THURSDAY, SEPTEMBER 16, 1880

THE TOOTHED BIRDS OF KANSAS

Odontornithes: a Monograph of the Extinct Toothed Birds of North America. By Prof. O. C. Marsh, Yale College. Vol. I. of Memoirs of the Peabody Museum of Yale College, New Haven, Conn., and Vol. VII. of the Geological Exploration of the 40th Parallel.

WEST from the valley of the Mississippi the stratified formations which underlie the prairie region spread over thousands of square miles nearly as horizontal as when they were deposited. Here and there they have been ridged up into anticlines, now deeply trenched by denuding agents, or have had wedges of the ancient Archæan rocks thrust through them, along the flanks of which their upturned beds can be examined in detail. Hence in spite of their prevalent flatness opportunities are afforded for tracing their stratigraphical succession from top to bottom. They reach a maximum of thickness of some seven or eight miles. Yet throughout this vast depth of strata the unconformabilities seem to be nearly all of local and unimportant character. The several geological systems follow each other continuously, and generally in such a sequence of insensible gradation as to show that geological history in that part of the globe was marked by comparatively few great and destructive geographical revolutions. The record of this history remains in an almost unbroken series of strata from the Primordial zones up into the older Tertiary formations.

Here surely if anywhere in the world there should be a tolerably ample chronicle of the sequence of living creatures, so far at least as regards marine forms. If the intermediate types, so much desired by the evolutionist, are ever to be found imbedded in the rocks of the earth's crust, surely here we may expect to find them. An area of continuous tranquil deposit, and of slow subsidence, unaffected for almost the whole of geological time by serious upheaval, metamorphism, or unconformability, containing within itself a well-nigh unbroken record of geological changes—a very promised land for the palæontologist! Hardly more than a dozen years have passed since this great region began to be systematically searched for organic remains. Yet during that brief period what treasures have come from its teeming strata! New orders of Vertebrates, some of them of extraordinary types, have thence been added to the long roll of organic forms. Other orders, scantily developed in Europe, and previously but little known, have been ascertained to have teemed in these far western plains. Whether we regard the prodigious number of individual specimens, and the great variety of genera and species, or the marvellously perfect state of preservation in which the remains occur, there is no other known area where facilities for palæontological research of the most minute and thorough kind exist so abundantly.

Thanks to the labours, first of the universally-honoured Joseph Leidy, and then of his younger successors, Marsh and Cope, the firstfruits of that rich palæontological harvest have already been gathered In the Yale College Museum alone about 1,000 new species of extinct Vertebrates have been received from the West during the past twelve years, at least one-half of which remain to be investigated. Mr. Cope's museum at Philadelphia is likewise crowded with new forms. If such results have been achieved merely by expeditions equipped for at most but a few months of such labour as is possible at present in these wilds, what may not be looked for when some of the habitable portions of the fossiliferous regions come to be searched, when quarries, railway cuttings, and other artificial openings add to the opportunities of exploring the rocks, and when systematic fossil-hunting can be carried on from a near centre of supplies, instead of from a base several thousand miles away in the Eastern States!

Among the organic wonders of which from time to time during the past decade announcements have appeared, none have been received with more interest than the discovery of birds with teeth, made by Prof. Marsh near the end of the year 1870, in the middle Cretaceous rocks, which in Kansas and Colorado spread out eastward from the base of the Rocky Mountains. The more striking features of this remarkable transitional ornithic type were described by Mr. Marsh as far back as 1872, and are now tolerably familiar to naturalists from his writings, and to geologists from the descriptions and restorations which have appeared in scientific journals and text-books. But its detailed structure has only now been made known in the splendid monograph on Odontornithes which has just appeared. This work is intended to form volume vii. of the Geological Exploration of the 40th Parallel, carried out by Mr. Clarence King for the Engineer Department, and also to stand as the first of a series of memoirs of the Peabody Museum of Yale College. As a fitting termination to the noble Survey series of quartos, and as a splendid forerunner for what we hope will prove a long and illustrious series of memoirs from Yale, the volume is doubly welcome. The splendour of paper, printing, drawing, and engraving (and in the advanced copy with which we have been favoured, the sumptuousness of binding) that have been lavished on the work bespeak preliminary acknowledgment.

So perfect a matrix do the peculiar buff, chalky, or marly beds of the Kansas middle Cretaceous formations furnish for the preservation of organic remains, that almost every bone of the skeletons of some of the birds has been recovered. The materials for the study of their osteology is thus almost as ample as that for any living bird. Full advantage of this abundant store of material has been taken. The cases and cellars in the Peabody Museum at New Haven contain the remains of about fifty different individuals of a single bird. Every bone of its skeleton, with the exception of one or two terminal toe-bones and the extreme point of the tail, has been recovered, and is here carefully drawn of the natural size. Never before has it been possible, we believe, to reconstruct so perfectly so ancient an organism.

The volume is divided into two parts. In the first of these the detailed structure is given of the bird on which the author has bestowed the name of *Hesperornis.* The skeleton of this animal if extended to its full length would measure about six feet from the point of the bill to the end of the tail. It must have been a typical aquatic bird, without any power of flight, but with strongly developed limbs and a long flexible neck, whereby it was doubtless endowed with remarkable powers of diving and swimming, and of seizing the abundant fishes of the shallow seas in which it lived. Compared with our modern birds, the two features of this ancient form which most forcibly arrest attention are the teeth and the legs. The teeth were covered with smooth enamel, terminating upward in conical pointed crowns and downward in stout fangs, closely resembling those of mosasauroid reptiles. Their mode of growth and replacement have been determined to have taken place in a manner very similar to that in some reptiles, the young tooth forming on the inner side of the fang of the tooth in use, and increasing in size, while a pit for its reception was gradually made by absorption. The old tooth, being progressively undermined, was finally expelled by its successor, the number of teeth thus remaining unchanged. The teeth were implanted in a common alveolar groove, as in *Ichthyosaurus*. In the upper jaw they were confined to the maxillary and entirely absent from the pre-maxillary bone; in the lower jaw they extended from near the anterior extremity of the ramus along the entire upper border of the dentary bone. Mr. Marsh believes that they were held in position by cartilage which permitted some fore and aft movement, but on the decay of which after death the teeth readily became displaced and fell out of the jaw. This is an important fact in its bearing upon the nature of the teeth found on the same slab of Solenhofen limestone with the well-known *Archæopteryx*. These teeth, it will be remembered, were referred by Mr. Evans to the bird itself—a reference fully confirmed by Mr. Marsh, who says that he at once identified the teeth as those of birds and not of fishes, and by the subsequent discovery of other remains of the bird. In *Hesperornis regalis* there appear to have been fourteen functional teeth in the maxillary bone and thirty-three teeth in the corresponding ramus of the lower jaw. The wings are rudimentary or aborted, a remnant of the humerus alone existing. They may have gradually diminished from disuse until, as the power of flight ceased, the legs and feet increased in proportion, and assumed the massive dimensions shown in the specimens, or, as Mr. Marsh suggests, the bird may have been a carnivorous aquatic ostrich, never having possessed the power of flight, but descended from a reptilian ancestry which is strongly recalled by different portions of the skeleton. Among recent birds, the peculiar legs and feet of *Hesperornis* find their nearest analogues in the Grebes of the genus *Podiceps*. They were admirably adapted for propulsion in water, but scarcely served for walking on land. Locomotion must have been entirely performed by the posterior limbs—a peculiarity which distinguishes *Hesperornis* from all other birds recent or fossil. The tail appears to have been composed of twelve vertebræ, unique in their peculiar widely extended transverse processes and depressed horizontal ploughshare bone. Broad and flat, somewhat like that of the beaver, it must have been a powerful instrument in steering the bird through the water.

The second part is devoted to a description of the remains which have been found of birds belonging to a second order of Odontornithes, termed *Odontotormæ*. Unlike *Hesperornis*, they seem to have been all of comparatively small size and to have possessed powerful wings, but very small legs and feet. From that contemporaneous form, and from all other known birds recent and fossil, they are distinguished by certain types of structure which point back to a very lowly ancestry, lower even than the reptile. Their bones, being mostly air-filled, would enable the carcases to float on water until, by decay or the rapacity of other animals, they were separated and dispersed. Hence skeletons of these flying birds are less entire than those of the massive-boned *Hesperornis*. Nevertheless the remains of no fewer than seventy-seven different individuals have been disinterred. These are included in two well-marked genera, *Ichthyornis* and *Apatornis*, and were all small birds, reminding us by their strong wings and delicate legs and feet of the Terns, like which they were probably also aquatic in habit. Besides the reptilian skull and teeth, the birds of this second order were marked by the character of their vertebræ, which in their biconcave structure recall those of fishes. This is the more remarkable, as in *Hesperornis* the vertebræ are like those of modern birds. Yet these two utterly dissimilar types were contemporaries, and their remains have been preserved in the same strata. Mr. Marsh points out that the transition between the two vertebral types may be traced even in the skeleton of *Ichthyornis* itself, where the third cervical vertebra presents a modification in which the ordinary avian saddle-shaped form appears as it were in the act of development from the biconcave ichthyic form.

In a concluding chapter the author briefly touches upon some of the broader biological questions suggested by the structure of the animals described in the volume. The striking differences between the three orders into which Prof. Marsh divides toothed birds—*Archæopteryx*, *Hesperornis*, and *Ichthyornis*—serve to indicate the high antiquity of the class, and to encourage the search for ornithic remains in the earlier Secondary, if not in the later Palæozoic, rocks. The peculiar character of each of the orders Prof. Marsh believes to have been united in some earlier type, of which no trace has yet been found. This ancestral type may have been almost as much a reptile as a bird. The earliest birds were doubtless closely related to the Dinosaurs and Pterodactyles.

Of the plates, thirty-four in number, which accompany and adorn the monograph it is impossible to speak in terms of too great praise. They are strictly and rigidly scientific diagrams, wherein every bone and part of a bone is made to stand out so clearly that it would not be difficult to mould a good model of the skeleton from the plates alone. And yet with this faithfulness to the chief aim of the illustrations there is combined an artistic finish which has made each plate a kind of finished picture. We heartily congratulate the genial Professor of Palæontology at Yale on the advent of this truly imperial volume. May it be the earnest of many more from the rich store of materials which he has so courageously and enthusiastically gathered among the wilds of the far West!

THE THEORY OF DETERMINANTS

A Treatise on the Theory of Determinants and their Applications in Analysis and Geometry. By Robert Forsyth Scott, M.A. (Cambridge: At the University Press.)

THE list of English text-books on the subject of Determinants is comparatively meagre, and this notwithstanding the fact that the first separate treatise of all on the subject was the work of an Englishman, now the distinguished president of the Royal Society. Dr. Spottiswoode's "Elementary Theorems Relating to Determinants" appeared in 1851 (4to, pp. viii. + 63, London, Longmans), and, as a pioneer work, was eminently successful; at the honouring request of the editor of *Crelle* it was republished, with additions, in that well-known journal three or four years later (vol. li. pp. 209–271, 328–381). After considerable intervals came Dodgson's "Elementary Treatise" (London, Macmillan, 1867) and a pamphlet by Wright; and here, until quite recently, the list ended. The chapters on the subject by Todhunter and others belong to a different category, but deserve to be mentioned, as it is doubtless in part owing to their existence that separate treatises have been so rare.

In view of the dearth referred to, he would be a very captious critic indeed who would not gladly welcome the handsome volume whose title is given at the head of this notice. In form and general outward appearance it resembles Part I. of Thomson and Tait's "Elements of Natural Philosophy," and extends to about 250 pages. The matter is arranged under fourteen chapters, the first seven being meant to deal with determinants in themselves, the last seven with the so-called applications; the line of separation, however, is not very well maintained.

In the introductory chapter we have the usual account of permutations, inversions of order, &c., and the usual definition of a determinant; but this is followed by something less familiar, viz., a page or two of exposition regarding Grassmann's "alternate units" or "polar elements," and by the establishment of the theorem that a determinant is expressible as a product of alternate numbers linear in the elements.[1] The constant use afterwards made of this theorem—if theorem we can call that which is but a symbolical expression of the ordinary definition of a determinant—is the distinguishing feature of Mr. Scott's mode of treating the subject. There may be room for doubt whether the study of determinants is thus, as he says, much simplified—the example of § 20, p. 15, is not a happy introductory instance of such simplification—and it may certainly be questioned whether beginners should have the subject at first presented to them in this way; but undeniably a freshness is thereby imparted to the book, which will make it pleasant reading to those who already know something of the matters in hand. Chapters II. to V., on "General Properties of Determinants," "The Minors and the Expansion of a Determinant," "Multiplication of Determinants," and "Determinants of Compound Systems," contain proofs and illustrations of *most* of the well-known general theorems. One might, however, fairly expect so large a work as the present to be more complete in this respect; the omissions for example, of Sylvester's beautiful theorem expressing the product of two determinants as a sum of like products is not easily excusable. Chapter VI., on "Determinants of Special Forms," is good, and the same may be said of the next, which treats of "Determinants with Multiple Suffixes." Belonging to the first part, although included under "Applications," are Chapters IX. and XII. The one concerns what are called "Rational Functional Determinants," but which might be more fitly designated as "Alternants"—to use one of Sylvester's happiest coinages; the other concerns "Determinants of Functions of the same Variable," a title again which is anything but sufficiently discriminative. Both chapters are fresh and interesting. To the borderland between the two parts may be assigned Chapter X., on "Jacobians and Hessians;" then there are chapters (VIII., XI., XIII.) dealing with the applications to three departments of Analysis, viz., Theory of Equations, Theory of Quadrics, and Continued Fractions; and, lastly, there is a very readable chapter (XIV.) on "The Applications to Geometry."

No exercises for the student are given under the individual chapters, but a considerable collection is placed towards the end.

Following this is a "List of Memoirs and Works Relating to Determinants," the arrangement being alphabetical according to authors' names. Mr. Scott acknowledges the incompleteness of the list; but, all the same, one cannot help expressing regret that such an excellent opportunity of publishing an exhaustive, or tolerably exhaustive, bibliography of determinants was lost. Had the list been a judicious *selection*, there would have been less cause for regret, but not rarely the worthless are taken and the good left out. Cauchy, who in a sense laid the foundations of the whole subject, is not once mentioned; Grassmann, who laid the foundation of Mr. Scott's method, is not included; Nägelsbach's name occurs, but his most important paper is omitted: and many more such instances might be cited.

Mr. Scott has given us a very acceptable addition to our mathematical text-books: a little more of the conscientious labour he has shown would have produced a work still more worthy of the press which has issued it.

[1] *E.g.* $\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & k \end{vmatrix} = (a\epsilon_1 + b\epsilon_2 + c\epsilon_3)(d\epsilon_1 + e\epsilon_2 + f\epsilon_3)(g\epsilon_1 + h\epsilon_2 + k\epsilon_3)$, where $\epsilon_1\epsilon_2\epsilon_3 = 1$, and $\epsilon_1, \epsilon_2, \epsilon_3$ are symbols subject to the laws of ordinary algebra, except that $\epsilon_r\epsilon_s = -\epsilon_s\epsilon_r$, and therefore $\epsilon_r^2 = 0$.

LETTERS TO THE EDITOR

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

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

The Stone in the Nest of the Swallow

THE name of swallow's stone was preserved in France even to our days, for Dr. Patrin, a member of the French Institute and of the Academy of Sciences in St. Petersburg, wrote in the "Dictionary of Natural History," Paris, Deterville, 1803 (V° Agate), as follows:—

"On trouve dans les ruisseaux des environs de Sassenage en Dauphiné de très petites Calcedoines ou Agates de forme lenticulaire qu'on a nommées *pierres de Chélidoine*, parce qu'elles ont quelque ressemblance avec les semences de cette plante, *pierres d'hirondelle* parcequ'on en a trouvé dans l'éstomac de ces oiseaux."

Of course this naturalist did not try to throw light on the legend, or to explain the confusion made by some authors between the respective skill of the eagles in geology, and of the swallows in botany, which Phile, in his "Remedies Against Sortileges," clearly sets out in the following verses:

φθορᾶς δὲ τηρεῖ τὰς γονὰς ὑπερτέρας
εἰς τὴν καλίαν ἀετὸς κρύψας λίθον
ὡς ἡ χελιδὼν τοῦ σελίνου τὴν κόμην
'Εξάψασα δὲ τοῦ τραχήλου τὸν λίθον
κυοῦσα γυνὴ κερδαινεῖ ζῶν τὄβρεφος.

"A stone which the eagle conceals in her nest (aery) preserves her lofty breed from destruction, just as the top of a parsley sprig does for the swallows. This stone worn by a woman round her neck during pregnancy will procure her a living child."

This use of parsley is mentioned by Ælianus *de Natura Animal.* lib. i. chap. 37, as follows:—

Αἱ σίλφαι καὶ τουτῶν τὰ ὠὰ ἀδικοῦσιν οὐκοῦν αἱ μητέρες σελίνου κόμην προβάλλονται τῶν βρεφῶν καὶ ἐκείναις τὸ ἐντεῦθεν ἄβατά ἐστιν.

"As the beetles injure their eggs the mothers throw tops of parsley sprigs in front of their young, which become inaccessible to the beetles."

But this parsley must not be confounded with the miraculous herb giving sight to the young swallows. (Ælianus, lib. iii. chap. 25).

