone, *spirifer* limestone with gypsum, resting on *Cyathophyllum*-bearing limestone and dolerite, possibly the equivalent of the Carboniferous shale with *Cyathophyllum* of the south of Ireland.

URSA STAGE of O. Heer.—Sandstones, with shale and coal-seams. All the beds contain plants.

DEVONIAN.—Russian Island limestone, red shale.

The Russian Island limestone, which spreads over so large an area in Spitzbergen, contains no determinable fossils, and, like the shales beneath it, is of doubtful geological age, probably, as suggested by Nordenskjöld, belonging to the Devonian. No true coal measures are present either in Spitzbergen or Bear Island.

The "Ursa Stage" Prof. Heer correlates with the Kiltorkan beds in Ireland, the Greywacke of the Vosges and southern Black Forest, and the *Spirifera Verneuilii* shales of Aix, and the sandstones of Parry and Melville Islands in the Arctic Archipelago; and from the marked absence of Devonian and coal-measures species, regards the stage as of Lower Carboniferous age, the base of which he considered to be beneath the yellow sandstones; but Sir Charles Lyell, from the fact that these sandstones at Dura Den, in Fife, and in the co. Cork, contain the exclusively Devonian fish *Asterolepis* and *Glyptolepis*, believed these deposits to be Devonian, which

* Quar. Journ. Geol. Soc., vol. xxviii. p. 161. (Read Nov. 9, 1868.)

opinion Mr. Carruthers also expressed in reference to the plant both of the Irish and Bear Island deposits.*

In Eastern America the Lower Carboniferous Coal-measures (Calciferous Sandstone of Scotland) lie unconformably on the Devonian, which contains different fossils; but in Ohio a transition between the Devonian and Carboniferous flora takes place, according to Principal Dawson, at the base of the latter,† and he suggests a similar blending in Bear Island.

Prof. Meek has shown that the rock exposures of the Mackenzie River between Clearwater River and the Arctic Ocean are of Devonian age, and correspond to the Hamilton formation and Genesee slate of the United States. The slates contain brine springs and petroleum, and it is through that they extend in a north westerly direction from Rock Island, Illinois, to the Arctic Sea, a distance of 2,500 geographical miles, the fossils being identical on each end of the tract, proving how little the palæozoic marine life was influenced by climate. From the Mackenzie slates many new corals and brachiopods were obtained, also a cephalopod, *Gyoceras Logæni*, collected by the late Mr. R. Kennicott.‡ It is therefore in the highest degree probable that the coal-bearing beds of Parry and Melville Islands belong to a continuation of these beds, and are referable to the "Ursa Stage" of Heer, whether that slate is the top of the Devonian or the bottom of the Carboniferous; and from the fact that not a single species of the Bear Island flora exists in the Upper Devonian Cypris shales of Saalfeld in Thuringia, Prof. Heer believes that the Ursa Stage is Lower Carboniferous. In Bear Island it is characterised by *Calamites radiatus*, *Lepidodendron Veltheimianum*, *Knorria acicularis*, *Stigmaria ficoides*, all of which are found in the Yellow Sandstone of Kiltorkan; and considering the persistence of freshwater genera, it is not remarkable that some genera of fish that occur in Old Red of Scotland still lived on in these Kiltorkan sandstones. Should, however, fish remains be found in the strata lying in synclinal hollows of the Silurian rocks of the Arctic regions, their specific determination and that of the associated forms, may be expected to throw much light on the vexed question of the line of demarcation between Devonian and Carboniferous. The presence of *Knorria acicularis* in the Melville Island flora is a link between the flora of the South of Ireland and that of Bear Island; the latter is undoubtedly an outlier of the Russian Lower Carboniferous coal tract. Looking to the number of species in this flora, which can be traced in the northern hemisphere, both in the Old and New World, from 47° to 74° and 76° north lat., and to the fact that it is the first rich land flora in the earth's history, there is evidence that a widespread continent occupied much of the Arctic as well as of the temperate zone, over which ran large rivers tenanted by the freshwater mussel (*Anodonta*) and Neuropterous insects.

The subsidence which brought in the deposition of the Mountain Limestone and the existence of extensive coral reefs equally affected the Arctic zones, and these formations occur both in Spitzbergen and Bear Island, as in the islands of the Arctic Archipelago. Equally also is the return of continental conditions expressed by the European Millstone Grit, represented in the Arctic zone by the siliceous schists of Bear Island. During this period many plants of the Ursa Stage still lived in Europe, proving that islands covered with the old flora existed throughout the whole era occupied by the deposition of the Mountain Limestone. And it is worthy of note, as Prof. Heer has pointed out, that the leaves of the evergreen tree *Lepidodendra*, and the large fronds of *Cardiopteris frondosa*, are as fully developed as those from the South of Ireland and the Vosges; and it is clear that the climate of these Arctic regions must have been far warmer than at present, even if the darkness of the long winter nights were the same as now.*

* Geol. Mag., vol. vii. p. 580.
† Quar. Jour. Geol. Soc., vol. xxix. p. 245.
‡ Trans. Chicago Acad. of Science, vol. i. (Chicago, 1868.)

Spitzbergen.—In the Klaas Billen Bay of the Eis Fjord, Wilander and Nathorst discovered the Ursa Stage in 1870; overlying it are the Miocene beds which have yielded so rich a flora and fauna to various expeditions which have visited the island. In the black shales of Cape Staratschin, *Sequoia Nordenskjöldi* and *Taxodium distichum* are the most characteristic trees. At King's Bay, a Lime (*Tilia Malmgreni*), a Juniper, an Arborvitæ (*Thuites Ehrenswaerdi*)—many of the species occur in West Greenland—and two, *Taxodium distichum* and *Populus arctica*, were found by Lieut. Payer, of the German Exhibition, in the fossiliferous marls of the Germania Mountains, in Sabine Island, East Greenland, also. At the present time, firs and poplars grow in an area 15° further north than plane-trees; so that, assuming the former to have reached their northern limit in Spitzbergen in lat. 79°, the oaks must have grown, provided there was land, as far north as the pole.†

The so-called *wood-hills* discovered in 1806 by Sirowatskoi on the south coast of the island of New Siberia, stated by Wrangel ‡ to consist, according to Henenström, of horizontal beds of sandstone, alternating with vertical bituminous trunks of trees, forming a hill 180 feet in height, are no doubt part of the great Miocene deposit which stretches from Vancouver's Island through Northern Asia into Europe. The evidence of the former continuity of land is borne out by the presence in Greenland of species of the Japanese genera *Glyptostrobus* and *Thujopsis*, which last, *T. Europæus*, occurs in Europe, in Amber and at Armissan (Narbone); associated with it are American forms, which, as pointed out by Prof. Göppert (Geol. Trans. 1845), chiefly characterise the flora associated with the Amber pines of the south-eastern part of what is now the Baltic.

An examination of the fauna and flora of the Miocene rocks of Europe and Asia indicates a continental period of long duration, which experienced at its commencement a tropical climate, gradually becoming more temperate as time elapsed.

In the Upper Miocene beds of Œningen, North American types still live, and are more numerous than in the later Italian Pliocene flora: amongst them is a vine, four palms of the American type, *Sabal*, planes of American type, and conifers *Sequoia* and *Taxodium*. The palms, whether of the European or American type (*Chamærops* and *Sabal*), and other exotic forms, are found to be absent in the Miocenes of the northern area, proving that the climate became cooler in advancing northwards, as at the present time; for through the enormous expanse of continental land the climate was much more equable than at present. There is therefore no reason to believe, from the absence of these plants, and of bones of long-armed apes present in the Miocene of Central Europe, that the Lower Miocene is absent in the Arctic zone; and from the determination by Prof. Heer, of Cretaceous forms in the Greenland deposits, it is probable that the continental conditions expressed by the Miocene of Europe and India had commenced in these polar regions as early as Cretaceous times. Should further discoveries of freshwater Cretaceous and Miocene deposits lying in the hollows of the older rocks be found in the northern lands visited by the British Arctic Expedition, it will be of great interest to see how far southern species die out in advancing to the present pole, and what minimum of cold the surviving species appear to indicate.

C. E. DE RANCE

* Prof. Ramsay has directed my attention to Mr. Croll's recent work, "Climate and Time," in which the occurrence of Carboniferous and Miocene species in the Arctic zone is adduced as evidence of "warm inter-glacial periods" in these regions.
† Heer: "Miocene baltische Flora;" "Fossil Flora von Alaska," 1869; "Flora Fossilis Arctica," vols. i.–iii.; "Ueber die Fossile Flora der Polarlände." Zurich; Fr. Schulthess, 1867.
‡ "Reise längs der Nordküste von Siberien in den Jahren," 1820-24, th. i. s. 102.

THE PROGRESS OF THE TELEGRAPH *

IV.

IT will only be necessary to describe generally the construction of the Syphon or Recording Galvanometer. It consists essentially of two parts; first, that portion of the machine which, being influenced by the received current, oscillates or moves, thus becoming the motor or mechanical power; and, second, the arrangement for permanently recording or registering this motion. The motor or mechanical power is obtained by the employment of a very light suspended coil consisting of a small number of turns of fine insulated wire, placed in a very powerful magnetic field produced by permanent magnets or electro-magnets; these act with great exciting force upon the suspended insulated wire coil, causing it to deflect or vibrate when the current passes through it.

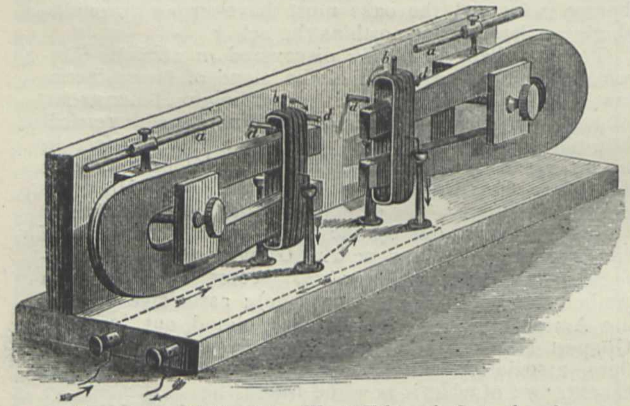

FIG. 18.—Mr. William Sykes Ward's Telegraph, September 1847.