Βραδέως δὲ ἐκβλέπει καὶ τὰ ταύτης βρέφη ὡς καὶ τὰ τῶν κυνῶν σκυλάκια· πόαν δὲ κομίζει καὶ προσάγει τὰ δὲ ὑπαναβλέπει εἶτα ἀτρεμήσαντα ὀλιγὸν ἐκπετήσιμα ὄντα πρόεισι τῆς καλίας ἐπὶ τὴν νομὴν. ταύτης τῆς πόας ἄνθρωποι γενέσθαι ἐγκρατεῖς διψῶσι· καὶ οὐδέπω νῦν τῆς σπουδῆς κατέτυχον.

"Like whelps, the young swallows are late endowed with sight, but on the application of a certain herb by their mother they begin to see; and after some rest leave the nest to seek their food. Men, though longing for this herb, could never get it."

Dionysius gives in his "Ornithology" some information about this eagle's stone (lib. i. ch. 3).

Ἣν δὲ ἀποτεκεῖν δέῃ κομίσαντές τινα λίθον ταῖς κοίλαις ἐντιθέασι καλιαῖς ἵνα ἐν καιρῷ τίκτωσι, καὶ μὴ τὸ τικτόμενον πρὸ τῆς ὥρας ἀτέλεστον ὠθοῖτο ὑπ' ἰσχύος· οὐ μὴν ἐστὶ τί σαφὲς περὶ τοῦ λίθου τούτου γινώσκειν, ἀλλ' οἱ μὲν αὐτὸν ἀπὸ τῶν Καυκασίων ὀρῶν οἱ δὲ ἀπὸ τῆς τοῦ ὠκεανοῦ ὄχθης φασὶ κομίζεσθαι λευκὸν ὑπερφυῶς ὄντα καὶ μεστὸν ἔνδοθεν πνεύματος ὡς καὶ ἦχον ἀποτελεῖν εἰ κινοῖτο. τικτούσῃ δ' εἰ τις αὐτὸν γυναικὶ περιάψειε, ὀλισθαίνειν διακωλύσει τὸ βρέφος. κἂν ἐνλέβητι παφλάζοντος ὕδατος ἐπιψαύσῃ τὴν τοῦ πυρὸς νικήσει πάντω ἰσχύν.

"They bring this stone in their nests to avoid a premature and forcible delivery. Nothing positive is known about this stone, which some suppose brought from the Caucasus, and others from the sea-shore. It is exceedingly white, full of air, so as to resound when moved. It prevents miscarriage in those who wear it. And if it does but touch the surface of a caldron of boiling water, it overpowers entirely the might of fire."

The confusion made by some writers between swallows and eagles is evident by the fact of their faulty quotation from Pliny.

For Pliny, chap. iv. lib. x. says—

"Tribus primis et quinto aquilarum generi inædificatur nido lapis *ætites* quem aliqui dixere gangitem ad multa remedia utilis nihil igne deperdens. Est autem lapis iste prægnans intus, cum quatias alio velut in utero sonante. Sed vis illa medica non nisi nido direptis."

And in chap. xxxix. vol. 36, he gives further particulars on these very stones, which he divides into males and females, and into four kinds, according to their origin.

Whilst in lib. viii. chap. 41, he says—

"Chelidoniam visui saluberrimam hirundines monstravere vexatis pullorum oculis illa medentes," and lib. xxv. ch. 50, "Animalia quoque invenere herbas, in primis que chelidoniam. Hac enim hirundines oculis pullorum in nido restituunt visum ut quidam volunt [see Aristotle *de Animal. Gen.* l. iv. ch. 6] etiam erutis oculis"; clearly tracing the distinction followed by Phile between the respective proficiency of eagles in geology and swallows in botany.

Jersey CHATEL

A Peat Bed in the Drift of Oldham

WE have here lately discovered a bed of peat intercalated with beds of undisturbed "glacial drift." I believe this phenomenon, if not unique, is very rare in England, and may, therefore, be interesting to your readers. In the depth of a section of 14 feet there are two thick beds of drift with washings of fine clay, and, midway in the section, a well defined bed of peat with a maximum thickness of 18 inches. Another bed of peat, somewhat less clearly defined, and not so true as the former, is likewise present, the two beds having beneath them a thin band of exceedingly fine clay of a bluish grey colour, which evidently is the equivalent of the "seatings" or "floor clays," which so invariably accompany our seams of coal. The beds of drift that inclose the peat are alike in some of their main features, but unlike in others. In both boulders are in great abundance. In the bed beneath the peat there are bands of fine clay, coarse sand, or grit, pebbles, and boulders; the upper, with very little variation, is uniformly made up of arenaceous clay and a great number of boulders. It is almost certain that at the close of the pleistocene period the upper deposit, that is, the one above the peat, could not have had a thickness of less than 75 feet. These deposits are the "upper drift" of the geologist. The beds beneath the peat, judging from their composition—boulders, pebbles, gravel, and fine sand—and the presence in the latter of "current bedding," probably represent the "middle drift." The "lower drift" beds are absent here. May I add that some of the mosses, which seem to make up the bulk of the peat, are in an excellent state of preservation, and are now under examination for identification. A considerable number of fragments of beetles, of undetermined species, are likewise amongst the finds. JAS. NIELD

29, Radclyffe Street, Oldham, September 13

On the Asiatic Alliances of the Fauna of the Congenian Deposits of South-Eastern Europe

HERR THEODOR FUCHS of Vienna has pointed out some important mistakes in the abstracts of his memoir in NATURE, vol. xxi. p. 528. In view of remedying these regrettable errors some revised extracts are here given. At p. 528, line 32, the passage should read thus:—"The genus *Neritina* at present shows a predilection for islands. Thus from Tahiti alone Reeve gives 8 species, and 11 from the Sandwich Islands; from the Philippines there are 39, and 40 from New Caledonia alone, according to Gassies. Further, according to Kobelt there are 11 in the Mediterranean; and, according to Reeve, 7 in the West Indies, and 10 in Central America. The great continental areas are strangely poor in *Neritinæ*. In North America the genus seems to be wanting, since the two or three known species are found only in the borderlands on the south. The genus *Melanopsis* has a very peculiar distribution. Twenty species, nearly all strongly ornamented, belong to the Mediterranean. This genus is wanting in Africa, East India, the Malay Islands, Australia, and the whole of America; but it occurs quite locally, with 19 species, in New Caledonia; and 2 species are found in New Zealand."

Again, at line 60, read:—"A very peculiar characteristic, hitherto overlooked, in the inland-water faunas of the later tertiaries in South Europe, is the absence of the African element (such as the Achatina, Etheria, Ampullaria, Iridina, Galatea, &c.); and this is the more remarkable because the mammalian fauna of the period, on the contrary, has a strongly-pronounced African character. The same may be said of the flora and for the whole tertiary period, since the tertiary flora of Europe had, in succession, an Australian, Indian, Japanese, and Mediterranean character, but never an African character. The tertiary land and freshwater shells of Europe show analogies to New Caledonia, India, China, and Japan, but not to Africa; although the last not only lies so very much nearer to our continent, but in its mammalian fauna, until the Diluvial period, kept so close a connection with Southern Europe." T. R. J.

Prosopistoma punctifrons

MY colleagues, Messrs. Joly and Vayssière, in announcing with justifiable pride (in the *Comptes Rendus* of the French Academy and elsewhere) the discovery of the perfect insect of *Prosopistoma*, attribute to me the former possession of an opinion that the insect might be an Ephemerid suited for a continuous aquatic life. I am not sensible of having published such an opinion, nor of having held it. In remarks on *Oniscigaster*, in the *Journal* of the Linnean Society of London, vol. xii. (Zoology) p. 145, footnote (1873), I ask, "Can there be apterous *Ephemeridæ?*" and "Can the imago of *Prosopistoma* be in that condition?" It did not occur to me that these words could be so translated as to bear the interpretation put upon them by Messrs. Joly and Vayssière. In congratulating my colleagues upon their discovery, I remark that I make this explanation solely because certain of my correspondents ask *where* I have published the opinion attributed to me. R. McLACHLAN

Lewisham, September 9

Mosquitoes

IN NATURE, vol. xxii. p. 338, an inquiry is made as to the best means of preventing the attacks of mosquitoes. I am informed that the smell of American pennyroyal (*Hedeoma pulegioides*), when sufficiently strong, drives them away at once. A few drops of the essential oil extracted from this plant added to an ointment and rubbed upon the skin will secure relief from these pests; likewise a sleeping apartment may be freed from them by strewing about a quantity of the leaves of the plant; or by allowing a quantity of the essential oil to evaporate in it. European pennyroyal (*Mentha pulegium*) is said to be very similar, and might possibly have the same effect.

Lyons, New York, August 30 M. A. VEEDER

Hardening of Steel

IN NATURE, vol. xxii. p. 220, Mr. H. T. Johnston-Lavis supposes the absorption of hydrogen to be necessary for steel to get hard.

The following facts seem to prove that this absorption can be very well dispensed with in hardening:—

1. Small pieces of steel wire can be hardened by moving them swiftly through the air when red hot, or by pressing them against a piece of cold metal.

2. Steel can be hardened very well by cooling in quicksilver.

Both facts seem to state that only rapid cooling is wanted for steel to get hard. T. W. GILTAY

Dordrecht, September 8

THE NEW ZEALAND INSTITUTE

PROBABLY none of our colonies have done so much for the promotion of the higher interests of their people as New Zealand; in this respect, indeed, it will compare favourably with almost any other country in the world. Its university is wonderfully complete and well organised; all the faculties are well represented; science, as well as literature, has its right place in the curriculum; the best men are tempted to go out as professors from the old country; and laboratory research is fairly encouraged. Quite recently we referred to a proposed system of education, which in its comprehensiveness and completeness will hold its own with any national system of education in Europe. The New Zealand Institute, again, is probably one of the best organised, and for its purpose, among the most efficient scientific bodies to be found anywhere. It is virtually a Government institution, and was organised by a special Act in 1867. It seems to bear the same relation to its incorporated societies that a university does to its affiliated colleges; it is independent of these societies, which must comply with certain rules imposed upon them by the Institute, and yet without these societies its occupation would seem to be gone. One part of its duty is the publication of summaries of the *Proceedings* of the societies, and of such papers and records in full as the Institute may deem of permanent scientific value. The societies at present incorporated with the Institute are the Wellington Philosophical Society, the Auckland Institute, the Philosophical Institute of Canterbury, the Otago Institute, the Westland Institute, and the Hawkes Bay Philosophical Institute. It must be gratifying in the highest degree to those who have the best interests of New Zealand at heart to find a love for culture so widespread as the existence of these societies indicate. And it must be remembered that, as a condition of incorporation with the Institute, each society must come up to a certain standard of membership and contribute a considerable sum yearly to the promotion of science, art, and literature, which is the aim of the Institute.

The genuine good work which the Institute is doing, and its efficiency in promoting not only science, but through that the practical interests of the colony, is evident from the handsome volume of *Transactions* which it publishes yearly, and which are entitled to take their place among the best class of similar publications. Some idea of the work which the Institute is doing, and of the value of its *Transactions*, may be obtained from the two last volumes, for 1878 and 1879, which we have just received.

Of course the first aim of a society like this, in a fresh country like New Zealand, should be the working out of its natural history (in its widest sense) in a scientific method. This the Institute has done and is doing, and its publications, and the publications of the separate societies, are already a mine of information on all subjects connected with New Zealand. The volumes before us contain a large number of papers on zoology, botany, chemistry, and geology, all of them important contributions to these various departments of science. Prof. Hutton, whose name is well known in this country, contributes a number of valuable papers on the various divisions of the fauna of New Zealand. Prof. von Haast (another name well known to science) has other various contributions of special value, and Mr. T. W. Kirk, of the Colonial Museum, has a long list of papers both on zoology and botany, all of them of novelty and interest, and several of them on such practically important subjects as Grasses and Fodder Plants. Other able workers in these departments are Mr. D. Petrie, Mr. W. Colenso, Mr. Charles Knight, Mr. Buchanan, and Mr. Buller. From Mr. J. C. Craufurd and Mr. W. Collie we have valuable contributions relating to the geology of New Zealand. Several of the papers classed under the head of Miscellaneous are of the greatest importance and interest. Thus we have papers of immense practical value to the colony on the Forest Question in New Zealand, by Mr. A. Lecoy; on the Influence of Forests on Climate and Rainfall, by Mr. F. S. Peppercorne; and on Forest Planting and Conservation, by Mr. G. W. Wilkins. Equally important from a colonial as well as a scientific standpoint is Commander Edwin's paper on the Principle of New Zealand Weather Forecast. We have several excellent papers on the New Zealand natives of much ethnological value: "Notes on Port Nicholson and the Natives in 1839," by Major Heaphy; "On the Ignorance of the Ancient New Zealander of the Use of Projectile Weapons," by Mr. Coleman Phillips; "Contributions towards a Better Knowledge of the Maori Race," by Mr. W. Colenso; "Notes on an Ancient Manufactory of Stone Implements," by Prof. von Haast, F.R.S.; and "Notes on the Colour-Sense of the Maori," by Mr. J. W. Stack. Mr. W. Colenso contributes papers on the Moa, a subject of great scientific interest. Mr. J. H. Pope's "Notes on the Southern Stars and other Celestial Objects" is a valuable contribution to astronomy. Prof. Bickerton has several papers on subjects of wide scientific interest,—on "Partial Impact," the "Genesis of Worlds and Systems," the "Birth of Nebulæ"; while Prof. F. W. Frankland writes interestingly on "The Doctrine of Mind-Stuff." There are several good chemical papers by Mr. W. Skey. In the *Proceedings* of the several societies there are numerous shorter papers of varied interest, as on Moa Feathers, by Dr. Hector; on Musical Tones in the Notes of Australian Birds, by Mr. C. W. Adams; on a new fish, by Prof. Hutton; and many others on subjects of wide and varied interest. We have besides meteorological, earthquake, and other records, and a variety of miscellaneous matter, all of real importance.

An institution capable of producing so much valuable work year after year deserves every encouragement from the government of the country. The New Zealand Government has hitherto granted a subsidy of 500*l.* yearly to the Institute, just sufficient, we believe, to defray the expenses of printing the *Transactions*, which are freely distributed to other societies all over the world. We are therefore astounded to learn that the Government has decided to withdraw this grant, thus suddenly bringing these valuable *Transactions* to a standstill. We can scarcely credit the statement; it is difficult to believe that so enlightened a Government as that of New Zealand would so seriously cripple one of its most valuable institutions, and so discourage an activity which produces results not only of the greatest value to science, but to the practical interests of the colony. The affiliated societies themselves contribute, we believe, 1,275*l.* annually to support the work of the Institute, the whole of which is spent in keeping up valuable museums and laboratories, and an interest in science in nine centres of population in New Zealand. Without the annual volume, we fear it is impossible to get members to keep up their subscriptions, and thus the organisation of the Institute, which has stood the test of twelve years, given universal satisfaction at home and abroad, and reflected the greatest credit on the colony, is in danger of breaking up and possibly expiring altogether. This would be little less than a calamity to the colony. Not a penny of the 500*l.* is spent in salaries; the editing, drawing of illustrations, and all else is a mere labour of love. The names of von Haast, Hector, Hutton, and others, are known to men of science all over the world. Dr. Hector especially has acquired a high reputation for his activity, zeal, and the results he has obtained. It is greatly owing to him that New Zealand has done for science far more than any colony of its age. The Institute itself is a model of organisation. The grant of the annual 500*l.* was a wise step worthy of general imitation, and its sudden extinction is a cruel blow to science. We can scarcely believe that New Zealand is capable of persisting in carrying out so shabby and short-sighted a policy, a policy of which any country should be ashamed. We trust that later news will show that there has been some misunderstanding, or that the Government has thought better of it, and continued a grant that could not possibly be better spent.

ALBERT J. MYER

THE young science of meteorology has sustained another heavy loss in the death of General Myer, of the Signal Service of the United States, at Buffalo, New York, on August 24, in the fifty-second year of his age. In 1854 he entered the United States army as an assistant surgeon, was assigned to special duty in the Signal Service in 1858, and in 1860 was made chief signal officer of the army, a position he held till his death.

The distinguished services rendered by General Myer to meteorology may be considered as having been made chiefly during the last ten years. Americans claim for the late Prof. Henry, of the Smithsonian Institution, the honour of having originated, upwards of thirty years ago, the idea of using the telegraph for conveying information regarding coming changes of weather. But it was reserved to General Myer, as respects the United States, to translate the idea into the action of every-day life, in devising, developing, and extending a system of telegrams and reports for the benefit of commerce and agriculture, which as regards the completeness of its organisation, the thoroughness with which it is worked, and its effective success, stands out as a model system of weather telegraphy, Three large weather maps are prepared and issued daily, along with three daily forecasts of the weather, which the telegraph at once sends through all the towns, villages, and hamlets of the States; and no time is lost, on the expiry of each month, in preparing and widely circulating a Weather Review, accompanied with maps showing the storm-tracks, the geographical distribution of the atmospheric pressure, temperature and rainfall for the month; together with occasional weather-maps of the highest importance in their bearing on the meteorology of America, Europe, and the rest of the northern hemisphere.

The other great service rendered by General Myer to practical science is the system of international meteorology established by him, one of the important outcomes of which is the series of United States weather-maps now appearing in NATURE, showing the meteorology of the globe for each month. When the scheme was first proposed to the Meteorological Congress at Vienna, in 1873, it was difficult to regard it in any other light than as an impracticable, if not wholly visionary, proposal; but the feeling quickly changed as General Myer unfolded the details of its practical working, and explained that what he required from his brother meteorologists, in addition to their approval of the scheme, was one daily observation at a selected few of their stations, he being authorised by the American Government to say that they would undertake the expense of collecting and discussing the observations.

As our readers are aware, the scheme in General Myer's hands has been a pre-eminent success; and a body of facts is being thereby amassed, destined to furnish the key to the larger problems of meteorology, a science which, from the complex intricacies it presents, requires more than any other science a whole hemisphere at least as its basis of observation. Perhaps the most important of the practical questions which will thus fall to be dealt with are those abnormal distributions of the mass of the earth's atmosphere, short continued or more permanent, from which arise great storms or devastating tornadoes, excessive heat or cold, fine seasons or their opposites, and long-continued rains or droughts, so terrible for the famines which attend them. The explanation of these anomalies will doubtless be the immediate precursor of an intelligent and practically successful forecasting of the character of coming seasons.

This magnificent work General Myer could not have accomplished unless he had been backed by the moral and material assistance so generously and readily accorded him by his Government. With a settled conviction that this national work, if undertaken at all, should be carried out in a spirit and manner worthy of the great Republic, the Government of the United States relegated the work to the Signal Service of the War Department, with an annual vote from the Exchequer, which, while not too large for the work to be done, no Government on this side the Atlantic has yet thought of emulating.

While writing this brief notice of General Myer's work, we have been repeatedly reminded of the name of Leverrier—probably because, though widely different in many ways, both rendered services to meteorology to a great extent identical, both possessed the rare genius of organising and the resolute will that easily sets obstacles aside, both secured the support of their respective Governments, both were animated by large views of the capabilities and requirements of the science, and both were successful in an eminent degree in largely extending the sphere of its operations.

PHYSICS WITHOUT APPARATUS[1]

V.

THE Science of Electricity may be regarded in several different aspects. Firstly, there is the study of the simple phenomena such as schoolboys delight to see: the attractions and repulsions of rubbed bodies, the sparks, the shocks, the heating of wires, and rotation of diminutive electric engines. Secondly, there is the exact measurement of electrical quantities, and the verifying of the great laws of the science, involving exact manipulation and standard instruments. Thirdly, there is the technical study of the applications of the science, the details of telegraphic apparatus, the necessities of construction and maintenance, the management of electric lights, and other branches of electrical engineering. Lastly, comes the high mathematical theory cultivated only by the few.

Of the practical portions of this vast mine of scientific wealth, the greater part is only to be reached by the aid

[1] Continued from p. 440.

of special instruments of an expensive character. Only the first and simplest of the elementary *phenomena* of the science can be shown without apparatus. Yet even here the rudest means suffice in the hand of the master to produce the desired ends.

In his lessons on Frictional Electricity, delivered to juvenile audiences at the Royal Institution, Prof. Tyndall has shown in his unrivalled way how with the commonest objects, tumblers, egg-cups, needles, sealing-wax, pewter-pots, eggs, apples, and carrots, may lend themselves to produce the sparks, the shocks, the movements of attraction and repulsion which are more commonly obtained by the use of large and expensive electrical machines. No doubt these lessons—masterly examples of elementary science teaching—are familiar to many of the readers of "Physics without Apparatus." To the science teacher they are an indispensable primer of instructions how to impress common objects into the service of science. The only matter for regret is that they stop so far short of the

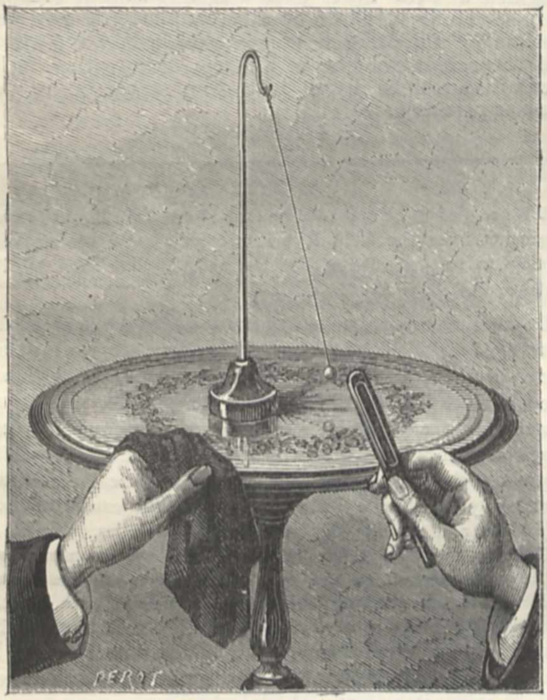


Fig. 16.

entire subject, and do not touch the kindred branches of voltaic electricity or magnetism.

The experiments we lay to-day before our readers are mere repetitions of ordinary lecture experiments, but require no apparatus of a technical kind for their performance. To show the attractions and repulsions due to electrification requires only the appliances depicted in Fig. 16. A stick of sealing-wax rubbed briskly through a dry warm piece of cloth or flannel suffices as a source of electricity. A small light ball cut out of pith or cork is attached by a drop of sealing-wax to a silk thread and thus suspended to any suitable support. It is first attracted toward the electrified stick of wax; and then repelled when by contact it has received a portion of the charge. The repulsion is not very easy to show if the ball is not exceedingly light. For this purpose a small feather, or bit of down out of a pillow, answers far better. A support from which to hang it may be improvised out of a penholder and a couple of books. The electricity excited on the wax by friction with a woollen fabric is of the *negative* kind. *Positive* electricity is no less easily obtained from a warm glass tumbler by exciting it with a warm and dry silk handkerchief. And, if both these sources are at hand the further experiment may be made

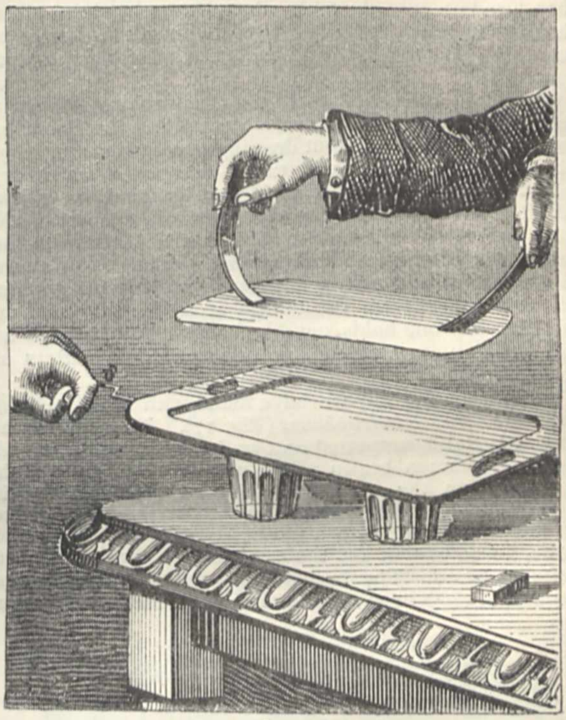


Fig. 17.

of charging the feather with either kind of electricity and then showing that though it is then repelled by electricity

Fig. 18.

of the same kind, the opposite kind of electricity attracts it. The mutual repulsion of two similarly electrified bodies is beautifully shown by means of two silk ribbons, as follows:—The two ribbons, about a foot long, are both side by side on the table, held at one end between the finger and thumb, and then electrified by drawing along them several times a piece of indiarubber. They are then lifted up from the table, when, if care has been taken that all is warm and dry, they are found no longer to hang straight down side by side, but to stand out and repel each other.

To obtain an electric *spark* requires preparations on a larger scale. M. Tissandier recommends the following method:—A piece of stout drawing-paper (warm and dry, of course) is laid upon a table—or upon a warm dry board. It is then rubbed with the dry hand, or with a silk handkerchief, or with a clothes-brush, or, best of all, with a piece of indiarubber. It will stick slightly to the table in consequence of its electrification. Now throw down on to it a bunch of keys, and grasping two corners lift up the sheet from the table. If at the very moment of lifting any one holds out his knuckle to the keys he will receive a small pale spark perhaps three-quarters of an inch long.

A more certain way we have found with what we may call a *Tea-tray Electrophorus* (Fig. 17). A common tea-tray of metal is supported on two dry glass tumblers. A piece of common brown paper cut so as to be a little smaller than the tray, and with rounded corners, is warmed, laid on the table and rubbed briskly with a piece of indiarubber, or with a clothes-brush. It is then laid down for an instant on the tray and the tray is touched with the hand. The brown paper is then lifted a few inches above the tray. If at this juncture some person

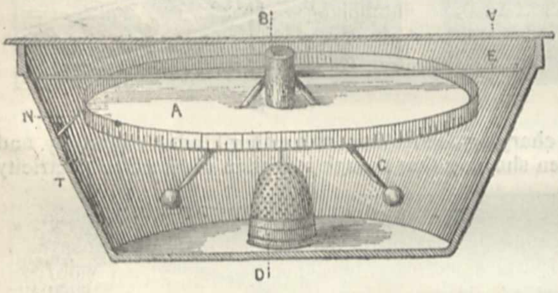


FIG. 19.

presents his knuckle to the tray he will receive a bright spark, which under favourable circumstances may be a couple of inches long. By simply putting the paper down, touching the tray, and again lifting up the paper the tray is again charged: and a large number of sparks may be thus drawn one after the other in rapid succession. The paper may be lifted by the hands, but it will be found better if a couple of ribbons or strips of paper be fixed on with wax to serve as handles, as shown in our figure.

The sparks obtained by the tea-tray electrophorus may produce a slight pricking sensation, but to give a regular electric *shock* will oblige us to store up a charge in a Leyden jar. This important piece of apparatus we have found possible to improvise in the following fashion. A round-bottomed glass tumbler is procured—if of thin glass it is preferable—and is filled to about three-quarters of its height with leaden shot. If shot is not at hand *dry* coal-dust will answer, but not so well, and great care must be taken to wipe clean the upper part of the tumbler. Everything must be warm and scrupulously dry. Into the shot a silver spoon is stuck to serve the place of a rod and knob. This is held as shown in Fig. 18, by grasping it well in the hollow of the hand, so that the hand may cover the whole of the rounded bottom of the glass. Having thus prepared and grasped our Leyden jar we must charge it with sparks from the tea-tray electrophorus. It should be held with the spoon handle near to, but not quite touching the edge of the tea-tray, while another person performs the operations of lifting the brown paper up and putting it down, then touching the tray, then lifting up again—and so on until a dozen sparks have been sent into the jar. On touching the knob a smart little shock is experienced in the wrists and elbows, and a short bright snapping spark announces the discharge of the jar.

The subject of currents of voltaic electricity is somewhat beyond the province of "Physics without Apparatus," and so is the greater part of the subject of magnetism. We may however conclude this article by presenting our readers with a simple mariners' compass described some time ago in a French magazine (Fig. 19). A short knitting- or darning-needle, E, which has been magnetised by rubbing it on a magnet, is pushed into a small cork, B, and balanced in the following way:—A sewing-needle is fixed, point downwards, in the lower end of the cork, and this is poised on a sewing-thimble. To balance it about the point of the needle a couple of matches pointed at the ends are thrust into the sides of the cork obliquely, and weighted at their lower ends with little balls of sealing-wax. A circle of paper or thin card marked with the "points" of the compass may be attached to the cork; and to prevent draughts of air from blowing the needle round it should be placed in a deep saucer or dish of glass or porcelain.

(*To be continued.*)

NOTES

WE are glad to be able to state that Mrs. Clifford is to receive a pension from the Civil List in recognition of the eminent services to mathematics of her husband, the late Prof. W. K. Clifford, F.R.S.

IN the absence of precise information as to the cause of the lamentable explosion at Seaham Colliery, we cannot say anything useful on the occurrence. When such terrible "accidents" occur, Science is invariably asked if she cannot do anything to prevent them, anything to render the miner's occupation less dangerous than it is. Those who ask such questions seem to be ignorant of the fact that, while much remains to be done, science has already done not a little to point out the causes of such explosions and provide the miners with remedies. But it is well known that a large proportion of such explosions are due to the wilful neglect on the part of the miners of the means which science has put into their hands to prevent such calamities. We are in a fair way of finding out the real nature of the connection between meteorological conditions and explosions in mines; it is in this direction that investigations should be carried out with thoroughness and zeal.

THE Sir Josiah Mason's Science College, Birmingham, is to be opened on October 1 next, with an introductory lecture by Prof. Huxley. The classes for students will commence on Tuesday, the 5th. The course of instruction, as at present arranged, includes mathematics, chemistry, physics, and biology. Further details may be learned from our advertising columns.

TWO eminent foreign botanists will, the *Gardener's Chronicle* states, shortly visit this country—Dr. Asa Gray and M. Alphonse de Candolle.

WE are glad to learn that the Gilchrist Trustees have given two engineering scholarships to University College, London, to be awarded by competition. There is an entrance scholarship (this year two are offered) of the value of 35*l.*, tenable for two years, to be competed for by those who have not previously been students of the College, and who are not more than eighteen years of age. The examination takes place this year on September 28, and candidates must send in their names to the secretary on or before the 23rd. The subjects of the entrance examinations will be as follows:—Mathematics, mechanics, mechanical drawing, essay on one of three given subjects connected with mechanics or engineering, French or German, the use of tools, either carpenters' tools, *or* the lathe (wood *or* metal), *or* the file. There is also a senior scholarship of the value of 80*l.* to be awarded at the close of each session from 1881–82 inclusive. Candidates for this scholarship must, to the satisfaction of the Faculty of Science, have attended during the whole of the session immediately preceding the award College classes in the following subjects:—Applied mathematics, practical physics, junior engineering, engineering drawing, geology. The scholarship will be awarded on the results of the ordinary class examinations in these subjects.

REFERRING to a short announcement in NATURE, vol. xxi. p. 306, of prizes offered by the Venetian Institute, we have been desired to point out that the limit of time for the first (that relating to the mechanical equivalent of heat) is March 31, 1881 (not 1880). In further explanation we may say that the task proposed is "to discuss minutely the determinations of the equivalent hitherto made, to investigate the causes of the considerable differences that have appeared in the results, to indicate what is the most probable value that may be deduced from these, and to determine the equivalent by new experiments, adopting the method which the competitor shall have proved to be most exact." Many writers of great authority assume 424 or 425 kilogrammetres as the mean value; but Joule's more recent experiments, based on observation of electric phenomena, give 430, and Violle has obtained a value approximating 435. The importance to physical science of a settlement of the question is obvious.

THE Vienna Academy (Section of Mathematics and Natural Science) has proposed as subject for the Baumgärtner prize of 1,000 florins the microscopic investigation of wood of living and fossil plants. By such investigation and the comparison of all known recent and fossil woods, it is desired to ascertain characters whereby it will be possible to determine the genus and species with certainty from microscopic sections. Papers must be sent in before December 31, 1882, and the prize will be awarded at the anniversary meeting in 1883. For further conditions see the *Anzeiger*.

THE *Philadelphia Record* deserves all the credit that has been accorded it for its public-spirited and successful efforts to break up the sale of bogus medical diplomas in that city. These diplomas were chiefly sold abroad, and it is appalling to learn, on the authority of the *Times* correspondent, that 11,000 of them have been issued during the past few years. "It was well known," the correspondent writes, "that Dr. John Buchanan, the Dean of 'The American University of Philadelphia,' and several other similar institutions, was engaged in this traffic; but as they were all properly chartered medical schools, and, though disreputable, existing under the sanction of law, the difficulty was to get evidence of the sale of the diplomas. Diplomatic complaints about the traffic came from various Governments of Europe, and our people began to be restive under the stigma." By the clever tact of the city editor of the *Record*, however, Buchanan has been brought within reach of the law, and the detectives are on his track. He attempted to put them off the scent by getting a man looking like himself to pretend to drown himself; this bogus case of drowning, however, has deceived nobody.

MR. A. L. SILER, the *American Naturalist* informs us, has discovered at Malley's Nipple Ranch, near Pahreah, Kane county, Utah, remains of cliff-structures, which he describes as follows:—The remains seem to have been the foundations of small huts built on ledges of red sandstone under overhanging cliffs. The walls were about six inches thick, made of thin flat sandstone brought up from the valley below, and laid in adobe. The structures are divided into rooms about four feet square, leaving all the space between the building and the back of the cliff, usually about ten feet, entirely free. Upon digging into one of the rooms, Mr. Siler found parched corn and rope in a good state of preservation.

THE August number of the *American Entomologist* contains an interesting article by the editor (Prof. C. V. Riley) on the effects of *Pyrethrum* (either as powder or fumes) on injurious insects, and the author believes this otherwise harmless substance is destined to entirely supersede the use of Paris green and other arsenical compounds. Experiments were made upon various insects, and on some the effect was remarkably rapid, the powder killing them in a very short time. "Squash bugs" appeared to resist the longest. Amongst other articles and notes is one on a luminous elaterid larva from Maryland, accompanied by figures; and an important one by Prof. W. S. Barnard on the larva of a *Simulium*, which forms black masses on the rocks in rapids near Ithaca, N.Y., the pupa being furnished with external breathing apparatus. This magazine still suffers from the inconvenient absence of any indication of the contents of each number, a want the editors will do well to supply.

THE members of the Geological Society of France arrived at Boulogne on Thursday last. At their reception in the Collége Communal, adjoining the museum, a *vin d'honneur* was offered them by the municipality. Among those present were Professors Prestwich and Seeley. The first meeting took place in the Salle Daunou, at the museum, where an opening address was delivered by M. de Lapparent, president of the Society.