This deflection of a vibratory coil through which a current is passed, over the poles of a magnet, was the subject matter of a patent in 1847, by Mr. William Sykes Ward, of Leeds, in which it is stated, "Signals are indicated by the deflection of electro-dynamic coils, free to vibrate over the poles of a permanent magnet;" the deflection of the coil to right or left indicating either the dot or dash of the Morse alphabet, or the beats of the old double-needle instrument.

This apparatus is represented in Fig. 18. Two permanent magnets are attached to a suitable frame, over the poles of which the oscillating coils are placed, the lateral motions of which, to the right or left, according to the direction of the current, are regulated by the stop pins *d d*.

In connection with each permanent magnet an adjustable permanent magnetic bar *a* is placed, which, acting upon a soft iron exponent *b* attached to the upper extremity of the oscillating coils, regulates the sensitiveness of their movement to the required degree, according as the magnetic bar *a* is advanced or withdrawn from proximity to the soft iron medium *b*. The completion of the circuit through the coils is indicated by the arrows and metallic contacts in the illustration.

In the Syphon Recording Apparatus, to produce the maximum amount of deflection of the coil with the minimum amount of current force, this delicate recording helix is suspended so as to vibrate over a soft iron core placed between the two poles of a powerful electro-magnet, so that the most delicate current traversing the coil receives the maximum amount of magnetic sympathy; the space between the iron core and the poles of the magnet being as narrow as is consistent with freedom of oscillation of the coil.

In tracing the history of the various step-by-step developments of the telegraph, which will be done subsequently, we shall show that a very beautiful scientific application of electrical statics, obsolete as regards practical results, was developed by Henry Highton in 1846, where the voltaic current was passed through a narrow strip of gold leaf enclosed in a glass tube and placed in a vertical direction before the poles of a powerful magnet. In this arrangement similar results were obtained to that of the oscillating coil over the poles of the magnet, the gold leaf filament being deflected in a curve to the right or the left, according as the current is passed in the one or other direction from the voltaic battery through the gold leaf strip.

Having thus briefly described the *motor*, the second part or recording mechanism of the apparatus comes under notice. The function of this is to impart the motion of the receiving coil to a light capillary tube or syphon of glass, suspended and adjusted to the coil by means of the torsional elasticity of a helical wire. The long leg of this syphon acts as the marker; the short end dips into a reservoir of ink or other marking fluid which is continuously caused to be spurted or ejected from the end of the syphon, by means of electric agency, on to a moving ribbon of paper mechanically drawn over a metal plate electrified in an opposite direction to that of the syphon. Thus a powerful difference of potential or electrical equilibrium is constantly maintained between the tube and the metal plate, the tendency to produce equilibrium resulting in a succession of sparks between the syphon and the metal plate, producing a fine stream of ink or a succession of minute dots on to the surface of the moving paper ribbon. A very fine hair-pencil may be attached to the syphon as a capillary marker, and so dispense with the electrical arrangement. If the syphon remains in a neutral position, a continuous line will be drawn over the paper, but when by reason of the motion of the receiving coil the syphon is drawn either to the right or left, a corresponding deviation from the straight line will be indicated; thus a record is maintained on paper of the movements of the coil, without that movement being in the least degree impeded by friction or any other mechanical defects. To develop fully the effective results of this most delicate recording apparatus, it is evident that some means must be employed more accurate than the human hand for the transmission of the several electric groups and sequences of currents passing through the wire which severally and collectively compose the message. From facts that have been already stated regarding the rapid transmission of electric currents through extended submarine cable circuits, it will be remembered that with a view to obtain a maximum amount of speed, the electric throbs transmitted by the cable should be of equal duration and at equal intervals of time, so as to allow mechanically for the regular difference of tension in the current at the distant end, as well as for the charge and discharge of the circuit. An automatic transmitter for passing the several currents and groups of currents into the circuit is therefore employed. The details of construction of this essential piece of mechanism will be given in the following description of Sir Charles Wheatstone's automatic high-speed printing instrument. It is only natural to suppose that there are several automatic transmitters scheduled in the Patent Office: the reader does not, however, require to become a dictionary upon patent lore or mechanical variations of electrical apparatus, but simply to acquire a general knowledge of the progress of the telegraph up to the year 1875.

In years long since passed, the invention and introduction of the Jacquard Loom produced a vast revolution in the processes of weaving; by its means an automatic record of the groups and sequence of the threads necessary to produce the pattern by being raised to the surface of the cloth was maintained, and a simple mechanical arrangement performed simultaneously with the succes-

* Continued from p. 472.

sive to-and-fro motion of the shuttle, superseded the laborious and complicated hand process previously in vogue. An endless band of cards is passed successively over the register of the loom, and brought forward at each throw of the shuttle, each card being perforated with holes to represent that integral portion of the pattern, and each hole controlling the elevation of one or more threads in the warp. A series of weighted needles are, as the holes pass, momentarily allowed to drop, and in so doing by a mechanical adjustment raise the respective threads or groups of threads to the surface of the cloth, so that the shuttle passes underneath, and thus the pattern thrown on the surface is automatically repeated as the cards in succession pass over the register. It is this Jacquard loom principle that Wheatstone has employed to weave his electric currents into the line and produce the electric pattern upon his paper at the distant end. The Jacquard loom weaves rapidly, because the mechanical labour incident to the preparation of the pattern is carried out before it is placed on the loom. So with the automatic printer, or electrical Jacquard, the transmitting speed is rapid. The cards used in the electrical loom to regulate the sequence of the currents and groups of signals are prepared before being passed through the instrument, so that the time occupied in transmitting any number of currents and groups of currents to represent letters and words is reduced to a minimum. In electrical transmissions this is important, the cost of manual labour per minute or hour being inappreciable as compared to the value of a minute or hour in the occupation of an extended telegraph wire, erected at a cost of thousands of pounds. For instance, a line of poles and a single wire between London and Glasgow would require at least 12,000*l.* for its erection. To obtain the greatest amount of work out of such a wire in a given time is one of the problems of mechanical telegraphy, and commercial success depends greatly upon the speed at which currents of electricity can be sent through a wire of given length. This speed is regulated by the rapidity with which the currents can be transmitted through the wire without coalescing, that is, without interfering with each other and running together to form a continuous mark at the distant end. Reference has already been made to the conditions to be observed in the passing of currents into metallic conductors to ensure the maximum of speed, that they should be passed into the wire at equal intervals of time and of equal duration. Now, this is what the electrical Jacquard of Wheatstone so beautifully carries out, and the mode by which this electric pattern is woven will now be explained.

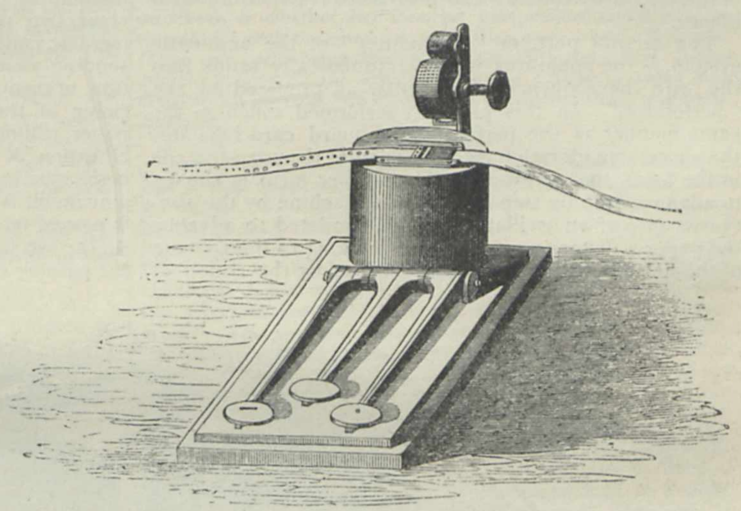

FIG. 19.—The "Perforator," for cutting out the message on the paper ribbon.

The apparatus consists essentially of three distinct parts—one for the preparation of the electrical loom card to regulate the succession and sequence of the currents in the electrical writing; another, the loom for the passing the currents so grouped into the line; and the third, the shuttle or pattern-producing arrangement by which the currents so passed into the line are recorded and transformed into symbols representing letters, words, and sentences. All automatic high-speed instruments for either submarine or land-wire circuits embody these essential conditions, the mechanical modification of parts

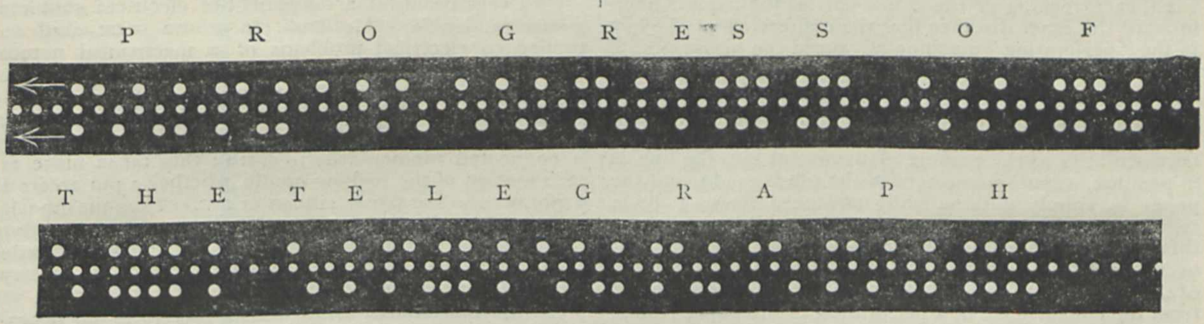

FIG. 20.—Perforated message on paper ribbon.

alone regulating the character of the apparatus for the work to be performed. The message to be sent is first punched out in holes (arranged to represent the "dot" and "dash" of the Morse alphabet) on a continuous paper ribbon by means of an instrument called the "Perforator," shown at Fig. 19, in an elementary form. Each of the three finger-keys on depression perforates a small round hole in the paper ribbon, the right being representative of the dot, the left of the dash, the centre one the mechanical spacing of the holes, and necessary for the regular motion of the ribbon through the loom or "transmitter."

This perforating machine is so constructed that upon the depression of any one of the keys a threefold action takes place: namely, the paper ribbon in the machine is locked in position to receive the perforation; secondly, the hole is cut by the pressure on the paper of a steel pin; thirdly, a mechanical movement, which at first holds the paper in the direction in which the ribbon enters, after the hole is cut automatically, carries it forward the requisite distance to receive the next hole; and thus, by successive depression of the respective punches, the holes are cut in the paper ribbon in the necessary sequences to represent letters and groups of letters to form words. The centre punch, besides mechanically spacing the perforations to ensure their proper passing through the "transmitter," also by individual pressure spaces the distance between the letters and words of the message. The appearance of the paper ribbon thus prepared is shown full size at Fig. 20. Thus the message is written away from the wire, and the time taken up in its preparation is independent of loss of revenue on capital incident to the unnecessary occupation of the circuit by the slow and protracted results of manual labour.

The second part, or "transmitter" of the automatic system, is the apparatus which automatically sends into the wire the sequence of currents, as prepared by the "perforator." In this process, performed much in the same manner as the perforated Jacquard card regulates the successive elevation or depression of the warp-threads in the loom, the perforated ribbon-paper strip is caused to advance step by step through the machine by the successive grip of an oscillating cradle, regulated to advance the paper a distance exactly corresponding to the spacing of the holes by the "perforator," so that by the action of a rising pin, elevated and depressed alternately at each to-and-fro motion of the rocking frame, the message ribbon is automatically and mechanically impelled forward. Two other spring *contact* pins, representing respectively the contact with the positive (copper) or negative (zinc) currents of the battery (which may be either magneto- or voltaic-currents of electricity), are actuated by the same mechanical movement, by means of eccentric cam arrangements. Thus, when the perforated paper ribbon is carried automatically forward step by step in rapid succession by the action of the central pin, if a "current-passing" perforation is in position at the moment of passing the paper ribbon with either pin, the respective pin will rise through the hole and make a metallic contact with the battery through the instrument, sending a current into the line in the one or other direction, according to the position of the perforation and the rising of the respective pin. If no perforation in the paper ribbon is in position at the time of the automatic elevation of the respective pins, they fall back by the compensating influence of adjusting springs, and a *mute* movement is made by which no current from the battery is passed into the circuit. It will thus be understood that the action of the transmitter is also threefold as regards the passing of the current and the motion of the paper.

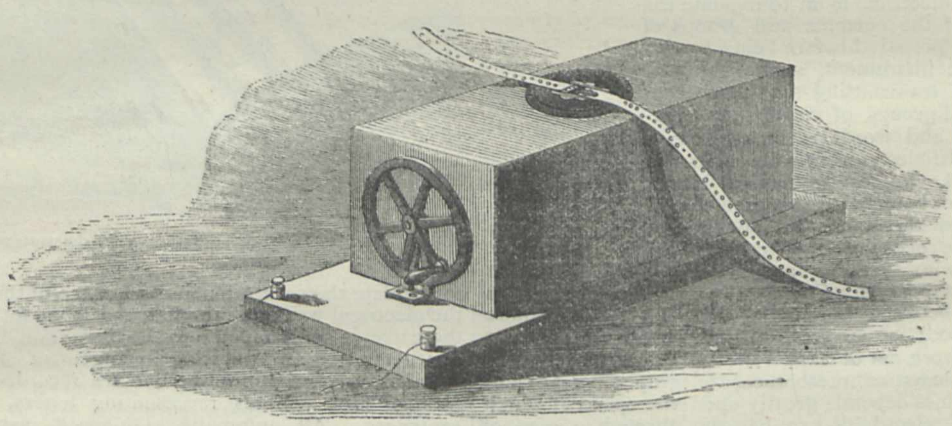

FIG. 21.—Wheatstone's Automatic Telegraph. The "Transmitter."

First, each rocking of the cradle carries the paper ribbon forward the exact distance that the depression of the key in the "perforating" machine advanced the message slip. Secondly, when the paper ribbon has been thus advanced, it is momentarily held in suspense to admit of the entrance of the respective pin, completing battery contact according to the position of the hole; and thirdly, if no perforation representative of the passing of a current into the line is in position, a mute movement of the pin is made, and the paper is simply automatically advanced forward by a regular step by step movement. In addition to these three mechanical cam and eccentric movements in connection with the advancement of the ribbon, the elevation of the pins, and the passing of a current into the circuit from the concurrence of a perforation in the paper ribbon and the rising of a pin, a fourth important electrical contact movement takes place at each successive motion of the rocking cradle, independent of the rising of the pins, namely, that of momentarily making contact between the line wire and the earth after each successive elevation of either current-passing pin. The importance of this discharge to earth to clear the line has previously been pointed out as arising from the sensible retention in the insulated wire of a portion of the transmitted current, which, unless drawn out, would interfere with the integrity of the succeeding current, reducing the transmitting speed of the wire.

By a very beautiful arrangement of electrical contacts (perfected by Mr. A. Stroh, to whose great skill as applied to electrical problems of a mechanical nature Wheatstone is indebted for the absolute perfection of the mechanism in his automatic telegraph—the A B C telegraph—and the sympathetic electric clock movements), after each successive elevation of the pins, the circuit wire is connected momentarily to earth; this takes place at each motion of the rocking cradle, whether a pin enters a perforation in the paper ribbon or not. Thus the line is connected for discharge at regular intervals, irrespective of its charge by the elevation of a pin, a current only passing into the line by the contact made with the battery on the elevation of either pin.

In this mechanical arrangement, therefore, the necessary contacts with the battery and the regular discharge of the line are produced without recourse to manual labour; mistakes are avoided, for machinery never forgets its registers or makes false records, both of which errors are inseparable from the employment of the human hand and brain. Man, though a thinking being, is not a machine, and it is not possible ever to turn the human frame into an automaton; were this so, the value of invention would be at an end, and the accurate performance of machinery at a discount.

(*To be continued.*)

THE "ZÉNITH" BALLOON ASCENT

ON Monday, M. Gaston Tissandier read a paper before the Paris Academy of Sciences on the recent fatal balloon ascent, in which he expressed his deliberate intention of renewing the attempt. The real cause of the catastrophe was the throwing out of ballast at an immense height; Tissandier attributes it to the "vertigo of high regions." The pain felt is so small that one forgets the danger in wishing to reach a higher level; so that he who is not able to restrain himself is not fitted to be an aëronaut in high regions.

The carbonic acid tubes having been broken in the fall, no analysis could be made, and consequently it is necessary to make another ascent in order to complete the experiment.

The figures given by M. Tissandier in his paper are substantially the same as those given in last week's NATURE (p. 495). The height reached was 8,600 meters, as proved by maximum-barometers, which had been sealed up, and were opened in the laboratory of the Sorbonne.

I believe the rapidity of ascent, but mainly the gas which escaped from the balloon, were instrumental in the deaths of Sivel and Crocé-Spinelli.

The matter deserves to be carefully investigated, and I shall try to elucidate it by an ascent which I propose to make next Sunday from La Villette, with Duruof and the *Times* correspondent. Our intention is not to make a race for a high altitude, and we will do our best to resist the vertigo of high regions so vividly described by Tissandier in his paper.

W. DE FONVIELLE

LECTURES AT THE ZOOLOGICAL GARDENS

ON Thursday, April 15, the first of the ten lectures announced for the present season was given by Mr. Sclater, F.R.S., "On Monkeys and their Geographical Distribution."

After referring to the considerable series of monkeys in the Society's collection, from which a specimen of the Chimpanzee (*Troglodytes niger*), of an albino Macaque Monkey (*Macacus cynomolgus*), and others were exhibited, Mr. Sclater drew attention to the six zoological provinces into which the surface of the earth was generally acknowledged to be divided. These he had named and defined as follows:—

1. *Palæarctic Region.*—Europe, Africa north of the Atlas, and North Asia.

2. *Ethiopian Region.*—Africa south of the Atlas, and Madagascar.

3. *Indian Region.*—South Asia, Philippines, and Islands of Indian Archipelago to Wallace's Line.

4. *Nearctic Region.*—North America down to Isthmus of Tehuantepec.

5. *Neotropical Region.*—Central America, south of the Isthmus of Tehuantepec, and South America.

6. *Australian Region.*—Australia, New Guinea, and Austro-Malay Archipelago. No monkeys being found in the Australian or Nearctic regions, and none in the Palæarctic, except the Macaque of North Africa and Gibraltar.

Commencing with the Anthropoid Apes, the Gorilla (*Troglodytes gorilla*) was shown to inhabit the tropical regions of West Africa only, not extending south beyond the River Gaboon. The same region is the home of the Chimpanzee, which, however, spreads to the east for a considerable distance, having been captured in Abyssinia. It is also found as far south as the north bank of the River Congo. Of the two other genera of Anthropoid Apes, the Orang Utan and the Gibbon, the former is confined to Borneo and Sumatra, the latter to the Malay Peninsula, Assam, and the islands of the Indo-Malay Archipelago.

Of the Catarrhine or Old World Monkeys, there is a peculiar long-tailed genus, *Semnopithecus*, found in India and the Malay region. This is represented in Africa by the similarly peculiar genus *Colobus*, which wants the thumb; it is found mostly in West Africa, extending east as far as Abyssinia. Of this group the Indian Entellus Monkey is best known. The genus *Macacus* is almost confined to the Indian region; a species (*M. speciosus*) is, however, found in Japan; and the Barbary Ape (*M. inuus*) from Ape's Hill has crossed to Gibraltar. The genera *Cercopithecus* and *Cynocephalus* are confined to the Ethiopian region.

The Platyrrhine Monkeys, with an extra premolar on each side of each jaw, are inhabitants of the tropical portions of the Neotropical region only. Amongst them are included the genera *Cebus*, *Ateles*, *Mycetes*, *Brachyurus*, and others, some with, and others without, prehensile tails, many of which have, at one time or other, lived in the Society's Gardens. The Marmosets have one less molar in each half of each jaw, which makes the number of their teeth the same as in man, although this is the consequence of there being four more premolars and four fewer true molars.

The Lemuridæ, whether they ought to be included with the monkeys, or whether they form an independent group, may be considered with the quadrumana, as has been usually the case. They are distributed throughout the Ethiopian and Indian regions, nearly all the species, including Chiromys, being confined to Madagascar, which must be considered their true headquarters.