ON August 18 and 24 storms of almost unprecedented violence swept over Kingston, Jamaica, and its neighbourhood. The destruction has been widespread and terrible, reminding one of the dire effects sometimes experienced from storms at Mauritius.

PROF. SILVESTRI, in a recent ascent of Etna, found that, as a result of recent volcanic activity, the summit has been lowered to the extent of 12 metres, so that its present height above sea-level is 3,300 metres, and that the interior edge of the crater, which was formerly 1,500 metres in circumference, is now 1,800. The platform which was formerly seen on the east side, at 60 metres below the edge of the crater, has completely fallen into the heart of the volcano, and the eruptive axis, which before the eruption of 1879 was situated on the west side of the crater, is now right in the centre. Thus the interior walls of the crater of Etna now present the virtually characteristic form of a great funnel.

ON September 5 the adherents of the Positive Philosophy went in procession to the Père Lachaise to the tomb of Auguste Comte, the founder of this system. Their number was about 200. Three speeches were pronounced on the spot, and in the evening a banquet took place in the very rooms that Auguste Comte occupied during his lifetime and which have been preserved in their former state.

TRACES of the last exceptionally cold winter are now visible in Paris, a large number of trees in the squares and streets having lost their foliage at an early period. Many of them are showing leaves belonging to a second formation, and which are probably doomed to a speedy death. We daresay many of our readers will have noticed a similar result in London.

ACCORDING to the *Révue Scientifique* a change has taken place in the Observatory of Algiers, but of a very unusual character. M. Balard, who has been during so many years director of this establishment, has been reduced to the grade of astronomical *attaché*, and M. Trepied, adjoint member of the Bureau des Longitudes, and one of the staff of the *Révue Scientifique*, has been appointed director.

MONSIGNOR ELIGIO COSI, Bishop *in partibus infidelium* at Chang-Tong in China, is said to have invented a new alphabet, composed of thirty-three letters, with which all sounds of the Chinese tongue can be clearly expressed; until now 30,000 were requisite. The Emperor of Austria, to whom Monsignor Cosi communicated his invention, presented him with a complete typographical apparatus for a printing establishment.

THE boring of the Arlberg Tunnel is in active progress on the Austrian side of the mountain, and ground will shortly be broken on the Swiss side. The St. Gothard line in its entire length is expected to be in running order in April next.

A RATHER smart earthquake shock was felt at Zermatt on the 3rd inst., and other two on Friday last.

ON Wednesday, September 8, lightning fell on the Sorbonne at about half-past two o'clock. A globe of fire was observed by persons present on the spot. Some of them say it was seen coming from the point of the north-western conductor, which was struck, as well as the south-western, with a great noise. The Sorbonne had, until recently, no lightning conductor, and never, as far as is known, has any thunderbolt struck the venerable abode of the French University. But within the last few months six stems have been erected and connected by an iron bar, making a circuit which goes all over the roof of the immense building. Unfortunately the pit where the earth conductor has been placed is situated at a great distance from the main building, in a courtyard adjoining the laboratory of M. Jamin, and the conductor which connects the roof with this is a square iron box of less than 15 mm. on each side, so that there is not sufficient conductibility in it to establish an efficient connection with the earth. This accident proves the sagacity of M. Karsten, the Schleswig-Holstein physicist, who published a table giving a formula for regulating the dimensions of the connecting-rods with their lengths, as is taught by Ohm's laws. It shows also how little the knowledge of lightning-conductors is spread in France, in spite of the several official commissions which have been established by the Government.

DURING the severe thunderstorm which passed over North London on Monday, a peculiar phenomenon was witnessed in the grounds of the Welsh Harp, Hendon, by some gentlemen boating on the lake. A vivid flash of lightning was succeeded by a tremendous peal of thunder, a great ball of fire at the same time descending from the heavens into the water. When the storm had abated over 100 fish of various kinds, including two fine carp, weighing together 23 lb., were found floating dead on the lake.

THE elevation of temperature which has been so remarkable in Paris during the end of August and the beginning of September has been accompanied by the production of a putrid odour spread all over the city, and which has been obnoxious to the public health. A report has just been published by the Prefect of Police, explaining that it must be attributed to the want of water for flushing the sewers, and also to the existence of a number of establishments where sulphate of ammonia is produced, and matters extracted by night-men are dried to be turned into manure. The Prefect of Police says that measures will be taken for producing an enlarged supply of water, and that gradually all the sewage will be conducted to Clichy by the sewers. The completion of this scheme involves the purchase by the city of a large tract of land for utilising these matters, which could not be thrown into the Seine without poisoning the stream.

THE *Daily News* Naples correspondent writes that since the 4th instant Vesuvius has again become more active, and has launched his projectiles in greater number and to a greater height. The seismograph at the observatory is also more animated, and new lava has issued from the side of the cone, flowing, fortunately for the railway, to the north-east.

THE new number of the *Canadian Naturalist* (which, we believe, is kept up with difficulty) contains a paper by Mr. G. M. Dawson on the Distribution of the more Important Trees of British Columbia, which has also been printed separately, and another by Principal Dawson, on the Geological Relations and Fossil Remains of the Silurian Ores of Pictou, Nova Scotia. Mr. G. F. Matthew has a paper on Tidal Erosion in the Bay of Fundy. Are such specimens of etymological jugglery as the Rev. J. Campbell's paper on the "Hittites in America" supposed in Canada to have any connection with science? Unfortunately some of our own scientific societies are guilty of encouraging similar elaborate trifling.

FURTHER excavations, the *Times* Geneva correspondent states, made in the ancient glacier bed near Solothurn have produced some very interesting results, and the spot is being daily visited by geologists and sightseers. The *débris* removed consisted of 4½ metres of drift mixed up with boulders and crystalline erratic blocks. The rock bared measures 20 metres long by 7 wide. It is highly polished by the action of the ice, and traversed by channels, through which the glacier-water found its way into the so-called "giants' pots," or "kettles." These, so far as has yet been ascertained, are three in number. The largest measures 8 metres from west to east, 3·7 from north to south, and is 3½ metres deep. The second is 5½ metres across, and still contains the great boulder or mill-stone by which it was hollowed out. The third is smaller and oval-shaped, and there is reason to suppose that, if the excavations were continued, several more would be brought to light. This interesting relic of the great ice-age, or rather of the last glacial epoch, is at present private property, but a project is on foot for its acquisition by the canton, and preservation as a glacier garden in the manner of that of Lucerne.

WE have on our table the following publications:—"Familiar Wild Flowers," by F. E. Hulme (Cassell); "On the Educational Treatment of Incurably Deaf Children," by W. B. Dalby (Churchill); "Brain and Nerve Exhaustion," by Mr. Stretch Dowse (Baillière); "Lectures on the Science and Art of Education," by Joseph Payne (Longmans); "The Morals of Evolution," by M. J. Savage (Trübner); "Animal Magnetism," by R. Heidenhain (Kegan Paul); "Stonehenge Plans, Descriptions, and Theories," by W. M. F. Petrie (E. Stanford); "Ambulance Lectures," by Lionel A. Weatherly, M.P. (Griffith and Farren); "Astronomy, Text-Books of Science," by R. S. Ball (Longmans); "The Land and Freshwater Shells of the British Isles," by R. Rimmer (Bogue); "British Wild Flowers by Natural Analysis," by J. Messer (Bogue); "Glimpses of England," by J. R. Blakiston (Griffith and Farran); "Radical Mechanics of Animal Locomotion," by Mr. Wainwright (Van Nostrand).

THE additions to the Zoological Society's Gardens during the past week include a Common Cuckoo (*Cuculus canorus*), European, presented by Mr. G. Chandle; a Stock Dove (*Columba œnas*), European, presented by Mr. A. Basil Brooke; a Common Raven (*Corvus corax*), European, presented by Mr. W. A. Mitchison; a Rufescent Snake (*Leptodira rufescens*) from South Africa, presented by the Rev. G. H. R. Fiske, C.M.Z.S.; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Mrs. Budgett; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, two Bull Frogs (*Rana mugiens*) from Nova Scotia, deposited.

OUR ASTRONOMICAL COLUMN

FAYE'S COMET.—The following places of this comet are adapted, like those previously given in this column, to Berlin midnight or to about 11h. Greenwich time:—

	R.A. h. m. s.	N.P.D. ° ′	Log. distance from Earth.	Sun.
Sept. 23	23 53 48	83 24·3	0·0422	0·3174
25	— 52 45	83 46·9	0·0406	
27	— 51 46	84 10·0	0·0393	0·3134
29	— 50 51	84 33·3	0·0384	
Oct. 1	— 50 2	84 56·8	0·0379	0·3094
3	— 49 18	85 20·5	0·0377	
5	— 48 40	85 44·1	0·0378	0·3054
7	— 48 9	86 7·7	0·0383	
9	23 47 46	86 31·0	0·0390	0·3015

It will be seen that the nearest approach of the comet to the earth (1·09) occurs within this period, and the circumstances are as favourable for observation as they can be at this appearance. An observation by M. Pechüle at Copenhagen on September 1 shows that the ephemeris of Prof. Axel-Möller requires only the small correction of − 1·6s. in R.A., and + 15″ in N.P.D. In no case has the motion of a comet of short period been followed with more striking success than that of Faye's comet has been during the thirty-seven years which have elapsed since its discovery, through the masterly investigations of the Swedish astronomer. Nor has he confined himself to following the comet during this interval: he has confirmed in a great degree the inferences drawn by Leverrier with respect to the conditions attending the near approach of the comet to Jupiter, about the time of nodal passage in the year 1816, having previously calculated with precision the effect of an approximation of the two bodies within 0·64 in March, 1841, and assigned accurate elements for December 25, 1838. (See the *Proceedings* of the Academy of Sciences at Stockholm, January, 1873.)

SCHABERLE'S COMET (1880, APRIL 6).—The theoretical brightness of this comet, discovered seven months since, is on the increase, and we subjoin an extract from the ephemeris calculated by M. Bigourdan, from elements founded upon normal places for April 10, 28, and May 16. It is for Paris midnight, and the intensity of light at discovery is taken = 1.

	R.A. h. m. s.	N.P.D. ° ′	Log. distance from Earth.	Intensity of light.
Sept. 28	6 39 45	76 35·5	0·2882	1·03
30	6 37 16	77 32·0	0·2817	
Oct. 2	6 34 35	78 30·3	0·2751	1·06
4	6 31 42	79 30·4	0·2685	
6	6 28 38	80 32·3	0·2620	1·10
8	6 25 20	81 35·9	0·2556	
10	6 21 50	82 41·4	0·2494	1·14
12	6 18 6	83 48·6	0·2434	
14	6 14 9	84 57·6	0·2376	1·17

The maximum brightness is attained about November 4, near which date the following are the comet's approximate positions:—

12h. G.M.T.	R.A. h. m. s.	N.P.D. ° ′	Log. distance from Earth.	Sun.
Nov. 2	5 25 23	96 51	0·2029	0·3762
6	5 12 52	99 21	0·2024	0·3819
10	4 59 53	101 46	0·2047	0·3875
14	4 46 35	104 1	0·2108	0·3931

SWIFT'S NEW COMET.—Mr. Lewis Swift, writing from Rochester, New York, on August 18, gives some particulars of his observation of a cometary object on August 11, and explains the cause of his delay of a week in notifying his discovery. On the 11th he observed a nebulous object elongated in the direction of the sun in the field with and about 1° distant from the small bright nebula H. I. 262, the position of which for 1880 is in R.A. 11h. 20m. 32s., N.P.D. 22° 45′·2, and having been familiar with the neighbourhood for many years, he supposed it to be a comet, but cold detect no motion before the sky clouded. On the morning of the 17th, the sky being clear after the moon had set, he examined the spot, but the nebulous object was missing, and a search until daylight failed to recover it. He then cabled his discovery and made it known to astronomers in the United States. The position, he says, would not differ much from R.A. 11h. 28m., N.P.D. 22°. The comet was first detected with his comet eyepiece, power 25, and examined with powers 36 and 72; it was faint, but not very faint. We have not heard that it has yet been seen elsewhere. The place given is not upon the track of Pons' comet of 1812, the return of which is shortly expected, and for which it is much to be desired that a strict search should be maintained. Sweeping-ephemerides prepared under Prof. Winnecke's direction will be found in the *Vierteljahrsschrift der Astronomischen Gesellschaft*, 12. Jahrgang, 2. Heft.

THE BINARY STAR 85 PEGASI.—By five nights' recent measures of the close stars in this system, Mr. Burnham has satisfactorily established their binary character, which had been rendered probable by his earlier measures; the mean result is—

1880·59 ... Position, 298°·3 ... Distance, 0″·65.

For the distant companion Mr. Burnham finds from six nights' observations—

1880·57 ... Position, 25°·0 ... Distance, 15″·41.

GEOGRAPHICAL NOTES

THE sixth issue of Behm and Wagner's "Population of the Earth" has just been issued. Since the last issue several censuses have been taken, and the results of these, combined with the natural increase of the population, have added something like seventeen millions to the inhabitants of the globe. The population of the earth is now stated to be 1,455,923,550, as compared with 1439 millions two years ago. Europe has 315,929,000 inhabitants, or 32·5 per square kilometre; Asia, 834,707,000, or 18·7 per sq. kil.; Africa, 205,679,000, or 6·9 per sq. kil.; Australia and Polynesia, 4,031,300, or 0·4 per sq. kil.; and the Polar Regions 82,000, mostly divided between Iceland and Greenland. The *Bevölkerung* is just too soon to be able to utilise the results of the censuses of the United States and of Austria, which are taken this year, and that of our own country will not of course be available for at least two years. The editors have, however, made a very careful calculation of the present population of the States, on the basis of registration and emigration statistics, and find the probable population of the present year to be 48,000,000. The section of the work relating to Roumania and the Balkan Peninsula is specially valuable, and must have cost the editors a vast amount of trouble, considering the untrustworthy and imperfect nature of the data at their command. The areas of these countries, as well as of several other regions on the globe, including Africa, are mainly given from careful planimetrical measurements made under the direction of the editors. The area of Roumania is given as 129,947 square kilometres, and the population as 5,376,000; Servia, 48,657 sq. kil., 1,589,650 population; Montenegro (after the Berlin Treaty), 9,475 sq. kil., population 286,000; European Turkey, including the dependencies of East Rumelia, Bulgaria, Bosnia, and Herzegovina, 339,211 sq. kil., population 8,866,500; of Asiatic Turkey the area is given as 1,899,206, and the population 16,320,000. For Afghanistan, the *Bevölkerung* gives the details of the various tribes and populations contributed to NATURE by Mr. Keane in January last. It also gives Mr. Keane's table of the Turkoman tribes (NATURE, vol. xxi. p. 111), which is wrongly attributed to Prof. Vámbéry. The statistics of the Indian Archipelago have cost the editors great trouble, mainly owing to the confused and unsystematic way in which the Batavian Government compile their statistics. There is a very detailed and careful *résumé* of the areas and populations of the various Polynesian island groups. The result reached by the new estimation of the area of Africa in the *Bevölkerung* is 29,283,390 square kilometres, of which about 6½ millions are forest and cultivable land, the same are in prairies and light woods, 1¼ million bush, 4¼ millions steppe, 10½ millions desert, and 170,000 lakes. A new planimetric measurement of South America made by Dr. Wisotzki gives the area as 17,732,128 square kilometres. The total area of the North Polar lands is given as 1,301,100 square kilometres, and of the South as 666,000.

THE French scientific expedition headed by Prof. d'Ujfalvy, the celebrated French explorer of Central Asia, has arrived at Nijni Novgorod, on its way to Turkestan, to explore Bokhara and the whole of Afghanistan north of the Hindoo Koosh. The expedition will proceed to Tashkend, where it will pass the winter, *viâ* Siberia, taking the steamer from Nijni Novgorod to Perm, the train thence to Ekaterinburg, the post-road to Turmin, the steamer again to Semipalatensk, and completing the distance to Tashkend by post-road. As soon as possible in the spring the expedition will set out for Samarcand, and, after exploring the antiquities in the Zerafshan district, will cross the border into Bokhara, proceeding thence, at the completion of the exploration of the Khanate, to the Pamir Wakhan, Badakshan, and other little known Afghan possessions in the Hindoo Koosh.

It will depend on the state of affairs in that region whether the expedition afterwards crosses the Hindoo Koosh to Cabul and Candahar, and proceeds to India and China, or whether it takes the road to Pekin through Kashgaria and Thibet. Persia and Asia Minor will be touched on the way home, and Prof. d'Ujfalvy hopes to reach Paris by the beginning of 1882. D'Ujfalvy has received a subsidy of 80,000 francs from the French Government, and is accompanied by two salaried officials connected with the Ministry of Public Instruction, Gabriel Bonvalo, a naturalist, and Guillaume Kapius, a doctor of natural science.

THE current number of the Geographical Society's *Proceedings* opens with Sir R. Temple's lecture on the highway from the Indus to Candahar (illustrated by woodcuts from his own sketches), which is most appropriately followed by Capt. Beavan's "Notes on the Country between Candahar and Girishk." The map, which will embody new material, is promised with next number. The other paper is an account by Mr. Coppinger, R.N., of a visit to Skyring Water, Straits of Magellan. In the geographical notes much prominence is naturally given to Mr. Thomson's letters describing the concluding part of his very successful journey in East Africa, the only disaster of which has been the sad death of Mr. Keith Johnston at the very outset. In the letters now before us Mr. Thomson tells us how he vainly—owing to the opposition of his own men—endeavoured to trace the course of the Lukuga Creek from Lake Tanganyika to the Congo, failing in which he returned to his camp at the south of the lake, and then, having examined the previously unseen Lake Hikwa (or Likwa), made the best of his way back to Zanzibar through Unyanyembe. Among the other notes we find one on the French expedition from the Senegal to the Niger, under Capt. Galliéni, followed by others on routes between Kurram and Ghazni, Russian Manchuria, Saghalin Island, the Indo-Chinese peninsula, and the affluents of the Rio Purûs. Sir J. H. Lefroy's address to the Geographical Section of the British Association is also given, together with a few notes on new books and maps, the whole forming an exceedingly good number for the time of the year.