The following is an abstract of Mr. J. W. Clark's lecture on Sea Lions, delivered on April 22nd.—The Pinnipedia, comprising the Sea Lion, Sea Bear, Seal, and Walrus, are true mammalian animals, entirely differing from fish both in structure and habit. The Order naturally falls into two subdivisions, namely, the Eared and the Earless Seals; or, the Otariadæ, otherwise called Sea Lions, and the Trichechidæ (Walrus), together with the Cystophoridæ (Bladder-nosed Seals) and Phocidæ (True Seals). The former of these groups, the Otariadæ, differ from the Seals, the Phocidæ, in other respects than the possession of ears. They can use their limbs freely to raise the body from the ground and to walk on the land. They can even run swiftly for a short distance. The Seals, on the contrary, always retain their hind feet stretched out backwards, the legs being so enclosed within the integument of the body that they have little or no independent motion. They consequently are only able to progress on land by a series of ungraceful bumps, wriggling on the stomach. The body of the Sea Lion is peculiarly flexible, whilst that of the Seal has but little motion on its axis, the animal progressing in the water in much the same manner as the Porpoise. The Sea Lion's head is also more elongated and narrow in proportion to its width than that of any Seal. Its ears are small, conical organs, projecting backwards, and so rolled up, scrollwise, that their concavity is rarely shown. But by far the most modified portions of the body of the Sea Lion are the hands and feet. In the Seal the arm is wholly imbedded in the integument, the hand alone projecting. In the Sea Lion, on the contrary, nearly the whole of the upper half of the limb is free, and the thumb is much lengthened, this digit in the Seals being of the same length as the others. In the hinder extremity the lower part of the leg and the foot are free, the rest of the limb being bound up with the body.

With regard to the *skin* of the Sea Lion; on a superficial view the body appears to be covered with coarse stiff hair, which varies in length on different parts. Old males are said to develop a mane, whence the name given them by early voyagers, but it is not certain that this ornament is present in all the species. Beneath this hair there is a crop of under wool, distributed in delicate, short, fine hairs set at the base of the other larger ones. It appears to exist all over the body.

This part of the subject is rather involved. It is stated that of these Otarias, or Sea Lions, some species have under-fur whilst others have not, and attempts have been made to divide them into families accordingly. It is, however, highly probable that all Otarias have under-fur *at some period of their lives*. It is this under-fur of the Sea Lions which makes that sealskin in which all ladies delight.

The habits of the Sea Lion are among the most curious in the whole of the animal kingdom. Its food consists mostly of fish, mollusca, crabs, and penguins. The molar teeth being small, it cannot masticate its food, and when it has caught a fish, too large to be swallowed outright, it has been seen to give its head a sudden twist, so as to break off a portion of the fish, which it swallows rapidly. It then dives into the water, picks up the other portion, and repeats the tearing process until the last fragment is devoured.

Their favourite places of resort are solitary islands, either far out at sea, or at any rate clear of an inhabited coast. Many return year after year to the same rock. The natives at the

Pribylov Islands * affirm that one old male seal, recognised by the loss of one of his flippers, returned seventeen years in succession. The ground they occupy, called a "rookery," is the space between the high-water line and the foot of the cliffs. The sandy beach forms the play-ground for the pups, the uplands being their sleeping places. Like the bees, they are

" Creatures that, by rule in nature, teach
The art of order to a peopled kingdom."

The arrangement of their dominions are adopted by common consent, and enforced by the elders with much severity. The old males and the full-grown females are alone allowed upon the rookeries; the young seals swim about during the day, at night retiring to the uplands. The natives of the Pribylov Islands called the old males "Married Seals," the old females "Mothers," and the young females "Bachelors."

During the winter months the rookeries of the Pribylov Islands are entirely deserted, except by a few stragglers; but Capt. Musgrave, who was wrecked on the Auckland Islands, south of New Zealand, tells us that there numbers remain all the year round. In the spring a few old veteran males—the chiefs of the herd—make their appearance near the islands, swimming about for several days. If all is safe, they land and examine the rookery; they depart for a few days, and return accompanied by a number of other veteran males. These land, each taking up a position, reserving for himself a space of about thirty square yards, which he defends against all comers. About two months later the females begin to make their appearance. It is the duty of the "Bachelors" to drive them on to the rocks, the nearest adult male going down to meet each female, coaxing her until he can get between her and the shore. His manner then immediately changes, and with an angry growl he drives her up to his resting-place. It seems to be the object of each of these polygamous sultans to attach to himself a harem of from fifteen to twenty wives. When the males nearest the water have made their choice, those in the next row higher up watch for an opportunity to steal the wives of their more fortunate neighbours. When all the females have landed and been distributed among the claimants, no further change takes place, each sultan walking round and round his family and driving off all intruders. This is the account given by Capt. Bryant, commander of the station at the Pribylov Islands. Capt. Musgrave, in his account of the Seals of the southern hemisphere, does not indicate that this jealous distribution is so customary.

The cubs are born a few days after the arrival of their mothers, and always on shore. They have a great aversion for the water at first, and are taught to swim by their mothers. It is a most curious fact that during all the while these creatures are on shore they remain absolutely without food; they arrive excessively fat, and, as is not surprising after a fast of two months, depart extremely lean. When the young can shift for themselves the rookeries are broken up.

Respecting the different species of these Sea Lions and their geographical distribution, Magellan, in 1519, was the first to notice their chief peculiarities. He found them on an island south of the River Plate, and called them Sea Wolves. No naturalist, however, distinguished them from the Seals proper, with the exception of the Russian Steller, who, visiting the Aleutian Islands in the middle of the last century, saw the two species which are found there, and described them as the Sea Bear and the Sea Lion. Linnæus, in 1758, nevertheless included them all in his genus *Phoca*, and it was not till 1800 that Péron again separated them. Subsequently, they have been minutely studied by Dr. J. E. Gray, and Dr. Peters of Berlin. Both these authors, however, have been far too fond of making new genera and species upon single skulls, or even single skins. It seems to me better to retain Péron's original genus *Otaria* for the whole group, the number of species of which amount to nine. True Seals inhabit the Arctic and Antarctic seas, as well as the temperate regions in both hemispheres, together with the Antilles and Madeira. The Otarias are more tolerant of warmth, and are apparently more susceptible to changes of climate. A remarkable fact about their distribution is that none are found in the Atlantic, except in its extreme south. From the mouth of the River Plate they extend all round the coasts of South America and the adjoining islands. Proceeding north, they are numerous upon the coast of California, and extend round by the Aleutian Islands to the coast of Japan. Their most northern known station is that of the Pribylov Islands; further investigation will perhaps reveal their existence in some of the islands north and south of the equator in the Pacific Ocean. They are found all round the coasts of New Zealand, the Aucklands, Tasmania, and Southern Australia. They are said to inhabit Kerguelen's Land and the Crozets: we also know that there is one species at least near Capetown, a specimen from that locality being now alive in the Zoological Gardens.

* Situated in Behring Sea.

(*To be continued.*)

NOTES

An appeal is being made by the Committee for the Exploration of the Victoria Cave, Settle, for additional funds; the work, we much regret to say, being actually at a stop from want of means. This is not as it should be, and we feel sure that the state of matters only needs to be made known to the scientific public in order to have it remedied. The importance of these explorations need not be insisted on in these pages; results have been already achieved of the highest value to the geologist, the historian, and the antiquary. What further records may be found at the cave in lower and earlier deposits than those yet investigated, is a question which can only be solved by actual work. The bottom of the cave has never yet been reached. The series of bones obtained during the past year is exceedingly fine, and may challenge comparison with any in the kingdom; and altogether the work, besides bearing already many important results, is one of great promise. The British Association have given three several grants of 50*l.*, but by far the greater share of the expense has fallen on a few individuals who have contributed liberally. This should be so no longer, and we earnestly hope that all our readers will do what they can to help forward an undertaking of so great importance. Subscriptions should be forwarded to John Birkbeck, jun., hon. treasurer of the "Settle Caves Exploration Fund," the Craven Bank, Settle, Yorkshire.

A telegram dated Bombay, April 22, states that the members of the Solar Eclipse Expedition have left that place on their return to England.

News is to hand of a recent volcanic eruption in Iceland; the following particulars we gather from the Icelandic correspondent of the *Scotsman*:—Shortly before Christmas 1874 earthquakes were experienced over the north-east part of Iceland. About Christmas, columns of smoke were seen rising, and therefore a party were sent from the My-vatn on the 15th of January to reconnoitre. They went straight southwards over Odadahravn, and made for the Dyngjufjoll. The Dyngjufjoll form a circle of mountains, and within this circle there is a lava stretch called Askja (The Box). Here the exploring party found the eruption to have taken place, and they state that a large crater has been formed, from which lava and clay are being thrown hundreds of feet upwards. They found many small craters grouped round the big one, and from several of these water was flowing. All around the earth was rent into large fissures, and at some places it had subsided to a considerable extent. Since this visit, the column of smoke has been seen daily in clear weather, and slight earthquakes have been felt at intervals. On the night of the 18th February, the gleam of a great fire was seen from Grimsstodum, in a western direction. A new exploring party found the fire to be twenty miles from the inhabited district, to the west of the so-called Sveinagja, in the Austurfjollum. The eruption had taken place from several craters. Some have piled up the lava around them into shapes resembling castles; from others the lava had flowed in a stream, and formed a lava-field of large extent. Most of the craters were smoking when the party arrived. The lava stream from all the craters is between two and three miles long, and from 600 to 800 yards broad. At many places the glowing fire was seen on looking down through the fissures, and the crust was found to be two or three feet thick. In two or three places small hollow cones had been formed, capable of containing two or three barrels inside. Explosions occurred at intervals in the crater, and lava, earth, and stones were thrown up to a height computed at 160 yards. The distance from My-vatn to the craters is calculated to be from forty to fifty English miles.

IN connection with the above, it is interesting to note that reports from Sweden and Norway state that during the night of March 29–30 last, a heavy rain of ashes or sand took place from the west coast of Norway to the Swedish frontier; the whole of the country was covered with grey dust to such an extent that from a pint of snow more than a tablespoonful of residue was left after the snow had melted. Some chemists of Christiania have examined the ashes, and one of them, Prof. Waage, states that the dust consists of little, irregular, but sharp-edged grains, almost all colourless—some few are of brown colour—and they consist principally of silicates. Acids extract some lime, iron, and alumina from their powder. The professor thinks it likely that the dust originates from an eruption in Iceland. This view is confirmed by a mineralogical investigation made on another sample of the dust at the Christiania University, by Profs. Kjerulf and Fearnley; they recognised the dust to consist of fragments of pumice-stone which is identical with the Hecla pumice-stone. According to Swedish newspapers, some traces of the dust-fall were observed even in the vicinity of Stockholm. Prof. Kjerulf also thinks it highly probable that an eruption took place in Iceland. The distance from the Iceland volcanoes to the Swedish frontier is about the same as that from Mount Etna to the Baltic.