AFTER spending two years in South Africa, Lieut. Een, a Swedish traveller, has lately returned to Europe, bringing with him valuable collections which he has formed in Damara-land, in the departments of natural history and ethnography.

CAPT. CASATI, an Italian traveller, is going to the Bahr-el-Ghazal, whence he will endeavour to reach Lake Chad through the Niam-Niam country, with the view of thoroughly investigating the interesting problem of the relations between the Rivers Welle and Shari.

M. LOMBARD has gone to Abyssinia on a mission from the French Government, to study the topography of the country, as well as its civil and military organisation.

THE last issue of *Le Globe* contains a paper on "La Topographie comme Base de l'Enseignement géographique," and another by M. Th. Vernet, on South Africa.

THE current number of *Les Missions Catholiques* contains three papers of interest, viz., the conclusion of the narrative of a journey in West Africa, part of the particulars respecting the march of the Algerian Missionary Society's last expeditions to Lake Tanganyika and the Victoria Nyanza, and the first instalment of a paper communicated by the Very Rev. Father Dominique of Aden, on Somali-land, a region which is gradually attracting a good deal of attention at the hands of travellers as well as of missionaries.

THE most noteworthy contributions to the new number of *Les Annales de l'Extrême Orient* are a notice of M. Aymonnier's Khmer-French Dictionary, and a vocabulary collected by the well-known Thibetan traveller, Abbé Desgodins, of words in use among several tribes on the Lan-tsang-kiang, or Upper Me-kong, the Lou-tsé-kiang, or Upper Salween, and the Upper Irrawaddy.

A TELEGRAM from San Francisco, dated the 1st inst., states that a despatch has been received at that port from Victoria, a district at the northern extremity of America, to the effect that the barque *Malay* has arrived there from Ounalaska, bringing no tidings of the *Jeannette*, the vessel despatched some months ago by the United States Government upon a voyage of Polar discovery. The *Malay* reported that at Ounalaska the *Jeannette* was given up for lost, on account of the severity of last winter. A despatch from Washington, in reference to the above rumour, ridicules the idea that the *Jeannette* has met with a mishap, inasmuch as she was made as strong as human ingenuity could contrive, and specially equipped and provided for the service on which she was sent. Officers, says the *Herald*, who have had experience of the Arctic seas, say they know of no reason why Lieut. De Long should not be as successful as Nordenskjöld was in his Northern voyage.

THE series of letters from the enterprising correspondent of the *Daily News* in Central Asia are well worthy of attention; they contain many valuable observations both on the country and the people. The Burmese correspondent of the same paper, in a long letter in last Friday's issue, describes a journey into the interior, giving much fresh information on a little known region.

THE FRENCH DEEP-SEA EXPLORATION IN THE BAY OF BISCAY[1]

I FEEL that I am indebted for the opportunity of giving an account of the French Expedition which forms the subject of this paper to my esteemed friend and colleague the Marquis de Folin of Bayonne. He was until lately the Commandant of that port, and is a most zealous and excellent naturalist. I may indeed say that the Expedition originated with him. For more than ten years he had at his own expense assiduously and carefully explored the sea-bed lying off Cap Breton, in the Department of the Landes, as well as could be done in a fishing-boat; and the result of his researches among the marine Invertebrata has been described, with illustrations by his pencil, in a useful work called "Les Fonds de la Mer," published at Bayonne under his direction. M. de Folin has from time to time sent me the mollusca procured in his dredgings for my opinion; and our correspondence, with a visit which I paid him in December, 1878, led to his making an application to the French Government for the grant of a vessel to explore the depths which were known to exist at a comparatively short distance from the northern coasts of Spain in the Bay of Biscay. This evidently could not be done in a fishing-boat; and naturalists have much less money than science. It was in fact a project for a nation, and not for an individual. The application was, I believe, referred to the Dean of the Academy of Sciences, M. Milne-Edwards, whose reputation as an eminent zoologist has been universally recognised for more than half a century. His report was favourable; and a Government vessel was ordered to be placed at the disposal of a Commission, of which M. Milne-Edwards was appointed president. The other members of the Commission were the Marquis de Folin, Prof. Alphonse Milne-Edwards, Prof. Vaillant, Prof. Marion of Marseilles, Dr. Paul Fischer, and M. Perier of Bordeaux. The selection of these savants augured well for the success of the Expedition, and it has been fully justified. At the suggestion of M. de Folin, the Minister of Public Instruction graciously invited me and the Rev. A. M. Norman (a well-known zoologist) to take part in the expedition. Mr. Norman had been my valued companion for many years past in similar but less important excursions to Shetland and Norway. It was to me a great pleasure to be again associated with him. I regarded the invitation as far more than a compliment: it was a great honour.

I may here mention that immediately before the commencement of the Expedition M. de Folin, Mr. Norman, and I had some preparatory boat-dredging in the Fosse de Cap Breton. This was done at the expense of the French Government. When has our own Government shown such generosity in the cause of science to French naturalists?

The vessel assigned for the purposes of the Expedition was the *Travailleur*, a paddle-wheel steamer of over 900 tons, of 150 horse-power, and carrying four guns. She is an "aviso," or despatch-boat, and is stationed at Rochefort for occasional service. She was supplied with a capital donkey-engine and immense stores of cordage, sounding-wire, and other apparatus. She had a very happy name, being an indefatigable worker. Capt. E. M. F. Richard was the commander, or "Lieutenant de Vaisseau;" and the other officers were Lieutenants Mahieux, Jecquet, Villegente, and Bourget, Aide-Commissaire Gousselin, and Doctor Duplouy. Let me now express my sincere thanks to the officers for their great kindness and urbanity. They took a great interest in the work, and materially promoted the welfare of the Expedition. The crew consisted of 128 men; the usual number was between eighty and ninety, but

[1] Paper read at the British Association by J. Gwyn Jeffreys, LL.D., F.R.S.

extra hands were taken in consequence of the heavy work entailed by sounding during the night. All these men seemed to be well conducted, as well as good sailors; and although they had only two meals a day, their physique was quite equal to that of our best British seamen. Mr. Norman and I took with us as dredger a steady and intelligent man, John Wilson; and Prof. Marion had his dredger, named Armand. These men were of great use in sifting the material brought up by the dredges. For the Captain, I can only echo the opinion expressed by Prof. A. Milne-Edwards in his Preliminary Report, that his arrangements were first rate, and his skill admirable, especially considering that the kind of work was new to him, and that he had not previously made or even seen any deep-sea dredging.

The members of the Commission assembled at Bayonne, and the *Travailleur* arrived there on July 16th. The next morning she went to sea, with all the party on board except the President, who was obliged to return to Paris, and might also have justly claimed exemption from active service, being in his eightieth year. Until August 1st (with the exception of Sundays, the 18th and 25th, which we spent at San Sebastian and Santander) we were hard at work sounding, dredging, and trawling. The weather was very fine; and the dreaded Bay of Biscay lost its stormy character on this occasion.

The principal object of the Expedition was to ascertain the nature of the fauna which inhabits at considerable depths this part of the Bay of Biscay; and this object was thoroughly and successfully accomplished. Twenty-three dredgings were made for that purpose at depths ranging from 337 to 2600 mètres, each mètre being about thirty-nine inches, or rather more than half a fathom. The dredgings between 600 and 1,000 fathoms were the most important. Every department of the Invertebrata was well represented; and novelties were discovered in Mollusca, Crustacea, Echinoderms, Annelids, Actinozoa, and Sponges.

As regards myself, this Expedition had a peculiar charm. Having had the scientific charge of similar expeditions for the Royal Society in H.M.S. *Porcupine* in 1869 and 1870, and in H.M.S. *Valorous* in 1875, and having examined the collections made during the voyages in H.M.SS. *Shearwater* and *Challenger*, as well as those made in nearly all the Swedish, Norwegian, Dutch, and American deep-sea and exploring expeditions in the North Atlantic, I was naturally glad to participate in the French Expedition, and particularly as it embraced that part of the sea which was at no great distance from the scene of my former labours in the cruise of the *Porcupine* along the western coasts of Spain and Portugal, and which cruise was so unusually productive. Impelled by this recollection, I made last year a verbal and informal application to the late First Lord of our Admiralty for the use of one of Her Majesty's ships to explore the Bay of Biscay this summer. The answer I received was very favourable; but the pecuniary resources of our Government were then at a very low ebb, and I was encouraged to renew the application when commerce revived and times became more prosperous. I hope our new Government will avail itself of the now improved finances, and not neglect this genuine and beneficial method of instructing the nation and maintaining its credit for maritime discovery.

The fauna observed during the *Travailleur's* cruise closely resembled that which I ascertained during the *Porcupine* cruise in 1870 to exist at corresponding depths. This will be shown, so far as the Mollusca are concerned, in the list of species appended to the present paper; and I have no doubt that the other branches, when they have been worked out by the experienced naturalists to whom they have been assigned, will confirm my opinion.

In a physical and geological point of view this French Expedition has borne good fruit. No less than 103 soundings were made. They have proved the existence, within a few miles of the coast, of a submarine valley opening from the Fosse de Cap Breton and extending to a point opposite Cap Pēnas. The large diagram and chart which I now exhibit will give a better explanation than I can do by any words. The diagram was prepared for me when I presented to the Royal Society my Reports of the *Porcupine* Expeditions of 1869 and 1870; and the chart has been filled up and given to me by my kind friend the Hydrographer.

The striking inequalities of depth within a narrow area which thus appear were noticed in a Bayonne newspaper of August 4th, as "des grands fonds sous-marins, qui continuent sous les eaux de l'Atlantique les vallées pyrénéennes." As a general rule, it may be said that where mountains or high land approach the sea the depth of water is greater off that coast than where the land lies low. But this must depend in a great measure on the geological nature of the land adjacent to the sea. If the formation be granitic or gneissic, the wear and tear or denudation must be slower than if the formation be sandstone, Cretaceous, or Tertiary; and the action of rivers and streams on the surface of the land must be proportionally increased or decreased, and must cause the sea-bed to be more or less filled up in the course of time. Everywhere during the dredgings of the *Travailleur* in deep water the sea-bed was found to be covered by a thick layer of mud, of a different colour from that of the Atlantic ooze; and this mud has probably accumulated from untold ages by the incessant efflux of the Gironde, the Adour, and numerous other rivers and streams into the Bay of Biscay. As may be supposed, the fauna which inhabits such mud is very scanty; and it required a considerable amount of patience and perseverance to extract a few organisms from the unpromising material. No wonder that Dr. Carpenter was discouraged, as a zoologist, by what he termed "the singular barrenness of this deposit in regard to animal life," when he described the Mediterranean cruise of the *Porcupine* in 1870.

Within a few days after the return of the Expedition Prof. A. Milne-Edwards presented to the Academy of Sciences at Paris a Preliminary Report of the zoological results of the Expedition, which was published in the *Journal Officiel de la République Française*. As most of the departments of the marine Invertebrata have been so fully and carefully treated by him in this Report, I will content myself with a few supplementary remarks as to the Mollusca, which especially engaged my attention during the cruise. At the request of Dr. Fischer, who will undertake this department, and with the sanction of the President, I was entrusted with all the more critical specimens of Mollusca: and these specimens I have now cleaned, assorted, and compared with my own collection from the *Porcupine* Expedition of 1870, on the western coasts of Spain and Portugal. I subjoin a complete list of the *Travailleur* Mollusca, distinguishing in separate columns those species which are *Porcupine*, those which were previously known to me from Norway or the Mediterranean only, and those which I consider new to science. The total number of the species in this list is 152, out of which 138 are *Porcupine*, three only appear to be peculiarly northern, one peculiarly southern or Mediterranean, and eleven new to science.

The results, especially in the last-mentioned category, are most noteworthy. They serve to show how little we know of the deep-water Mollusca, when we reflect that the area of the sea-bed lately explored in a short period of time, and in a necessarily cursory manner, is but a very small corner of the Atlantic, and that it would take many years to complete the exploration so auspiciously commenced. The area traversed by the dredge during this cruise represents probably much less than a ten-thousandth part of the sea-bed lying between Cape Breton and Cape Pēnas; and our means of exploration by the dredge are by no means satisfactory, particularly on muddy ground, of which the deep-water zone is mainly composed. Instead of our being able to scrape a few inches of the surface of the sea-bed at considerable depths, so as to collect in the dredge all the animals which inhabit the superficial layer, we find too often, to our disappointment, that the dredge, when it reaches the bottom, sinks into the mud from its own weight and from the momentum given to it by the motion of the ship, and that it then acts as a subsoil plough, and not as a scraper. I must ask one of my engineering friends to devise some instrument more efficient than the modern dredge.

Although it cannot be positively stated that the abyssal zone, or even the benthal zone, is inhabited only by certain species of Mollusca, some species observed by me during the preparatory excursion to Cap Breton and the *Travailleur* cruise bear out the statement to some extent. For instance, *Nucula nitida*, *Dischides bifissus*, *Rissoa abyssicola* (a now inappropriate specific name), and *Defrancia decussata* occurred only in the shallow water excursion; while *Nucula corbuloïdes*, *Siphodentalium olivi*, *Rissoa deliciosa*, and *Defrancia hispidula*, occurred only in the deep-water cruize.

Several deep-water species of Mollusca occurred in this Expedition, which had been until lately supposed to be extinct; they are fossils of the Upper Tertiaries of Europe. For the Geological definition of this term see "British Conchology," vol. i. pp. 315, 316.

A curious provision of nature—if we may in these philosophical days use such a phrase—was observable in the case of a deep-water mussel of considerable size, which I propose to name *Mytilus luteus*. It inhabits the layer of mud which I have above described, and moors or fixes itself by means of a large and densely-matted byssus which is spun by the foot. This byssus is capable of being spread over a considerable extent of surface; and it not only prevents the mollusk sinking into the soft mud and being smothered or buried alive, but enables it to feed comfortably on the innumerable animalcula which swarm on the surface of the sea-bed. It is of the same use to the mollusk as the snow-shoe is to the Arctic traveller. This species of Mytilus I at first took to be the *Modiola incurvata* of Philippi—*M. martorelli* of Hidalgo, which lives on the south coast of Spain in rather shallow water; but on comparison I am satisfied that they differ essentially in shape, sculpture, colour, and epidermis.

I cannot conclude this account without acknowledging my most grateful thanks to the French Government for their extremely generous conduct in my case and for the excellent hospitality which I enjoyed on boaid the *Travailleur*, as well as to the President and Members of the Scientific Commission for their obliging and friendly companionship.

The zoological results of this French Expedition are fully equal to those made by Capt. Baudon in 1801, M. d'Urville in 1829, the *Recherche* in 1835, the *Astrolabe* in 1841, and other French expeditions; and I sincerely hope that a further expedition of the present kind may take place next year in the Mediterranean, where our good and gallant neighbours have such an important stake.

The list of Mollusca referred to in this paper includes the following new species named or recognised by the author:—*Pecten obliquatus*, *Lima Jeffreysi* (Fischer), *Mytilus luteus*, *Modiolaria cuneata*, *Axinus tortuosus*, *Mytilimeria* (?) *Fischeri*, *Thracia tenera*, *Cadulus semistriatus*, *Rimula asturiana*, *Odostomia lineata*, and *Bullina elongata*. The species which he considers peculiarly northern are *Chiton alveolus*, G. O. Sars, *Fusus turgidulus*, Jeffreys, and *Pleurotoma nivalis*, Lovén; and the species which he considers peculiarly southern or Mediterranean is *Odostomia fasciatus*, Forbes.

THE SHOWER OF AUGUST PERSEIDS, 1880

THE August meteors were observed under peculiarly favourable circumstances this year. Not only was the moon entirely absent during the display, but the weather, which so frequently interrupts such observations, remained fine night after night, thus allowing an unbroken series of watches to be maintained from the 6th to the 13th, and enabling the rise and fall of the display to be distinctly traced from a comparison of the results obtained each night. On the 10th, however, when the maximum was expected, the state of the sky scarcely admitted of successful observation, and the number of shooting-stars recorded that night was below the experiences of past years, but it must be remembered that, this being leap year, the chief intensity of the shower was due earlier than usual, so that it may have occurred before the evening of the 10th, when observers generally were watching for its reappearance.