THE following information regarding an eruption of the volcano of Ternate (Moluccas) we have received from Dr. A. B. Meyer:—Mr. van Musschenbroek, Resident of Ternate, having made an ascent to the volcano, writes under date Feb. 5: "About fifty small new craters, or rather deep wells, have appeared along the walls of the large crater, and independent of the proper cone of eruption; they are all deep (but it is difficult to say how deep), and about twenty feet in diameter. On some spots, the 'Alang-alang' green was turned upside down. These new, small craters were surrounded by still smaller ones, and by stones thrown out from the interior. This happened at the same time as a rather heavy eruption of the volcano Roeang, near Tagoelanda." Tagoelanda, Dr. Meyer states, is an island in the north of Celebes. He witnessed part of a heavy eruption of the Roeang in 1871 (see NATURE, vol. iv. p. 286). This coincident action of the volcanoes of Ternate and Roeang in January 1875 is interesting, because the same coincidence happened in 1871. Then the eruption of the Roeang was felt in the form of earthquakes and thundrous sounds in the earth, as far as Gorontalo in Celebes to the south, and as far as Ternate (Moluccas) to the east. At a former eruption of the Roeang, in August 1870, the ashes are said to have been thrown to the north as far as Mindanao (Philippine Islands), about 200 miles distant. The Roeang, therefore, appears to be still now a formidable centre of volcanic action.

DURING the present term at Oxford, Prof. Lawson and Prof. Ray Lankester are conducting a class from 10 till 4 o'clock each day, which presents features of special interest on account of its novelty. The course is one of general biological instruction, devised so as to give a survey of the leading features of plants and animals. The practical work is preceded by a lecture. Great pains has been taken to get the types required, some being very difficult to procure, and quite novel as educational specimens. Among these may be included Æthalium, Gonium, Cordylophora, and Amphioxus. We hope that Profs. Lawson and Lankester will find that their enterprising attempt to raise the standard of biological study will be sufficiently appreciated to lead them to continue the course on the next seasonable opportunity.

THE Cambridge Museum and Lecture-rooms Syndicate have issued their Ninth Annual Report. They draw attention to the insufficient accommodation for examination purposes and the insufficiency of space for the students in comparative anatomy. Considerable use has been made during the past year of the Cavendish Laboratory, which is being rapidly fitted at the expense of his Grace the Chancellor, the Duke of Devonshire, with the apparatus required for physical research. The want of proper accommodation for Dr. M. Foster's classes in Physiology is painfully evident, as those rooms are neither sufficiently large nor sufficiently well lighted for class rooms. The donations made to the different collections have been numerous.

IN a Congregation at Oxford University on Tuesday, a statute, the principal effect of which would be that the examinations in the Natural Science Schools would be held only once a year, and that honours might be obtained in different subjects at different times—creating, in fact, independent Schools of Physiology, Chemistry, and Physics—was thrown out, after a sharp debate, by 25 votes to 23.

THE Council of the Senate of Cambridge University propose to offer a grace early this term for the appointment of a syndicate to consider the propriety of establishing a professorship of Mechanism and Engineering.

THE High School at Newcastle-under-Lyne, which will open after the summer, under Mr. Kitchener, is fortunate enough to have already met with a liberal and wise friend in Mr. Mayer. He has founded a 50*l*. exhibition from the school to the Universities, for Science and Mathematics, besides two minor exhibitions for Art.

WE are informed that Mr. A. R. Wallace has in hand a work on the Geographical Distribution of Animals, which will be looked for with great interest.

THE Annual General Meeting of the Iron and Steel Institute will be held in the rooms of the Institution of Civil Engineers, 25, Great George Street, Westminster, S.W., on Wednesday, May 5, and two following days; the president-elect being Mr. William Menelaus. Among the papers to be read are the following:—Notes of a Visit to Mines and Ironworks in the United States; and on the Sum of Heat Utilised in Smelting Cleveland Ironstone, by Mr. I. Lowthian Bell, F.R.S. The Estimation of Small Quantities of Phosphorus in Iron and Steel, by Spectrum Analysis, by Sir John G. N. Alleyne, Bart. The Manufacture of Bessemer Steel in Belgium, by M. J. Deby, Brussels. The Summer Meeting will be held at Manchester early in September.

SIR HENRY RAWLINSON, at Monday's meeting of the Royal Geographical Society, intimated that the Society had awarded the two medals of the year to the two great Arctic explorers, Lieut. Payer and Lieut. Weyprecht. With reference to the prizes the Society offered to the public schools, the following are the awards:—Physical Geography—Gold medal, Henry Alexander Miers (Eton College); bronze medal, Archibald Edward Garrod (Marlborough College). Political Geography—Gold medal, Sydney H. B. Saunders (Dulwich College); bronze medal, W. C. Graham (Eton College).

THE Paris Geographical Society held last week its annual meeting in the great hall of the *Société d'Encouragement*, Rue Bonaparte; more than 3,000 persons were present. The number of members of the Society has largely increased since MM. Thiers and Barthélemy Saint-Hilaire joined it. Preparations are being actively made for the forthcoming International Geographical Meeting, which is to be held at the Tuileries, as we have already intimated, in August next. The offices of the Congress are already opened in the *Pavillon de Flore*, but all communications should be sent to the Geographical Society, 3, Rue Christine.

AT the meeting of the French Geographical Society last week, a gold medal was presented to Mr. Washburne for the family of the late Capt. Hall, the American Arctic explorer.

IN the University of Edinburgh, Miss Flora Masson has passed the examinations for University certificates in Arts for women, with honours of the first class, in English Literature; and Miss Annette Conan Doyle has passed the ordinary examinations in English Literature, Chemistry, and Mathematics.

M. EUGÈNE GODARD will probably obtain authority to hold an international balloon race in Paris. The proceeds will be given to the families of Sivel and Spinelli.

THE death is announced on Saturday last, at the early age of thirty-seven years, of Mr. Winwood Reade, whose name is no doubt familiar to readers of NATURE as the author of "Savage Africa" and the "African Sketch Book."

THE Norwegian Storthing has adopted the Government Bill for the introduction of the metrical system of weights and measures.

M. WURTZ is to remain the Dean of the Paris École de Médecine. The report of his resignation, to which allusion was made in our last number, has been contradicted.

IN a paper on the age of the Tertiary deposits of Malta, published in the third part of the *Sitzungsberichte der Akademie der Wissenschaften in Wien*, Dr. T. Fuchs states that these beds belong to two distinct stages; the older, representing the "Bormidian" of Sismonda (Aquitanian), may be regarded as equivalent to the Oligocene marine Molasse of Switzerland and Bavaria, the strata of Bajas, Merignac, and some less known Central European deposits; the newer as equivalent to the "Leythakalk" of Vienna (Sarmatian stage). He states, in opposition to previous authors, that these two series of beds have scarcely any fossils in common, and remarks especially that the great Pectens and Echinoderms do not occur in the upper strata. Dr. Fuchs believes that many Syracusan Pliocene fossils have been described as derived from Malta. The two series are conformable in their stratification.

IN a second paper in the same publication, Dr. Fuchs announces the occurrence of Miocene beds, which he also identifies with the "Leythakalk," unconformably underlying the Pliocene deposits near Syracuse, and forming a great plateau to the west of that city.

THE same journal contains an interesting contribution to the palæontology of the Arctic regions, in the shape of descriptions of fossil shells from the Carboniferous Limestone and Zechstein rocks of Horn Sound, on the south-western coast of Spitzbergen, collected during the recent Austrian expedition to those regions. The author of the paper, Dr. F. Toula, enumerates seventeen species of Brachiopoda, three of which are described as new, and a new Aviculopecten. Most of the fossils are figured.

MR. VAN VOORST has just ready for publication "The Flora of Eastbourne," by Mr. F. C. S. Roper, F.L.S., President of the Eastbourne Natural History Society.

PROF. HELMHOLTZ' work "On the Sensations of Tone, as a Physiological Basis for the Theory of Music," translated (with the author's sanction) from the third German edition, with additional notes and an additional appendix, by Mr. A. J. Ellis, F.R.S., is nearly ready, and will be published in the course of a week. It will be issued by Messrs. Longman and Co.

THE same firm will publish, during next month, "A Short Manual of Heat," for the use of Schools and Science Classes, by the Rev. A. Irving, Second Master of the High School, Nottingham.

THE following information, with regard to the Gresham Lectures, we take from the *Journal of the Society of Arts*:—"It appears that the nomination to vacancies as they occur among the lecturers, is alternate between those members of the Gresham Committee who are appointed by the Corporation of London, and those appointed by the Mercers' Company. It is understood that the filling up the present vacancy, occasioned by the resignation of the Rev. Jos. Pullen, the lecturer on astronomy, rests with the Corporation side of the Committee, and that they have determined to commence a reform in the administration of this bequest. They therefore intend to make the appointment annual, dependent on the popularity of the lecturer, to increase the number of English lectures, and to get rid altogether of the useless Latin lecture. It is to be hoped that the Mercers' Company will take up the question in a similar spirit."

THE *Journal of the Society of Arts* contains some details concerning Scientific and Literary Societies in India. The Bengal Asiatic Society was founded by Sir Wm. Jones in 1774, and the Madras Literary Society was formed in 1818. The Bombay branch of the Asiatic Society dates from the year 1804, and in 1817 it was grafted on to the Royal Asiatic Society in England as the Bombay branch. Its Journal was established in 1841, and the publication has been regularly kept up ever since at intervals of one or two years. The Bombay Geographical Society, which dates from 1830, was in 1873 amalgamated with the Bombay branch of the Asiatic Society. The Medical and Physical Society, though it languished from 1863 to 1869, has now been revived, and published a large volume of transactions in 1871. The Sassoon Mechanics' Institute has 346 members, courses of lectures, and a good library of reference of 13,935 books. In Calcutta, besides the venerable Asiatic Society, there are several other societies both for Europeans and natives, and for the latter alone. In Bombay, the Students' Literary and Scientific Society consists exclusively of natives, and has 111 members.

THE additions to the Zoological Society's Gardens during the past week include a Great Kangaroo (*Macropus giganteus*) from New South Wales, presented by Mr. Carleton V. Blyth; a second specimen and a Red Kangaroo (*Macropus rufus*) born in the Gardens; a Persian Gazelle (*Gazella subgutturosa*) from Persia, presented by Mr. C. Czarinkow; two Kinkajous (*Cercoleptes caudivolvulus*) from North Venezuela, presented by Mr. Chas. Campbell Downes; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mr. H. M. Grellier; a Macaque Monkey (*Macacus cynomolgus*), White var., from Samar, Philippines, presented by Mr. J. Ross; a Crowned Eagle (*Spizaëtus coronatus*) from Senegal, received in exchange; two Silky Marmosets (*Midas rosalia*) from Brazil; an Ocelot (*Felis pardalis*) from South America, purchased.

EASTER WEEK AT THE SORBONNE

(*Réunion des Délégués des Sociétés Savantes des Départements.*)

THE idea of utilising the Easter vacation as the date, and the venerable Sorbonne as the place, of the annual gathering of the representatives of the learned societies of France was a very happy one, and, like all good ideas, it is crowned by a yearly increasing success. Numbers are but a feeble guide as to the importance of a gathering, yet even in numbers the list of delegates was strong (more than 250); but the true value of the meeting will be better estimated when we have given a brief report of some of the communications read and discussed, in doing which we shall necessarily mention some of the best-known names. We have purposely used the term "some of the communications," because, as the science list alone contains ninety-one papers, it would obviously exceed our limits if we were to notice them all.

The first general meeting took place on Wednesday, March 31, at noon, under the presidency of M. Leverrier, who, after congratulating the members on the very full attendance, announced the nominations of the various sectional officers which had been made by the Minister of Public Instruction, viz. :—

1. Section for History and Philology.—President, M. Léopold Delisle; Vice-president, M. Lascoux; Secretary, M. Hippeau.

2. Section for Archæology.—President, M. le Marquis de la Grange; Vice-president, M. Léon Renier; Secretary, M. Chabouillet.

3. Section for Science.—President, M. Leverrier; Vice-president, M. Milne-Edwards; Secretary, M. Emile Blanchard.

After the transaction of some formal business, the meeting was closed. At 2 P.M. the members assembled in the various section-rooms, and the reading of papers commenced.

There were several interesting papers in the Sections of *History and Philology* and *Archæology*, and we regret that want of space prevents us referring to them in detail. We can only mention M. Le Héricher's paper on the "Application to Philology of the Darwinian Theory of 'the Struggle for Life;'" M. Vimout's "Notice of the Archæological Excavations made under the superintendence of the Academy of Clermont-Ferrand on the summit of the Puy-de-Dôme;" and M. Léon de Vesly's, "On Symbolism in Egyptian and Asiatic Decorations."

Science.

This section was divided into three sub-sections, as follows :— Mathematics: President, M. Dieu; Vice-president, M. Allegret; Secretary, M. Saint-Loup.

Physics and Chemistry.—President, M. Isidore Pierre; Vice-president, M. Lissajous; Secretary, M. F. Michel.

Natural Sciences.—President, M. de Rouville; Vice-president, Prof. Raulin.

Some of the communications were read only before the sub-sections, others both before the sub-section and the full section at its afternoon meetings; we however shall not distinguish between them, but, as with the other sections, give brief notes of the most important papers.

M. Léon Vidal.—"Photographs in Colours." M. Vidal submitted several albums of specimens of the results of his method, which he stated to be extremely inexpensive. As far as we were able to understand the method adopted, it appeared to be that of repeated colour-printing; if so, it is not easy to imagine how perfect specimens can be produced at the price stated, namely, 3 cents per copy.

M. Doumet-Adanson.—"Remarks on the formation of the Salt Lakes of Tunis." The author holds that the saline matter has been derived from the decomposition of the surrounding mountains, and rejects altogether the hypothesis of a great disturbance having simultaneously produced the Mediterranean and the Sahara.

Dr. de Piétra-Santa.—"Consumption in Algeria." The author stated that the evidence collected by the official inquiries of the Climatological Society of Algiers showed that while in the early stages of phthisis the climate of Algiers was beneficial, it was, on the other hand, fatal if it had reached an advanced stage.

Prof. Pousset.—"Application of the method of least Squares to the Radiants of Meteor-showers." This was illustrated by the discussion of nearly 500 observations for the determination of the radiant for August 1874.

Mr. Marsham Adams exhibited and described his Cœlometer and his Mensurator.

M. Tarrissan.—"Meteorological Observations on the Pic-du-Midi de Bigorre." The most salient facts in this communication were (1) that the rate of decrease of temperature with elevation is, in the Alps, 1° F. for 338 feet, and in the Pyrenees, 1° for 333 feet: (2) at equal altitudes the mean temperature is 5° higher in the Pyrenees than in the Alps, and the height of the snow line in the two districts is found conformable thereto, it being about 10,000 feet in the former, and 9,000 feet in the latter.

At the request of M. Leverrier, General de Nansouty ascended the tribune, and related his hazardous descent from the summit last December.

The General had resolved upon passing the winter at the observatory with an assistant and a mountaineer, but on December 11 the window of their house was smashed by a block of ice detached from a neighbouring peak by the wind. They were unable to repair it; the temperature inside soon fell below zero Fahrenheit, and the observatory became uninhabitable. They battled with the storm for three days, but finally resolved on attempting to descend; in this they were successful, but it occupied sixteen hours instead of three, which are usually sufficient.

M. Mayet.—"Note on the Medical Statistics of the Hospitals of Lyons." This paper was rather a description of the method adopted than of the results obtained; M. Mayet, after classifying his data, plots them upon curve paper, and compares them with the principal meteorological elements.

M. Truchot.—"On the disintegration of the rocks of Auvergne considered in connection with the formation of arable land." The title of this paper sufficiently explains its nature, except that the author called special attention to the importance of phosphoric acid for agricultural purposes.

M. Abria gave a demonstration of the law of "Double total reflection in uniaxal crystals."

Prof. de Rouville.—"Geological maps of l'Hérault." The author briefly explained the maps which he exhibited and the geological features of the department, and incidentally pointed out the undesirability for many purposes of scientific maps terminating with political or legal rather than physical boundaries.

M. Sirodot.—"Complete dental system of the Mammoths." The author of this paper had certainly ample data whereupon to base his researches, for the collection which he exhibited completely covered the tables, and must have numbered at least 100, and ranged in size from two little milk teeth less than an inch long to full-sized specimens weighing many pounds.

M. Barthélemy gave a brief account of his researches on the respiration of plants, showing how it was continued even in a single leaf detached from the plant on which it had grown.

Prof. Raulin.—"Distribution of rain in the Alps."—The learned author gave a brief extempore summary of the seasonal distribution of rain in the Alps, based upon the records of about 200 stations, of which ninety-three were in the Alps and sixty-nine in Switzerland. He stated that the summer rains of Northern Germany extend to the very summits of the Alps, that the system of autumnal rains prevails on their southern slope, while the system of vernal and autumnal rains extends from the foot of the mountains to the banks of the Po. It is only thence, in the plains of Venetian Lombardy, that the system of summer droughts which prevails over Italy is fully established.—M. Renou asked what length of registers had been used, because he doubted if the periods were long enough to determine accurately the seasonal variation; he doubted if ten years was sufficient. Prof. Raulin said that usually the periods were much longer, and he added that, if the seasonal features were pronounced, three or four years would reveal to which class the station belonged, otherwise ten or even twenty years might be necessary.

Dr. Monoyer.—"New formula for determining the proper focal length of spectacles, and other questions in physiological optics." Perhaps the most important feature of this paper was the reference to, and exhibition of, a standard decimal typographical scale, printed in type of the same character throughout, but so graduated in size as to give a perfectly decimal measure of the power of the eyes. We should strongly urge oculists to obtain copies of this scale and introduce them into this country.

Prof. Rochard gave a most spirited and interesting description of his new "Musical Alphabet," of which, if it proves as successful in other places as it has at Nantes, we shall certainly hear more. The professor claims that it is to music what the nomenclature is to chemistry, and what numerals are to calculation; he showed how it almost annihilated the difficulty of time, lessened that of intonation, and facilitated the reading and writing of music. Speaking of the question of transposition and change of key, he added that he had almost ready a piano of which the pitch could be instantly altered to any extent, even in the middle of the most rapid playing. Prof. Rochard concluded by stating that his pupils at the Association Polytechnique had victoriously solved every difficulty put before them; nay, more, they had attacked problems impossible to be resolved by any other system than the musical alphabet.

Prof. Delage presented a memoir "On the Devonian system of the north of the department of Ille-et-Villaine and on its relation to the Silurian and Carboniferous systems." He showed, by a series of sections taken in the south of the department, that the order of superposition of the various Silurian beds is that adopted in the geological map of the department.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, 1875, No. 1. This number contains the following papers:—On the electric conducting power of solutions of the chlorides of alkalies and alkaline earths, and of nitric acid, by F. Kohlrausch and O. Grotrian.—On the gliding of electric sparks, by K. Antolik. The author published his first paper on this subject at the beginning of last year, and has since then been gaining much new experience on the subject; he had observed long ago that if the two discharge balls of a Holz electric machine are at a certain small distance from each other, the path of the spark is not in a zigzag line, but straight, and that the spark is often strongly bent or broken in a certain point, which lies nearer the negative pole. Mr. Antolik's idea was that negative electricity leaves bodies somewhat slower than positive electricity, and that the bending point in the spark was the place where the two electricities united. He successfully tried to obtain an image of the spark by letting it pass over a blackened glass bulb; thus he found that the spark glides in three and often five parallel lines. The paper is very elaborate and highly interesting, the author having varied his experiments in all possible ways.—On a universal meteorograph for solitary observatories, by E. H. von. Baumhauer. The Dutch Scientific Society of Haarlem offered its gold medal and a purse of 300 florins in January 1872, for a sufficient means to determine temperature, density, and degree of moisture of the atmosphere at a considerable elevation above the surface of the earth, and in a manner which makes self-registration and constant repetition of observations possible. Herr Baumhauer's paper enters into the details of this problem and describes certain instruments which the author devised, and which go far to solve the question at stake, although certain modifications of the Society's demand became necessary, there being a great difference when the term "at a considerable elevation" is applied to a spot which is comparatively easy of access at any time, or when, for instance, it denotes a captive balloon. The author, however, describes instruments which would answer very well in both cases.—Continuation of researches on rod magnetism, by A. L. Holz (see vol. 151, p. 69 of these *Annals*).—On the measuring of angles by means of the eyepiece micrometer in astronomical telescopes, by Dr. Matern.—On the proportion of specific heats under constant pressures and in constant volumes, by J. J. Müller.—On some observations of the spectra of gases, by Eugen Goldstein. The author has made a series of experiments which tend to show that Wüllner's idea as to the independence of the gas spectra from differences in the temperature is an erroneous one. They principally consist in interpoisng a layer of air into the induction current, which lights up the spectral tubes filled with the rarefied gases, sometimes with a simultaneous insertion of a Leyden jar, and thus forcing the current to produce a spark. Mr. Goldstein then shows that in the whole circle of the current the discharge takes place in the same rhythm, therefore that the current passes the tube filled with the rarefied gas just as momentarily as any other part of the circle; from this he concludes that also in the tube the discharge takes place in form of a spark, that therefore the gas ought to show a line spectrum. Now, as this is not the case, and the gas on the contrary shows a band spectrum, the author thinks this a contradiction of Wüllner's explanation.—The next paper in the number is by Herr Wüllner himself, and explains the subject very satisfactorily, as he proves that not one of Herr Goldstein's experiments is contradictory to his theory of the different spectra of gases; the form of the electric discharge in the tubes containing the gases is the main point in question, and Herr Wüllner proves this to be in the so-called *dilated* form, and not as a spark.—Finally, the number contains a preliminary report by Dr. V. Dvorak, on the velocity of sound travelling in water.