At Bristol the following summary was derived from observations by the writer:—

Date, 1880.	Length of watch.	Time of watch.	No. of meteors seen.	No. of Perseids.	Horary Nos. for one observer.		Chief radiant point.
					All meteors.	Perseids.	
	h.	h. h.					° °
August 6	1½	10 –11½	19	5	13	3 }	38 +56
7–8	4½	11 –14	112	54	25	12 }	41 +55
9	2½	11 –13½	111	71	44	28	44 +55
10	1½	10 –11½	50	41	34	28	45 +57
11	2½	10½–13	64	43	26	17 }	48 +57
12	2½	10½–13	45	19	18	8 }	
13	1½	10½–12	18	7	12	5	49½+57½
Aug. 6–13	16½	10–14	419	240	24·6	14·4	44 +56

The observed maximum occurred on the 9th, when, during a watch of 2½ hours, meteors were falling at the rate of 44 per hour (for one observer), and the proportion of Perseids was nearly two-thirds of the aggregate number visible. On the 10th the horary number of 34 was determined under less favourable conditions. A fog partially overspread the sky, rendering the stars dim, so that many small meteors passed unrecorded, and at 11½h. it was found impracticable to continue observations. The horary number of Perseids found on the 10th coincides with that of the preceding night, and it is obvious that, allowing for the clearer atmosphere of the 9th, the maximum of the display really occurred as usual on the 10th. It is fair to assume from the numbers actually counted in the fog-shrouded sky of the 10th that later in the night, as the radiant attained greater elevation, the meteors from Perseus were as numerous as during the few preceding apparitions of the shower. The brightest meteor observed at Bristol appeared at 13h. 37m., on August 8. The sky had become overcast except near the western horizon, where a few stars could still be distinguished. A vivid flash startled the observer, who, on looking towards the direction indicated, at once saw a brilliant meteor streak attached to the star γ Ophiuchi, and its position was such as to leave no doubt that it had been left by a magnificent Perseid. Other large meteors were registered as follows:—

	Time.	Mag.	Path		Length.
			From	To	
	h. m.				
August 6	10 52½	♂	51 +66	60 +70	6
7	10 49	♂	265 −10	261½−19	10
7	12 0	♂	329 +10	322½± 0	12
7	12 25	<♀	55 +53	64 +50	6
7	12 54	♂	52 +48½	55 +45	4
8	10 5	♂	61 +72	109 +76	13
8	11 14	♂	314½− 2	306 −18	17
8	11 32	♂	16 +46	2 +36½	14
8	12 8	♂	324 +43	310 +30	17
8	12 49	<♃	28 +44	24 +39¾	5
9	11 35	♂	36 +33	35 +27	6
9	12 5	♂	36 +34	33½+28	7
9	12 23	>♀	332 + 7	320 −10	20
9	12 40	♃	122 +73	158 +66½	14
10	10 29	♃	316 +81	259 +67	19
10	11 11	♃	327 +55	302 +37	24
11	9 20	♃	291 +12	292 − 3	15
11	10 40	♂	331 +47	312 +28	23½
11	11 10	♂	322 +15	304 −10	30
11	11 52	♂	343 +20	332 + 3	19
12	11 15	♂	322 +49	328 +30	19½

These meteors all belonged to the shower of Perseids. Motions very swift. They all left bright streaks.

The radiant point showed a displacement on nearly every successive night of observation. It was noted at 38° + 56° on the 6th, yet on the 13th a few meteors indicated it very exactly at 49½° + 57½°. This corroborates observations made by the writer in 1877, and reported in NATURE, vol. xvi. p. 362. A large number of Perseids were seen that year, and from an exact record of their flights the radiant point was seen to advance in R.A. as follows:—

$$
\begin{aligned}
& \qquad\qquad\qquad \alpha \qquad \delta \\
1877,\ \text{August } 3\text{–}7 &= 40^\circ + 56^\circ \\
10 &= 43^\circ + 58^\circ \\
12 &= 50\ + 56^\circ \\
16 &= 60^\circ + 59^\circ
\end{aligned}
$$

This is further borne out by Mr. Henry Corder's extensive observations at Writtle, near Chelmsford, during the recent display, which may be tabulated as under:—

1880.	Watch.	Time.	Meteors seen.	Perseids.	Radiant point.
	h.	h.			
August 1	2½	9½–12	25	9	35 + 56
2	1½	10½–12¼	21	7	{ 35 + 56
4	2	10 –12½	35	13	{ 46 + 57
6	¾	{10 –10¼ / 14 –14½}	13	6	43 + 56
8	2½	10 –13	59	26	45 + 59
9	4¼	9 –13¼	120	84	45 + 58
10	1	9 –12	46	39	—
11	3	9 –13	76	50	46 + 58
Aug. 1–11	17½	9 –14½	395	234	

Mr. Corder places the average position of the radiant of the true Perseids at 45° + 58°. On the first few nights of August he found it well defined at 35° + 56°, though on the 11th it had apparently shifted to 46° + 58°. And it is to be remarked that on July 29-30 Mr. Corder had seen a shower of twenty meteors from the point $29° + 56°$, which no doubt represented the first on-coming of the Perseids.

The night of August 10 at Mr. Corder's station was very hazy and generally overcast, so that though he was watching during the three hours preceding midnight, he estimated that his observation was not more than an equivalent to one hour of clear sky. He reckoned that under favourable conditions of the atmosphere the Perseids were falling at the rate of 40 per hour. Only one meteor he saw on the 10th was a fine one about = ♃. It appeared at 11h. 23m. rather low in Ursa It was rich orange in colour, with a long narrow streak broken in the middle. On August 11 Mr. Corder found meteors scarce; the shower had evidently fallen off considerably. The horary numbers found at Bristol were 26 of all meteors and 17 of Perseids, which very closely corresponds with Mr. Corder's figures, for, observing for three hours, he saw 76 meteors, amongst which were 50 Perseids. He mentions several instances in which the Perseid streaks were broken, and the same feature was frequently observed at Bristol. In such cases the nucleus had several maxima, and the streak-producing power seemed intensified at the point of each outburst.

Mr. Corder mentions a bright aurora as visible on the 11th and 12th instant. They were seen at Bristol also, but the phenomenon of the 12th was by far the most conspicuous. At about 10h. 20m. there was a vivid arch of crimson light spanning the horizon below the stars $\beta - \gamma$ of Ursa Major, and the whole northern quadrant was aglow with streamers. But it soon lost its striking character, though there were indications of streamers at a much later period, and an auroral glow was apparent above the north-west horizon as late as 14h. It was also seen by the Rev. S. J. Johnson at Mitcheldean, Glos., who writes:—"On the 12th there was a somewhat striking display of aurora. It began at 10h. 29m., and was bounded on the east by Capella, and on the west by Arcturus. The columns were often very vivid, but the brilliant character of the phenomenon only lasted 12 minutes."

Major Tupman observing at Cookham, near Maidenhead, Berks, reports the weather very cloudy on August 8, after 11h. 34m. In one hour (10h. 34m.—11h. 34m.) 13 meteors were seen, of which all but 2 were Perseids. August 9 very clear, and the sky watched from 9h. 56m. to 12h. 5m., when 31 meteors were seen, including 28 Perseids and 3 Cygnids. August 10—watch sustained from 9h. 5m. to 10h. 43m., when 15 or 16 Perseids were noted, and a few other small meteors. Sky clouded up at 10h. 43m. August 11 cloudy. Partly clear at 10h. 55m., and 3 Perseids observed, but at 11h. 9m. it again became overcast, and prevented further observation. The radiant point derived from a number of very accurately observed paths on August 9 was at $44° + 56°$, with indications of a sub-radiant 4° higher in declination.

The Rev. G. T. Ryves, of Stoke-on-Trent, writes as follows:—

"August 8—10h. to 11h.—19 meteors seen, of which not more than 10 or 11 were Perseids. Soon after 11h. clouds formed, and interrupted further watching.

August 9, 9h. 45m. to 11h., 65 meteors seen.
,, 11h. to 12h. 45m., 30 meteors seen.

"From 80 to 85 were Perseids. The falling off in numbers after 11h. is only apparent, as up to that time I had been assisted by two pairs of eyes, and owing to my defective sight many of the smaller meteors would have escaped me afterwards.

"August 10, 9h. 30m. to 11h. 30m., 126 meteors seen. Nearly all of these were Perseids. During the whole of this period I was assisted by the two young observers above alluded to. Several brilliant meteors were recorded. On August 9, 12h. 25m., one was imperfectly seen in the Milky Way near horizon, in S.W., moving about S.W." This is obviously the same as one described at Bristol at 12h. 23m. the same night.

Another was seen by Mr. Ryves at 12h. 35m., August 9, moving very slightly west of, and parallel to, the stars δ and γ of Cygnus, and at 11h. 2m., August 10, a fine meteor shot towards Aquila, the end point being noted slightly below and west of Altair. These meteors were evidently Perseids, though Mr. Ryves saw only a small proportion of brilliant meteors. He remarks: "The most noticeable feature in this year's display has been the great falling off in the average brightness of the meteors as compared with former years. Of the 240 meteors seen here not more than a dozen were such as would have attracted the attention of any one but trained observers, the great majority requiring rather exceptionally keen eyes to detect them at all."

Mr. Cornish, at Debenham, Suffolk, gives the following summary of watches between August 1 and 12:—

	Meteors.	Observers.
August 1, 10h. 15m. to 11h. 40m. ...	13	... V. Cornish
9, 10h. to 11h.	23	... H. Heather
9, 10h. 40m. to 11h.	13	... V. Cornish
11, 9h. 48m. to 11h. 38m. ...	56	... V. Cornish
12, 9h. 3m. to 9h. 33m.	6	... H. Heather

On the 11th no less than 24 were noted during the first half-hour's observation. The sky was partly cloudy after 11h. A 1st mag. stationary meteor was seen at $348\frac{1}{2} - 23$ on August 4, at 13h. 48m. On August 9, 10h. 23m., a meteor = Sirius shot from $0° + 37°$ to $349° + 28°$, and it appears to be identical with a fine meteor registered by Mr. Ryves at Stoke-on-Trent, August 9, 10h. 25m., path from α Andromedæ to α Pegasi. Mr. Cornish remarks that "the recent display of Perseids was not equal to that of last year, even supposing the circumstances to have been as favourable." It must be remembered, however, that on the all-important night of August 10 few observations could be obtained, owing to the generally unfavourable state of the sky, and that under these conditions a comparison cannot fairly be instituted. Mr. Corder estimated the horary rate of Perseids as 40 per hour on the 10th; and at Bristol, where the stars could only be seen in dim outline through the fog-laden atmosphere, the number actually counted at an early period of the night was 28 per hour. This compares favourably with the last successful observation of this shower obtained by the writer in 1877, when, with a perfectly clear sky, 57 Perseids were noted between 9½h. to 11h., = 38 per hour. Making allowance for the difference of weather, the recent display, though it cannot be regarded as in any way exceptional, may yet be classed as a fairly active return of the shower; and it is fortunate that on the several nights immediately preceding and following the 10th, the state of the sky allowed its progress to be traced with unusual distinctness.

The Rev. S. J. Johnson, at Abbenhall Rectory, Mitcheldean, Glos., saw 20 meteors during an hour's watch (10h. 57m. to 11h. 57m.) on August 9. The following night there was much cloud about at times, especially in the eastern sky, so that only 16 meteors were seen between 10h. 3m. and 11h. 3m. On the 11th the night was very clear, and 12 meteors seen between 10h. and 11h. Mr. Johnson gives a list of the brighter meteors, which includes several nearly equal to Jupiter, and many 1st magnitude.

The night of the 9th appears to have been very favourable at all stations, and more shooting-stars were seen on that date than on the 10th, when the sky was in part overcast. On the 11th there was a very evident falling-off in the number of meteors observed at Chelmsford and Bristol, the horary rate of apparition of the Perseids being noted as 17 at both places. The following night it had fallen to 8, and on the 13th to 5, as derived from observations at Bristol, and the absolute cessation of the shower was evidently near at hand.

W. F. DENNING

INTERNATIONAL METEOROLOGY

THE International Meteorological Committee appointed by the Congress of Rome held its first meeting at the Observatory, Berne, from the 9th to the 12th ultimo. All the members of the Committee, nine in number, were present. Their names are as follows:—

Prof. H. Wild (president), Mr. R. H. Scott (secretary), Professors Buys Ballot and Cantoni, Capt. de Brito Capello, Professors Hann, Mascart, and Mohn, and Dr. Neumayer. The following is a brief notice of the most interesting results of the meeting:—

The International Comparison of Standard Instruments.—The original scheme for this undertaking was based on the supposition that thirty-six European observatories would take part in it, each paying a contribution of about 15*l*. The number of acceptances of the proposal up to the date of the meeting was, however, insufficient to justify the Committee in commencing the comparison, and it was therefore determined to recommend each country to carry out a careful comparison of its own standard instruments with those of neighbouring countries.

The International Simultaneous Observations.—The proposal recently made by the Chief Signal Office, Washington, to change the time of this observation from 0h. 43m. to 0h. 8m. p.m. was discussed, and it was resolved to accede to the proposal, notwithstanding the inconvenience which the change might entail in individual systems of observation.

The Proposal for Concerted Arctic Observations.—The International Polar Commission appointed at Hamburg, in October, 1879, presented a report of a meeting it had recently held at Berne, and announced that Count Wilczek and Lieut. Weyprecht had consented to postpone their expedition to Nova Zembla until 1882 in order to allow of more time for the organisation of the other expeditions destined to co-operate with them. The International Committee resolved to aid the scheme by all the means in their power.

The Publication of Data referring to Rain, &c.—A proposal made by Dr. Köppen for an improved method of publication of information relating to rain, snow, &c., was ordered to be circulated among the different observatories, in order to obtain opinions as to its suitability.

Telegraphic Communication with the Atlantic Islands.—Capt. Hoffmeyer submitted a resolution as to the desirability of laying cables to the Faroes, Iceland, Greenland, and to the Azores. The Committee expressed their hope that it might be found possible to lay these cables, which would be of very great importance for the weather service of Europe.

The Publicaeion of Average Values for Meteorological Data.—The Committee, at Capt. Hoffmeyer's suggestion, recommended that all meteorological organisations should publish regularly the mean values for the most important elements for the telegraphic and international stations.

The Catalogue of Meteorological Literature.—A proposal made by Dr. Hellmann of Berlin for the preparation of such a catalogue was considered. Dr. Hellmann stated that he had calculated the cost of preparation of the catalogue of printed books and memoirs at about 550*l.*, and that of printing and publication (1,000 copies) at about 750*l.*

Several of the members of the Committee promised to aid in carrying out the scheme, if it were seriously undertaken, by the preparation of catalogues of the literature which exists in their own individual languages. The subject was finally referred to Mr. Scott and Dr. Hellmann, with power to act if they found sufficient encouragement.

As to the catalogue of unpublished records of observations, no definite resolution was adopted.

International Tables for the Reduction of Observations.—It was stated that a publishing firm in Leipzig was prepared to print and publish such tables at its own risk if the "copy" were delivered to them. The subject was referred to Prof. Mascart and Prof. Wild for the preparation of a definite plan for the calculation of the tables.

The Committee will include in its Report, which will shortly appear, a notice of the progress made in each country in carrying out the resolutions of the Congress of Rome.

It only remains to say that the members of the Committee were most hospitably entertained by the Federal Council and by the Municipality of Berne.

AGRICULTURAL CHEMISTRY [1]

SOME of my predecessors in this chair, whose duties as teachers of chemistry lead them to traverse a wide range of the subject every year, have appropriately and usefully presented to the Section a *résumé* of the then recent progress in the manifold branches of the science which have now such far-reaching ramifications. Some, on the other hand, have confined attention to some department with which their own inquiries have more specially connected them.

But it seems to me that there is a special reason why I should bring the subject of Agricultural Chemistry before you on the present occasion. Not only is the application of chemistry to agriculture included in the title of this Section, but in 1837 the Committee of the Section requested the late Baron Liebig to prepare a report upon the then condition of Organic Chemistry, and it is now exactly forty years since Liebig presented to the British Association the first part of his report, which was entitled "Organic Chemistry in its Applications to Agriculture and Physiology"; and the second part was presented two years later, in 1842, under the title of "Animal Chemistry, or Organic Chemistry in its Application to Physiology and Pathology." Yet, so far as I am aware, no President of the Section has, from that time to the present, taken as the subject of his address the Application of Chemistry to Agriculture.

Appropriate as, for these reasons, it would seem that I, who have devoted a very large portion of the interval since the publication of Liebig's works, above referred to, to agricultural inquiries, should occupy the short time that can be devoted to such a purpose in attempting to note progress on that important subject, it will be readily understood that it would be quite impossible to condense into the limits of an hour's discourse anything approaching to an adequate account, either of the progress made during the last forty years, or of the existing condition of agricultural chemistry.

For what is agricultural chemistry? It is the chemistry of the atmosphere, the chemistry of the soil, the chemistry of vegetation, and the chemistry of animal life and growth. And but a very imperfect indication of the amount of labour which has been devoted of recent years to the investigation of these various branches of what might at first sight seem a limited subject will suffice to convince you how hopeless a task it would be to seek to do more than direct attention to a few points of special interest.

From what we now know of the composition and of the sources of the constituents of plants, it is obvious that a knowledge of the composition of the atmosphere and of water was essential to any true conception of the main features of the vegetative process; and it is of interest to observe that it was almost simultaneously with the establishment, towards the end of the last century, of definite knowledge as to the composition of the air and of water, that their mutual relations with vegetation were first pointed out. To the collective labours of Black, Scheele, Priestly, Lavoisier, Cavendish, and Watt, we owe the knowledge that common air consists chiefly of nitrogen and oxygen, with a little carbonic acid; that carbonic acid is composed of carbon and oxygen; and that water is composed of hydrogen and oxygen; whilst Priestly and Ingenhousz, Sennebier and Woodhouse, investigated the mutual relations of these bodies and vegetable growth. Priestly observed that plants possessed the faculty of purifying air vitiated by combustion or by the respiration of animals; and, he having discovered oxygen, it was found that the gaseous bubbles which Bonnet had shown to be emitted from the surface of leaves plunged in water consisted principally of that gas. Ingenhousz demonstrated that the action of light was essential to the development of these phenomena; and Sennebier proved that the oxygen emitted resulted from the decomposition of the carbonic acid taken up.