SOCIETIES AND ACADEMIES

London

Royal Society, April 8.—"Experiments to ascertain the Cause of Stratification in Electrical Discharges *in vacuo*." By Warren De la Rue, Hugo W. Müller, and William Spottiswoode.

Some results obtained in working with a chloride-of-silver battery of 1,080 cells in connection with vacuum-tubes, appear to be of sufficient interest to induce us to communicate them to the Society in anticipation of the more detailed account of an investigation which is now being prosecuted, and which it is intended to continue shortly with a battery of 5,000 cells, and possibly with a far greater number.

The battery used up till now consists of 1,080 cells, each being formed of a glass tube 6 inches (15·23 centims.) long and ¾ of an inch (1·9 centim.) internal diameter; these are closed with a vulcanised rubber stopper (cork), perforated excentrically to permit the insertion of a zinc rod, carefully amalgamated, $\frac{3}{16}$ (0·48 centim.) of an inch in diameter and 4·5 inches (11·43 centims.) long. The other element consists of a flattened silver wire passing by the side of the cork to the bottom of the tube, and covered, at the upper part above the chloride of silver and until it passes the stopper, with thin sheet of gutta-percha for insulation, and to protect it from the action of the sulphur in the vul-

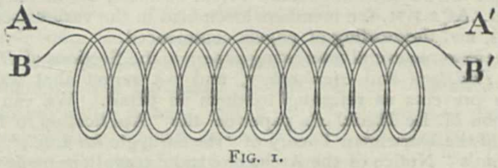

Fig. 1.

canised corks; these wires are $\frac{1}{16}$ of an inch (0·16 centim.) broad, and 8 inches (20·32 centims.) long. In the bottom of the tube is placed 225·25 grains (14·59 grms.) chloride of silver in powder; this constitutes the electrolyte; above the chloride of silver is poured a solution of common salt containing 25 grammes chloride of sodium to 1 litre (1,752 grains to 1 gallon) of water, to within about 1 inch (2·54 centims.) of the cork. The connection between adjoining cells is made by passing a short piece of indiarubber tube over the zinc rod of one cell, and drawing the silver wire of the next cell through it so as to press against the zinc. The closing of the cells by means of a cork prevents the evaporation of water, and not only avoids this serious inconvenience, but also contributes to the effectiveness of the insulation. The tubes are grouped in twenties in a sort of test-tube rack, having four short ebonite feet, and the whole placed in a cabinet 2 feet 7 inches (78·74 centims.) high, 2 feet 7 inches wide, and 2 feet 7 inches deep; the top being covered with ebonite to facilitate working with the apparatus, which is thus placed on it as an insulated table.

The electromotive force of the battery, as compared with a Daniell's (gravity) battery, was found to be as 1·03 to 1,* its

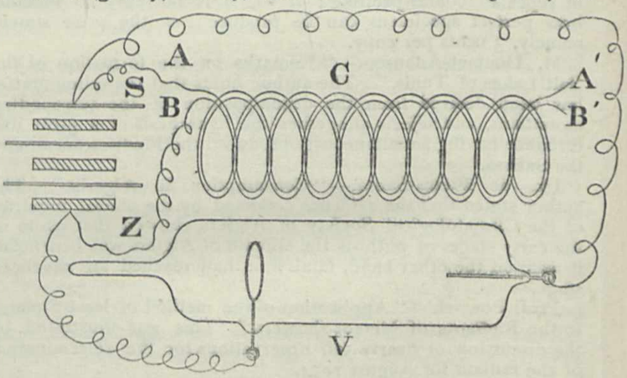

Fig. 2.

internal resistance 70 ohms per cell; and it evolved 0·214 cub. centim. (0·0131 cub. inches) mixed gas per minute when passed through a mixture of 1 volume of sulphuric acid and 8 volumes of water in a voltameter having a resistance of 11 ohms. The striking-distance of 1,080 elements between copper wire terminals, one turned to a point, the other to a flat surface, in air, is $\frac{1}{263}$ inch (·096 millim.) to $\frac{1}{250}$ inch (0·1 millim.) The greatest distance through which the battery-current would pass continuously *in vacuo* was 12 inches (30·48 centims.) between the terminals in a carbonic acid residual vacuum. This battery has been working since the early part of November 1874, with practically a constant electromotive force.

Besides 2,000 more cells like those just described, we are putting together 2,000 cells, with the chloride of silver in the

* Compared with a Daniell's battery, in which the zinc is immersed i dilute sulphuric acid in a porous cell, its electromotive force is about 3 pc cent. less than th Daniell.

form of rods, which are cast on the flattened silver wires, as in a battery described by De la Rue and Müller,* but in other respects similar to the battery above described; the glass tubes being, however, somewhat larger in diameter; the rods of chloride of silver are enclosed in tubes open at the top and bottom, and formed of vegetable parchment, the object of these vegetable parchment cases being to prevent contact between the zinc and chloride-of-silver rods. The internal resistance of batteries so constructed is only from 2 to 3 ohms per cell, according to the distance of the zinc and chloride-of-silver rods, and they evolve from 3 to 4·5 cub. centims. (0·18 to 0·27 cub. inch) per minute, in a voltameter having a resistance of 11 ohms. Their action is remarkably constant.

For the experiments detailed below, the vacuum-tubes were generally used of about 1½ to 2 inches (3·8 to 5 centims.) in diameter, and from 6 to 8 inches (15·24 to 20·32 centims.) long; also prolate spheroidal vessels 6 inches by 3 inches (15·24 by 7·62 centims.) The terminals are of various forms, and from 4 inches to 6 inches (10·16 to 15·24 centims.) apart, and made of aluminium and occasionally of magnesium and of palladium; the latter showing some curious phenomena with a hydrogen residual vacuum, which will be described in a future paper. A tube which has given the most striking results is 8 inches (20·32 centims.) long, and has a series of six aluminium rings varying in diameter from ⅜ of an inch to about 1¼ of an inch (0·95 to 3·17 centims.), the thickness of the wire being about 1/16 (0·16 centim.) of an inch; the rings are a little more than 1 inch (2·54 centims.) apart; and connecting wires of platinum pass through the tube from each ring and permit of the length and other conditions of the discharge being varied.

At times the terminals of the battery were placed in connection with accumulators of different kinds—for instance, two spheres of 18 inches (45·72 centims.) in diameter, presenting each a superficies of 7·07 square feet (65·68 square decims.), and cylinders of paper covered with tinfoil, each having a surface of 16 square feet (148·64 square decims.); the globe and cylinders were in all cases carefully insulated. Other accumulators were composed of coils of two copper wires 1/16 of an inch (0·16 centim.) in diameter, covered with gutta percha, in two folds, 1/32 of an inch (0·08 centim.) thick. One coil contains two wires, A A′ and B B′, coiled side by side, each being 174 yards (159 metres) long, another with two wires each 350 yards (320 metres) long; of the latter we have two coils.

In addition to these accumulators we have several others formed of alternate plates of tinfoil and insulating material, such as paper saturated with paraffin, and also sheets of vulcanite. These are of various capacities and contain from 5 to several hundred square feet. The largest has a capacity of 47·5 microfarads; when it is discharged it gives a very bright short spark, accompanied by a loud snap; the charge deflagrates 8 inches (20·32 centims.) of platinum wire, ·005 inch (0·127 millim.) in diameter, when it is caused to pass through it. Each accumulator gives different results, but for the present we shall confine ourselves to a description of the experiments made with the coil accumulators.

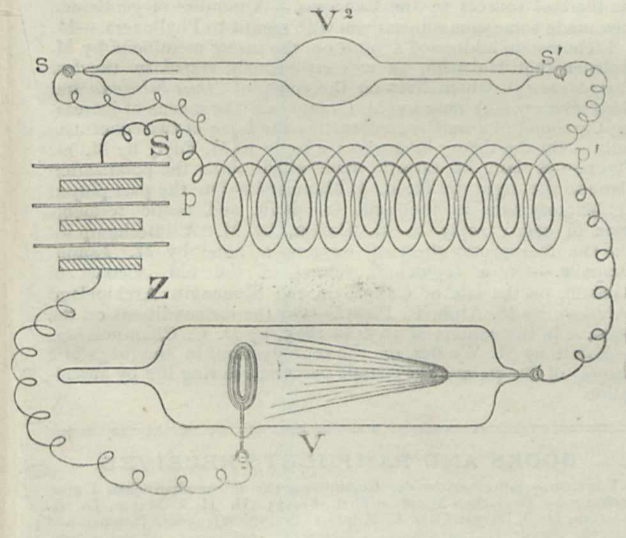

FIG. 3.