De Saussure concluded that air and water contributed a much larger proportion of the dry substance of plants than did the soils in which they grew. In his view a fertile soil was one which yielded liberally to the plant nitrogenous compounds, and the incombustible or mineral constituents; whilst the carbon, hydrogen, and oxygen, of which the greater proportion of the dry substance of the plant was made up, were at least mainly derived from the air and water.

Perhaps I ought not to omit to mention here that, each year for ten successive years, from 1802 to 1812, Sir Humphry Davy delivered a course of lectures on the "Elements of Agricultural Chemistry," which were first published in 1813, were finally revised by the author for the fourth edition in 1827, but have gone through several editions since. In those lectures Sir Humphry Davy passed in review and correlated the then existing knowledge, both practical and scientific, bearing upon agriculture. He treated of the influences of heat and light; of the organisation of plants; of the difference, and the change, in the chemical composition of their different parts; of the sources, composition, and treatment of soils; of the composition of the atmosphere, and its influence on vegetation; of the composition and the action of manures; of fermentation and putrefaction; and finally of the principles involved in various recognised agricultural practices.

With the exception of these discourses of Sir Humphry Davy, the subject seems to have received comparatively little attention, nor was any important addition made to our knowledge in regard to it during the period of about thirty years from the date of the appearance of De Saussure's work in 1804 to that of the commencement of Boussingault's investigations.

In 1837 Boussingault published papers on the amount of gluten in different kinds of wheat, on the influence of the clearing of forests on the diminution of the flow of rivers, and on the

[1] Opening Address in Section B (Chemical Science), at the Swansea meeting of the British Association, by J. H. Gilbert, Ph.D., F.R.S., V.P.C.S., F.L.S., President of the Section.

meteorological influences affecting the culture of the vine. In 1838 he published the results of an elaborate research on the principles underlying the value of a rotation of crops. He determined by analysis the composition, both organic and inorganic, of the manures applied to the land, and of the crops harvested. In his treatment of the subject he evinced a clear perception of the most important problems involved in such an inquiry; some of which, with the united labours of himself and many other workers, have scarcely yet received an undisputed solution.

Thus, in the same year (1838), he published the results of an investigation on the question whether plants assimilate the free or uncombined nitrogen of the atmosphere; and although the analytical methods of the day were inadequate to the decisive settlement of the point, his conclusions were in the main those which much subsequent work of his own, and much of others also, has served to confirm.

The foregoing brief historical sketch is sufficient to indicate, though but in broad outline, the range of existing knowledge on the subject of agricultural chemistry prior to the appearance of Liebig's memorable work in 1840. It will be seen that some very important and indeed fundamental facts had already been established in regard to vegetation, and that Boussingault had not only extended inquiry on that subject, but he had brought his own and previous results to bear upon the elucidation of long recognised agricultural practices. There can be no doubt that the data supplied by his researches contributed important elements to the basis of established facts upon which Liebig founded his brilliant generalisations. Accordingly, in 1841, Dumas and Boussingault published jointly an essay which afterwards appeared in English under the title of "The Chemical and Physiological Balance of Organic Nature;" and in 1843 Boussingault published a larger work, which embodied the results of many of his own previous original investigations.

The appearance of Liebig's two works, which were contributions made in answer to a request submitted to him by the committee of this Section of the British Association, constitute a very marked epoch in the history of the progress of agricultural chemistry. In the treatment of his subject he not only called to his aid the previously existing knowledge directly bearing upon it, but he also turned to good account the more recent triumphs of organic chemistry, many of which had been won in his own laboratory. Further, a marked feature of his expositions was the adoption of what may be called the *statistical* method—I use the word statistical rather than quantitative, as the latter expression has its own technical meaning among chemists, which is not precisely what I wish to convey.

The discussion of the processes of fermentation, decay, and putrefaction, and that of poisons, contagions, and miasms, constituted a remarkable and important part of Liebig's first report. It was the portion relating to poisons, contagions, and miasms, that he presented to this Section as an instalment, at the meeting of the Association held at Glasgow in 1840. It was in the chapters relating to the several subjects here enumerated that he developed so prominently his views on the influence of contact in inducing chemical changes. He cited many known transformations, other than those coming under either of the heads in question, in illustration of his subject; and he discussed with great clearness the different conditions occurring, and the different results obtained, in various processes—such as the different modes of fermenting beer, the fermentation of wine from different kinds of grapes, the production of acetic acid, &c. As is well known, he claimed a purely chemical explanation for the phenomena involved in fermentation. He further maintained that the action of contagions was precisely similar. In his latest writings on the subject (in 1870) he admits some change of view; but it is by no means easy to decide exactly how much or how little of modification he would wish to imply.

Liebig's second report, presented at the meeting of this Association in 1842, and published under the title of "Animal Chemistry, or Organic Chemistry in its Applications to Physiology and Pathology," perhaps excited even more attention than his first; and, probably from the manner as much as from the matter, aroused a great deal of controversy, especially among physiologists and physicians. Liebig was severe upon what he considered to be a too exclusive attention to morphological characters in physiological research, and at any rate too little attention to chemical phenomena, and, so far as these were investigated, an inadequate treatment of the subject according to strictly quantitative methods.

Omitting the fat which the carnivora might receive in the animals they consumed, he stated the characteristic difference between the food of carnivora and herbivora to be, that the former obtained the main proportion of their respiratory material from the waste of tissue; whilst the latter obtained a large amount from starch, sugar, &c. These different conditions of life accounted for the comparative leanness of carnivora and fatness of herbivora.

He maintained that the vegetable food consumed by herbivora did not contain anything like the amount of fat which they stored up in their bodies; and he showed how nearly the composition of fat was obtained by the simple elimination of so much oxygen, or of oxygen and a little carbonic acid, from the various carbohydrates. Much less oxygen would be required to be eliminated from a quantity of fibrine, &c., containing a given amount of carbon, than from a quantity of carbohydrates containing an equal amount of carbon. The formation of fatty matter in plants was of the same kind; it was the result of a secondary action, starch being first formed from carbonic acid and water.

He concluded from the facts adduced that the food of man might be divided into the *nitrogenised* and the *non-nitrogenised* elements. The former were capable of conversion into blood, the latter incapable of such transformation. The former might be called the *plastic elements of nutrition*, the latter *elements of respiration*. From the plastic elements, the membranes and cellular tissue, the nerves and brain, cartilage, and the organic part of bones, could be formed; but the plastic substance must be received ready-made. Whilst gelatine or chondrine was derived from fibrine or albumen, fibrine or albumen could not be reproduced from gelatine or chondrine. The gelatinous tissues suffer progressive alteration under the influence of oxygen, and the materials for their re-formation must be restored from the blood. It might however be a question whether gelatine taken in food might not again be converted into cellular tissue, membrane, and cartilage, in the body.

Apparently influenced by the physiological considerations which have been adduced, and notwithstanding in some passages he seemed to recognise a connection between the total quantity of oxygen inspired and consumed and the quantity of mechanical force developed, Liebig nevertheless very prominently insisted that the amount of muscular tissue transformed—the amount of nitrogenous substance oxidated—was the measure of the force generated. He accordingly distinctly draws the conclusion that the requirement for the azotised constituents of food will be increased in proportion to the increase in the amount of force expended.

It will be obvious that the question whether in the feeding of animals for the exercise of mechanical force, that is, for their labour, the demands of the system will be proportionally the greater for an increased supply of the nitrogenous or of the non-nitrogenous constituents of food, is one of considerable interest and practical importance. To this point I shall have to refer further on.

So far, I have endeavoured to convey some idea of the state of knowledge on the subject of the chemistry of agriculture prior to the appearance of Liebig's first two works bearing upon it, and also briefly to summarise the views he then enunciated in regard to some points of chief importance. Let us next try to ascertain something of the influence of his teaching.

Confining attention to agricultural research, it may be observed that about the year 1843, that is very soon after the appearance of the works in question, there was established the Chemico-Agricultural Society of Scotland, which was, I believe, broken up, after it had existed about five years, because its able chemist, the late Prof. Johnston, was unable to find a remedy for the potato disease. Shortly after this, the Highland and Agricultural Society of Scotland appointed a consulting chemist; somewhat later the Royal Agricultural Society of England did the same; and later still followed the Chemico-Agricultural Society of Ulster. Lastly, the very numerous "Agricultural Experimental Stations" which have been established, not only in Germany, but in most Continental States, owe their origin directly to the writings, the teachings, and the influence of Liebig. The movement seems to have originated in Saxony, where Stöckhardt had already stimulated interest in the subject by his lectures and his writings. After some correspondence, in 1850-51, between the late Dr. Crucius and others on the one side, and the Government on the other, the first so-called "Agricultural Experimental Station" was established at Möchern, near Leipzig, in 1851-52. In 1877 the twenty-fifth anniversary of the foundation of that institution was celebrated at Leipzig, when an account (which has since been published) was given of the number of stations then existing, of the number of chemists engaged, and of the subjects which had been investigated. From that statistical statement we learn that in 1877 the number of stations was 122.

Besides these stations on the Continent of Europe, the United States are credited with one, and Scotland also with one.

Each of these stations is under the direction of a chemist, frequently with one or more assistants. One special duty of most of them is what is called manure- or seed- or feeding-stuff-control; that is, to examine or analyse, and report upon such substances in the market, and it seems to have been found to the interest of dealers in these commodities to submit their proceedings to a certain degree of supervision by the chemist of the station of their district.

But agricultural research has always been a characteristic feature of these institutions. It is stated that the investigation of soils has been the prominent object at 16 of them, experiments with manures at 24, vegetable physiology at 28, animal physiology and feeding experiments at 20, vine culture and wine making at 13, forest culture at 9, and milk production at 11. Others, according to their locality, have devoted special attention to fruit culture, olive culture, the cultivation of moor, bog, and peat land, the production of silk, the manufacture of spirit, and other products.

Nor does this enumerations of the institutions established as the direct result of Liebig's influence, and of the subjects investigated under their auspices, complete the list either of the workers engaged, or of the work accomplished in agricultural research. To say nothing of the labours of Boussingault, which commenced some years prior to the appearance of Liebig's first work, and which are fortunately still at the service of agriculture, important contributions have been made by the late Professors Johnston and Anderson in Scotland, and in this country both by Mr. Way and Dr. Voelcker, each alike in his private capacity, and in fulfilment of his duties as Chemist to the Royal Agricultural Society of England. Nor would it be fair to Mr. Lawes (who commenced experimenting first with plants in pots, and afterwards in the field, soon after entering into possession of his property in 1834, and with whom I have myself been associated since 1843), were I to omit in this place any mention of the investigations which have been so many years in progress at Rothamsted.

So much for the machinery; but what of the results achieved by all this activity in the application of chemistry to agriculture?

The more I have looked at the subject with the hope of treating it comprehensively, the more I have been impelled to substitute a very limited plan for the much more extended scheme which I had at first hoped to be able to fill up. I propose then to confine attention to a few special points, which have either some connection with one another, or to which recent results or discussions lend some special interest.

First as to the sources and the assimilation of the carbon, the hydrogen, and the oxygen of vegetation. From the point of view of the agricultural chemist, the hydrogen and the oxygen may be left out of view. For, if the cultivator provide to the plant the conditions for the accumulation of sufficient nitrogen and carbon, he may leave it to take care of itself in the matter of hydrogen and oxygen. That the hydrogen of the carbohydrates is exclusively obtained from water, is, to say the least, probable; and whether part of their oxygen is derived from carbonic acid, and part from water, or the whole from either of these, will not affect his agricultural practice.

With regard to the carbon, the whole tendency of subsequent observations is to confirm the opinion put forward by Dr. Saussure about the commencement of the century, and so forcibly insisted upon by Liebig forty years later—that the greater part, if not the whole of it, is derived from the carbonic acid of the atmosphere. Indeed, direct experiments are not wanting—those of Moll, for example—from which it has been concluded that plants do not even utilise the carbonic acid which they may take up from the soil by their roots. However this may be, we may safely conclude that practically the whole of the carbon which it is the object of the cultivator to force the plants he grows to take up is derived from the atmosphere, in which it exists in such extremely small proportion, but nevertheless large actual, and constantly renewed amount.

Judging from the more recent researches on the point, it would seem probable that the estimate of one part of carbon, as carbonic acid, in 10,000 of air, is more probably too high than too low as an estimate of the average quantity in the atmosphere of our globe. And, although this corresponds to several times more in the column of air resting over an acre of land than the vegetation of that area can annually take up, it represents an extremely small amount at any one time in contact with the growing plants, and could only suffice on the supposition of a very rapid renewal accomplished as the result, on the one hand, of a constant return of carbonic acid to the atmosphere by combustion and the respiration of animals, and, on the other, of a constant interchange and equalisation among the constituents of the atmosphere.

It will convey a more definite idea of what is accomplished by vegetation in the assimilation of carbon from the atmosphere if I give, in round numbers, the results of some direct experiments made at Rothamsted, instead of making general statements merely.

In a field which has now grown wheat for thirty-seven years in succession there are some plots to which not an ounce of carbon has been returned during the whole of that period. Yet, with purely mineral manure, an average of about 1,000 pounds of carbon is annually removed from the land; and where a given amount of nitrogenous manure is employed with the mineral manure, an average of about 1,500 pounds per acre per annum more is obtained; in all an average of about 2,500 pounds of carbon annually assimilated over an acre of land without any return of carbonaceous manure to it.

In a field in which barley has been grown for twenty-nine years in succession, quite accordant results have been obtained. There smaller amounts of nitrogenous manure have been employed with the mineral manure than in the experiments with wheat above cited; but the increase in the assimilation of carbon for a given amount of nitrogen supplied in the manure is greater in the case of the barley than of the wheat.

With sugar-beet again, larger amounts of carbon have been annually accumulated without the supply of any to the soil, but under the influence of a liberal provision of both nitrogenous and mineral manure, than by either wheat or barley.

Lastly, with grass, still larger amounts of carbon have been annually accumulated, without any supply of it by manure.

Many experiments have been made in Germany and elsewhere, to determine the amount of the different constituents taken up at different periods in the growth of various plants. But we may refer to some made at Rothamsted long ago to illustrate the rapidity with which the carbon of our crops may be withdrawn from the atmosphere.

In 1847 we carefully took samples from a growing wheat crop at different stages of its progress, commencing on June 21, and in these samples the dry matter, the mineral matter, the nitrogen, &c., were determined. On each occasion the produce of two separate eighths or sixteenths of an acre was cut and weighed, so that the data were provided to calculate the amounts of the several constituents which had been accumulated per acre at each period. The result was that, whilst during little more than five weeks from June 21 there was comparatively little increase in the amount of nitrogen accumulated over a given area, more than half the total carbon of the crop was accumulated during that period.

I should say that determinations of carbon, made in samples of soil taken from the wheat-field at different periods during recent years, indicate some decline in the percentage of carbon in the soils, but not such as to lead to the supposition that the soils have contributed to the carbon of the crops. Besides the amount of carbon annually removed, there will of course be a further accumulation in the stubble and roots of the crops; and the reduction in the total carbon of the soil, if such have really taken place, would show that the annual oxidation within the soil is greater than the annual gain by the residue of the crops.

Large as is the annual accumulation of carbon from the atmosphere over a given area in the cases cited, it is obvious that the quantity must vary exceedingly with variation of climatal conditions. It is, in fact, several times as great in the case of tropical vegetation—that of the sugar-cane, for example. And not only is the greater part of the assimilation accomplished within a comparatively small portion of the year (varying of course according to the region), but the action is limited to the hours of daylight, whilst during darkness there is rather loss than gain.

But it is remarkable that whilst the accumulation of carbon, the chief gain of solid material, takes place under the influence of light, cell-division, cell-multiplication, increase in the structure of the plant, in other words, what, as distinguished from assimilation, vegetable physiologists designate as *growth*, takes place, at any rate chiefly, during the night; and is accompanied, not with the taking up of carbonic acid and the yielding up of oxygen, but with the taking up of oxygen and the giving up of carbonic acid. This evolution of carbonic acid during darkness must obviously be extremely small, compared with the converse action during daylight, coincidentally with which practically the whole of the accumulation of solid substance is accomplished. But as the product of the night action is the same as in the respiration of animals, this is distinguished by vegetable physiologists as the respiration of plants.

I suppose I shall be considered a heretic if I venture to suggest that it seems in a sense inappropriate to apply the term *growth* to that which is associated with actual loss of material, and that the term *respiration* should be applied to so secondary an action as that as the result of which carbonic acid is given off from the plant. It may, I think, be a question whether there is any advantage in thus attempting to establish a parallelism between animal and vegetable processes; rather would it seem advantageous to keep prominently in view their contrasted, or at any rate complementary characteristics, especially in the matter of the taking up of carbonic acid and the giving up of oxygen on the one hand, and the taking in of oxygen and the giving up of carbonic acid on the other.

But it is obvious that in latitudes where there is comparatively continuous daylight during the periods of vegetation, the two actions—designated respectively assimilation and growth—must go on much more simultaneously than where there is a more marked alternation of daylight and darkness. In parts of Norway and Sweden, for example, where during the summer there is almost continuous daylight, crops of barley are grown with only from six to eight weeks intervening from seed-time to harvest. And Prof. Schübeler, of Christiania, after making observations on the subject for nearly thirty years, has recently described the characteristics of the vegetation developed under the influence of short summers with almost continuous light. He states that, after acclimatisation, many garden flowers increase in size and depth of colour; that there is a prevailing tinge of red in the plants in the fjelds; that the aroma of fruits is increased, and their colour well developed, but that they are deficient in sweetness; and that the development of essential oils in certain plants is greater than in the same plants grown in other latitudes. Indeed he considers it to be an established fact that light bears the same relation to aroma as heat does to sweetness.