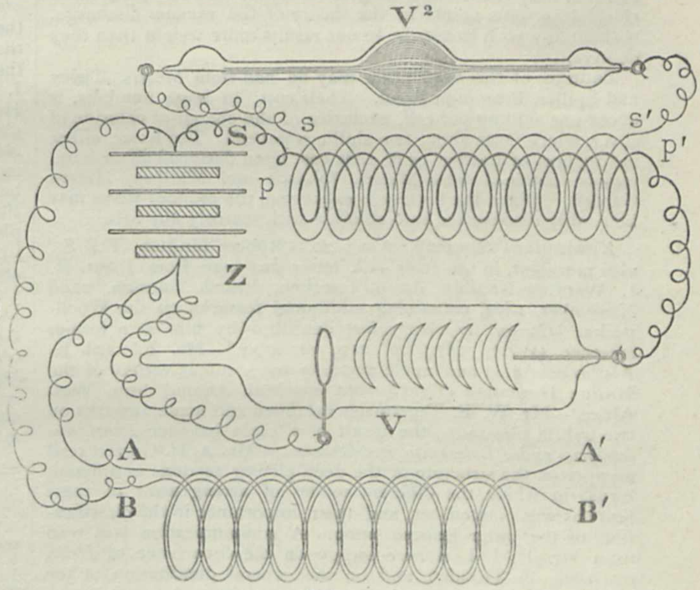

FIG. 4.

When the terminals of the battery are connected with the wires of a vacuum-tube which permits of the passage of the current, the wires (especially that connected with the zinc end) become surrounded with a soft nebulous light, in which several concentric layers of different degrees of brilliancy are seen In most cases there is either no indication of stratification or only a feeble ill-defined tendency to stratification; the tubes selected for these experiments were those in which the stratification did not appear at all.

When the battery, already in connection with the vacuum-tube, was also joined, as in Fig. 2, on to one or more coil-condensers (coupled to introduce a greater length of wire) in the following manner, then immediately well-defined stratifications appeared in the vacuum-tube.

S Z represents the battery, V the vacuum-tube, C the coil-condenser; one terminal is connected with the end A of the wire A A′, and the other terminal with the end B of the second wire B B′; connections are also led to the wires of the vacuum-tube. The ends A′ and B′ are left free; and it is clear that the coil forms a sort of Leyden jar when thus used; an interval, however short it may be, must elapse in accumulating a charge which at intervals discharges itself and causes a *greater flow* in the vacuum-tube in addition to that which passes continuously. It may be stated that the capacity of the accumulator has to be carefully adjusted to prevent any cessation of the current, to avoid, in fact, a snapping discharge at distant intervals. The periodic overflows, so to speak, which increase the current from time to time, would seem to have a tendency to cause an interference of the current waves, and to produce nodes of greater resistance in the medium, as evinced by the stratification which becomes apparent. To the eye no pulsation in the current is apparent; and in order to convince ourselves whether or not there was really any fluctuation in the current when the apparatus was thus coupled up with the battery, we made several experiments, and ultimately hit upon the following arrangement:—

The primary wire p p′ of a small induction-coil, both with and without the iron core, was introduced into the circuit as well as the vacuum-tube V; to the secondary wire, s s′, of the induction-coil was connected a second vacuum-tube, V². Under these circumstances there was no change in the appearance of

* Journal of the Chem. Soc., Second Series, vol. vi. p. 488; Comptes Rendus, 1868, p. 794.

the discharge in V, in consequence of the introduction of the induction-coil, the terminals being still surrounded by the soft nebulous light before spoken of; no luminosity appeared in the second vacuum-tube, V^2, in connection with the secondary wire of the induction-coil, except on making and breaking the connection with the battery. At other times there was evidently no fluctuation in the continuous discharge, no periodic increase or diminution of flow, and consequently no induced current in the secondary wire, s s', of the induction-coil.

In the second experiment wires were also led from the terminals of the battery (all other things remaining as before) to the coil accumulator, as in Fig. 4; then immediately the discharge in V became stratified, and the secondary vacuum-tube, V^2, lighted up; clearly showing that under these circumstances a fluctuation in the discharge really occurs on the appearance of stratification.

The brilliancy of the discharge in V^2 (the induced current passes through complicated vacuum-tubes through which the primary current cannot pass) depends greatly on the quality and quantity of the discharge in the primary vacuum-tube, V. Under some circumstances the secondary discharge is extremely feeble, and the illumination in V^2 barely visible; under others it is very brilliant.

Preparations are being made to render evident induced currents in the secondary wire of the coil too feeble to produce any illumination. Pending the further development of our investigation, we have ventured to give an account of our progress in elucidating some points in the theory of the vacuum discharge, without any wish to ascribe to our results more weight than they deserve.

Batteries of this description may be had from Messrs. Tisley and Spiller, Brompton Road. Their cost, in large numbers, is about one shilling per cell, exclusive of the charge of chloride of silver, which costs about two shillings per cell. The latter, either in the form of powder or of rods cast upon flattened silver wire, may be obtained from Messrs. Johnson and Matthey, Hatton Garden. When the battery is exhausted, the reduced silver may be readily reconverted into chloride with scarcely any loss.

Zoological Society, April 20.—Robert Hudson, F.R.S., vice-president, in the chair.—A letter was read from Lieut. R. J. Wardlaw-Ramsay, dated Tonghoo, British Burmah, 22nd November, 1874, containing additional remarks on the Woodpecker (*Gecinus erythropygius*) described by him at a former meeting (P.Z.S. 1874, p. 212, pl. xxxv.)—Mr. Edward R. Alston exhibited and made remarks on a rufous variety of the Murine Dormouse (*Graphiurus murinus*, Desm.) from West Africa.—Mr. W. B. Tegetmeier exhibited and made remarks on two hybrid pheasants, the result of a cross between *Phasianus colchicus* and *Euplocamus nycthemerus*.—Mr. A. H. Garrod read a paper on the structure of the deep plantar tendons in different birds, in which the different modes of arrangement of these tendons was pointed out, and their importance in the classification of the order insisted upon.—A communication was read from Mr. R. J. Lechmere-Guppy on the occurrence of *Helix coactiliata* in Trinidad, and on the general distribution of the land and freshwater mollusca of that island. A second communication from Mr. Guppy contained a note on a variety of *Bulimus constrictus* found in Venezuelan Guiana.—A communication was read from the Rev. O. P. Cambridge, in which he gave descriptions of nine new species of spiders of the genus *Erigone* additional to those described in a former communication on the same subject.—A communication was read from Mr. George Gulliver, containing a description of the spermatozoa of the Lamprey, *Petromyzon marænus*.—Mr. R. B. Sharpe exhibited and made remarks on some specimens of some rare species of birds of prey lately received by the British Museum from Australia.

Entomological Society, April 5.—Sir Sidney Smith Saunders, C.M.G., president, in the chair.—Mr. Jenner Weir exhibited a number of young *Mantidæ* that had emerged from an egg-case received from Ceylon.—Mr. Bond exhibited a specimen of an exotic locust taken alive at the bottom of a well near Brighton. Mr. Sealy read some notes on the habits of the species of *Ornithoptera* from the Malabar coast, exhibited at the last meeting.—Mr. McLachlan read a letter from an Englishman residing in Pueblo, Colorado, U.S., stating that from his experience of the potato beetle the insect could live on the tubers as well as on the haulm, and that unless the English authorities took some steps to prevent the importation of potato bulbs, he believed the beetles would soon be in this country.—Mr. Edward Saunders communicated the first part of a Synopsis of British Hemiptera (Heteroptera).

PARIS

Academy of Sciences, April 19.—M. Frémy in the chair.—The Secretary read a telegram from M. Janssen, dated Singapore, 16th April: "Eclipse observed; weather not absolutely fine. The results, specially those concerning the atmosphere of the corona, confirm those of 1871."—M. Ch. Sainte-Claire Deville then replied to the remarks made by M. Faye, at the last meeting, on M. Hildebrandsson's paper.—On the waterspout of Les Hayes (Vendômois) of Oct. 3, 1871, and the ravages produced by the same, by M. Faye.—On a great dust-fall observed in a part of Sweden and Norway, in the night of March 29-30, 1875, by M. Daubrée.—On the observations made at the island of St. Paul by the Transit of Venus party, by M. Ch. Vélain.—A (second) note by M. J. M. Gaugain on a theory of the processes of magnetisation.—A note by M. Donato Tommasi, on a new source of magnetism.—A note by M. de Boisbaudran, on the unequal solubility of the different planes of the same crystal.—On Japanese bronzes, a note by M. E. J. Maumené.—A note by M. Pagnoul, on the influence exercised by alkaline salts upon the vegetation of beetroot and potatoes.—On the equivalence of alkalies in beet-root, a note by MM. P. Champion and H. Pellet.—On the discovery of two new types of Conifera in the Permian schists of Lodève (Herault), by M. G. de Saporta; the names proposed for the new Conifera are *Ginkgophyllum grasseti* and *Trichopitys heteromorpha*.—M. J. Francois then addressed a communication to the Academy on the hydrothermal and saline emanations from the thermal sources in the Caucasus.—A number of gentlemen then made some communications with regard to Phylloxera.—M. J. Lichtenstein addressed a note on the insect mentioned by M. Holzner (not Helznem, as was erroneously stated in the last *Compte rendu*), which lives on the roots of *Abies balsamea* and *Abies Fraseri*.—A note by M. Granjon on the means of increasing the sound of a bell by constructing the same of two concentric bells.—On the theory of storms; a reply to M. Faye, by M. H. Peslin.—A note on tartaric acid, which turns the polarisation plane to the right, by M. E. J. Maumené.—On the part played by Microzymata in the acid, alcoholic and acetic fermentation of eggs; reply to M. Gayon, by M. A. Béchamp.—On the therapeutic effect of oxygen, a note by M. Tamin-Despalle.—On a sepulchral retreat of the old Aleouts of Aknañh, on the Isle of Ounga, in the Shumagin Archipelago (Alaska), by M. Alph. L. Pinart.—On the ice conditions on the Danube in the winters of 1836 to 1875, by M. C. Champoiseau.—A note by M. Woillez, on the reproduction, in the lungs of a corpse, of the pulmonary sounds perceived during life by auscultation.

BOOKS AND PAMPHLETS RECEIVED

FOREIGN.—Jahresbericht der Commission zur wissenschaftlichen Untersuchung der Deutschen Miere in Kiel, 1872–73: Dr H. A. Meyer, Dr. G. Karsten, Dr. V. Hensen, Dr. G. Kupffler (Berlin: Wiegandt, Hempel, und Parey). Revue Bibliographique Universelle. 2nd series, 1st vol. (Paris, Bureaux du Polybiblion)—Discorso letto in occasione della festa Centenaria di Ambrogio Fusinieri, by Enrico dall Pozzo di Mombello (Foligno, P. Sgariglia).—Verhandlungen der Naturforschenden Gesellschaft zu Freiburg, I.B. (Carl Trœmer).

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