In connection with this question of the characters of growth under the influence of continuous light, compared with those developed with alternate light and darkness, the recent experiments of Dr. Siemens on the influence of electric light on vegetation are of considerable interest.

In one series of experiments he kept one set of plants entirely in the dark, a second he exposed to electric light only, a third to daylight only, and a fourth to daylight and afterwards to electric light from 5 to 11 p.m. Those kept in the dark acquired a pale yellow colour, and died; those exposed to electric light only maintained a light green colour, and survived; those exposed to daylight were of a darker green colour, and were more vigorous; and, lastly, those submitted to alternate daylight and electric light, and but a few hours of darkness, showed decidedly greater vigour, and, as he says, the green of the leaf was of a dark rich hue. He concluded that daylight was twice as effective as electric light; but that, nevertheless, "electric light was clearly sufficiently powerful to form chlorophyll and its derivatives in the plants."

In a second series of experiments one group of plants was exposed to daylight alone; a second to electric light during eleven hours of the night, and was kept in the dark during the day; and a third to eleven hours day, and eleven hours electric light. The plants in daylight showed the usual healthy appearance; those in alternate electric light and darkness were for the most part of a lighter colour; and those in alternate daylight and electric light far surpassed the others in darkness of green and vigorous appearance generally.

I have carefully considered these general descriptions with a view to their bearing on the question whether the characters developed under the influence of electric light, and especially those under the influence of almost continuous light, are more prominently those of assimilation or of growth; but I have not been able to come to a decisive opinion on the point. From some conversation I had with Dr. Siemens on the subject, I gather that the characteristics were more those of dark colour and vigour than of tendency to great extension in size. The dark green colour we may suppose to indicate a liberal production of chlorophyll; but if the depth of colour was more than normal it might be concluded that the chlorophyll had not performed its due amount of assimilation work. In regard to this point attention may be called to the fact that Dr. Siemens refers to the abundance of the blue or actinic rays in the electric arc, conditions which would not be supposed specially to favour assimilation. On the other hand, the vigour, rather than characteristic extension in size, would seem to indicate a limitation of what is technically called growth, under the influence of the almost continuous light.

Among the numerous field experiments made at Rothamsted, we have many examples of great variation in depth of green colour of the vegetation growing on plots side by side under known differences as to manuring; and we have abundant evidence of difference of composition, and of rate of carbon-assimilation, coincidently with these different shades of colour. One or two instances will strikingly illustrate the point under consideration.

The point of special interest is, however, that all but identically the same amount of nitrogen has been taken up by the herbage growing with the deficiency of potass as by that with the continued supply of it. The colour of the vegetation with the deficiency of potass has been very much darker green than that with the full supply of it.

An equal amount of nitrogen was taken up in both cases, chlorophyll was abundantly produced, but the full amount of carbon was not assimilated. In other words, the nitrogen was there, the chlorophyll was there, there was the same sunlight for both plots; but the assimilation-work was not done where there was not a due supply of potass.

It may be stated generally that, in comparable cases, depth of green colour, if not beyond a certain limit, may be taken to indicate corresponding activity of carbon assimilation; but the two instances cited are sufficient to show that we may, so far as the nitrogen, the chlorophyll, and the light are concerned, have the necessary conditions for full assimilation, but not corresponding actual assimilation.

It cannot, I think, fail to be recognised that in these considerations we have opened up to view a very wide field of research, and some of the points involved we may hope will receive elucidation from the further prosecution of Dr. Siemens's experiments. He will himself, I am sure, be the first to admit that what he has already accomplished has done more in raising than in settling important questions. I understand that he proposes to submit plants to the action of the separated rays of his artificial light, and the results obtained cannot fail to be of much interest. But it is obvious that the investigation should now pass from its present initiative character to that of a strictly quantitative inquiry. We ought to know not only that, under given conditions as to light, plants acquire a deeper green colour, and attain maturity much earlier than under others, but how much matter is assimilated in each case, and something also of the comparative chemical characters of the products. As between the action of one description of light and another, and as between the greater or less continuity of exposure, we ought to be able to form a judgment whether the proper balance between assimilation on the one hand, and growth and proper maturation on the other, has been attained; whether the plants have taken up nitrogen and mineral matter and produced chlorophyll in a greater degree than the quantity and the quality of the light have been able to turn to account; or whether the conditions as to light have been such that the processes of transformation and growth from the reserve material provided by assimilation have not been normal or have not kept pace with the production of that material.

But one word more in reference to Dr. Siemens' results and proposed extension of his inquiries. Even supposing that by submitting growing crops to continuous light by the aid of the electric light during the night, they could be brought to maturity within a period shorter than at present approximately in proportion to the increased number of hours of exposure, the estimates of the cost of illuminating the vegetation of an acre of land certainly do not seem to hold put any hope that agriculture is likely to derive benefit from such an application of science to its needs. If, however, the characters of growth and of maturation should prove to be suitable for the requirements of horticultural products of luxury and high value, it may possibly be otherwise with such productions.

The above considerations obviously suggest the question: What is the office of chlorophyll in the processes of vegetation? Is it, as has generally been assumed, confined to effecting, in some way not yet clearly understood, carbon assimilation, and, this done, its function ended; or is it, as Pringsheim has recently suggested, chiefly of avail in protecting the subjacent cells and their contents from those rays of light which would be adverse to the secondary processes which have been distinguished as growth?

Appropriate as it would seem that I should attempt to lay before you a *résumé* of results bearing upon the points herein involved, so numerous and so varied have been the investigations which have been undertaken on the several branches of the question in recent years, that adequately to discuss them would occupy the whole time and space at my disposal. I must therefore be content thus to direct attention to the subject, and pass on to other points.

(*To be continued.*)

THE BRITISH ASSOCIATION

REPORTS

Report on the Tertiary Flora of the Basalts of the North of Ireland, by Mr. W. H. Baily.—Described the plants of Miocene deposits, consisting of variegated marls, resting on a leaf-bed near Glenarm. Amongst the plants were *Sequoia couttsiæ*, *S. lyelli*, *Fagus deucalium*, *Nyssa ornithobroma*, *Aralis browwia*, *Fraxinus guillelmæ*. These and others have been drawn and described.

Report on the Viviparous Nature of the Ichthyosauri, by Prof. H. C. Seeley.—Dr. Channen Pierce had formerly described a specimen of Ichthyosaurus in the Museum at Bristol which he considered contains a fœtus in the act of coming into the world, which view is supported by Prof. Seeley, who showed, reasoning by the analogy of the stomach of a crocodile, it was impossible that this animal could have swallowed a smaller ichthyosaurus, and its remains been retained in the stomach in a perfect form, and alludes to the spiral structure of the coprolite, pointing to a small intestine, and thought it is impossible that the animal could have passed through them in the process of digestion; and alluded to the fact that all German specimens show the head of the smaller projecting towards the tail of the larger, though the reverse is the case in a specimen at Madrid. But in Tübingen the most perfect specimens occur, in which the smaller animals are found lying completely preserved between the ribs of the parent animal; though, he suggests, in all cases viviparous characters may not have obtained in all forms of ichthyosauri.

The Sixth Report of the Underground Water Committee was read by Mr. De Rance, who pointed out that the watershed separating the basins of the Thames and Eastern Counties from those of the Humber and the Severn also divides the area of heaviest rainfall on the Palæozoic rocks, which are nearly all impermeable, from those of Secondary age, receiving a rainfall of about 30 inches. West of this line, with the exception of the Trias, no Secondary rocks occur. In Lancashire, Cheshire, and the Midlands the Triassic Sandstones absorb about one-third of the rainfall, giving a daily average of 400,000 gallons to each square mile of country: wells in these rocks are capable of drawing on several square miles, and in suitable situations of yielding from 2 to 3 million gallons per day. The discovery of the Manchester coalfield beds at Winwick, near Warrington, under the New Red Sandstone, at a depth of only 540 feet, was described. He referred to the position of the New Red boring at Bootle, for the Liverpool Corporation water supply, as very badly chosen, being close to one of the existing wells. He then showed the gradual attenuation in thickness of the Bunter Sandstones, in a southerly direction, against the old Palæozoic axis, ranging from the Belgian coalfield to the Mendips.

Report on the Present State of our Knowledge of the Crustacea, by C. Spence Bate, F.R.S.—This is Part v. of the Report, and deals with the subjects of fecundation, respiration, and the green gland.

SECTION A.—MATHEMATICAL AND PHYSICAL

Improved Apparatus for the Objective Estimation of Astigmatism, by Tempest Anderson, M.D., B.Sc.—Astigmatism has been defined as that condition of the eye in which refraction is unequal in the different meridians. In order to obtain suitable spectacles for correcting this defect, it is necessary to know accurately the focal adjustment of the meridians of maximum and minimum curvature, whence the focal lengths of glasses, generally either cylindrical or cylindrical on one side and spherical on the other, are readily calculated. Many plans have been adopted for determining this; some subjective, depending on observations made by the eye itself, and generally using a point of light or a series of radiating lines as an object. From their appearances when viewed at different distances, and with lenses of different powers, the focal adjustment of the different meridians is at last obtained.

The advantage of this group of methods is their theoretical delicacy, as they work by judging of the perfection of certain images refracted on the retina in a manner not very dissimilar to that in which they are usually formed; the practical disadvantage, that accurate observations are required from one who has never been accustomed to make them. Hence objective methods have been introduced. Their advantages are, substituting trained for untrained observation. Their disadvantages—

1. The vessels of the retina and the optic nerves, which are mostly employed as objects, are seldom in exactly the position desirable for estimating the refraction in different meridians, and are often at a different distance from the optical system of the eye from that at which the sensitive layer of the retina lies.

2. They mostly require the optical defects, if any, and the accommodation of the observing eye to be taken into account and allowed for, thus introducing risk of error.

In the author's two instruments, an image of a suitable object thrown on the retina of the observed eye, is used as an object by the observer, with the following advantages:—

1. The patient's sensations may be entirely disregarded, or only used as confirmatory.

2. The image used is necessarily at the retina, and not before or behind it.

3. The accommodation or any defects in the refraction of the observer's eye does not enter into the result, as the only function of this eye is to observe the formation of the image on the retina.

In the first plan a lamp *l* is provided with a condensing lens *c*, and a series of radiating wires *w* (supposed to be seen edgeways in the figure), thus giving a bright field with black lines on it.

The whole slides on a graduated bar *C*, at the other end of which is a convex lens *y* (4 and 10 dioptrics are the most convenient powers, *i.e.* 10 and 4 inch focus). Close to the lens, and at an angle of 45° to its axis, is a plane mirror (*m*), which reflects the rays at right angles to their former path. The instrument is to be held so that this pencil of rays enters the observed eye, and when the wire screen is at the proper distance, an image of it is formed on the retina. The mirror has the centre left unsilvered, as in an ordinary ophthalmoscope, and has a disk of correcting lenses behind it, to render the retina, and the image on it, visible by the direct method. The observed eye should have its accommodation relaxed by atropine.

The bar is so graduated that when an image of the whole or part of the screen is sharp on the retina, the figure opposite the screen expresses the refractive error of the meridian by which the image is produced. Hence if the image of the whole screen is seen to be equally sharp, the eye is known to be not astigmatic, and the graduation given the number of dioptrics by which it is myopic or hypermetropic. If the lines be not all sharp at once, then the most distant point at which a distinct image of any of the wires is formed on the retina gives the refractive error of the meridian of minimum refraction (expressed in dioptrics), and the point at which the line at right angles to this is best defined gives that of the meridian of maximum refraction. The least of these gives the spherical element of the correcting lens required for distant objects, and the difference between the two gives that of the cylindrical part. The meridian of maximum refraction is that in which the line is visible when the wires are at the greatest distance.

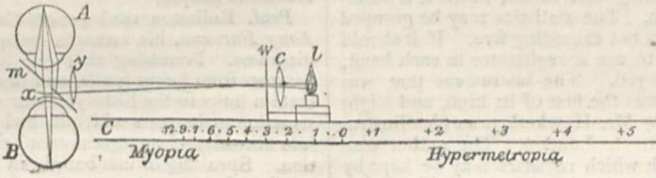
In the second plan the lamp, *l*, condensing lens, *c*, and wire screen, *w*, are similar, and only differ in size, the front lens, *y*, and mirror, *m*, are also similar, but the lamp and wires are permanently fixed by a tube, so that the wires are accurately in the principal focus of the front lens, *y*. By this means the rays from the wires (or rather from the interval between them), after refraction through the lens and reflection by the mirror, are parallel. If received by an eye which is emmetropic, and with its accommodation relaxed, an image of the wires is formed on the retina. The light radiating from the image passes out through the optical system of the eye; is rendered parallel and able to form an accurate image on the retina of an emmetropic eye observing through the hole in the mirror.

If the observed eye be not emmetropic, it is only necessary to introduce lenses of different powers close in front of it, so as to correct the rays both entering and leaving the eye. If the refraction be the same in all meridians, the image of all the wires is sharp with the same lens, and this lens is the one required to correct the ametropia. If any astigmatism exists, different lenses are required for rendering the images of the different wires sharp.

The strongest and weakest of these are the measures of the errors of refraction of the two principal meridians, and the difference of their numbers of dioptrics gives the cylindrical element of the correcting glass required.

In this form of apparatus a disc of correcting lenses behind the mirror is not required, as the single correcting lens near the observed eye corrects the rays both entering and leaving the eye.

For rapidly finding the proper lens a disk of lenses is used,



each a centimetre in diameter, and with intervals of one dioptric; a smaller disc is attached containing the quarter dioptrics, so that by their combination intervals of one quarter of a dioptric can be read—a degree of accuracy greater than the estimation is generally susceptible of.

The proper lens being calculated, its spherical and cylindrical elements are combined and put together before the eye. It it be the correct one, all the lines are seen sharp at the same time; if not, further examination is made.

The principal advantage of the first plan is that the adjnstment, being made by the motion of the wire screen, is continuous, and correcting lenses are not required for measuring the refraction, but only for rendering the retinal image visible; its disadvanatge that, as the rays are not parallel as they pass from the front lens, past the mirror to the eye, it is necessary for the apparatus to be very near, and at a determinate distance from the observed eye, otherwise the readings of the scale are vitiated. This, however, is not a serious objection.

In the second plan the rays in the corresponding position are parallel, and the instrument can be held at any convenient distance, say one or two feet from the observed eye, and the observer can get a view of the cornea at the same time as he views the image, so that he can estimate the refraction at different points of the cornea.

It is hoped that this may eventually lead to the determination of the refraction at different parts of conical cornea and other eyes with irregular astigmatism, and the application of suitable lenses to them.

Since writing the above, I find mention of an instrument by Coccius Stimmel, with an optical arrangement on the same plan as my second, but I have not heard of its being in use in this country.

The makers are T. Cook and Sons, York.

SECTION D.—BIOLOGY

After Dr. Sclater hadread report of Socotra Committee, Dr. J. B. Balfour gave a very interesting account of his visit to the island. The zoological and botanical collections have not yet been examined by specialists, but are expected to yield results of great interest. As not nearly sufficient time had been allowed for a complete exploration of the island, which is almost entirely unknown to Europeans, Dr. Balfour hoped that another similar expeditionwould be organised; but in that case it should be earlier in the season than the last, which was in the island during February and the early part of March. During the latter part of the time the heat was too great for it to be possible to do anything in the middle of the day. Dr. Sclater mentioned that the ornithological collection indicated distinct African affinities.

Further Remarks on the Mollusca of the Mediterranean, by J. Gwyn Jeffreys, LL.D., F.R.S.—This is a supplement to a paper by the author, which was published in the Report of the Association for 1878. Since that time many of the species which were supposed to be exclusively Mediterranean have been discovered in the North Atlantic. The number of such Mediterranean species, which were given in the former paper, was 222. In the present paper 41 of those species are enumerated as also Atlantic, thus reducing the number of exclusively Mediterranean species to 181, and it was remarked that the Atlantic nudibranchs and Cephalopods had not been completely worked out, these anounting to 58, and being included in the above residue of 181.

On the Migration of Birds, and Messrs. Brown and Cordeaux's Method of obtaining Systematic Observations of the same at Lighthouses and Lightships, by Prof. Newton, M.A., F.R.S. (Abstract).—Citing a passage from an article by the Duke of Argyll (*Contemp. Rev.*, July, 1880, p. 1), the author met with a direct denial the Duke's assertion that of "the army of the birds" it might be said that "it cometh not with observation," pointing out that all we know of the migration of birds arises from observation, and all we do not know from the want of it, remarking also that if it were not for observation we should not know that birds migrate at all, and inquiring whether it is not by renewed observation alone that we can hope to know more of their migratory movements. The author then proceeded to describe briefly the nocturnal passage of migratory birds as noticed by himself at Cambridge for the past seventeen years, and urged the importance of simlar. but more systematic observations being made at other statioins Remarking upon the especial advantages of lighthouses and lightships for this purpose, he recounted the successful attempt made in the autumn of 1879, with the sanction of the Trinity House authorities and the Commissioners of Northern Lights, by Mr. Harvie Brown and Mr. Cordeaux, to obtain a series of observations from the lighthouses and lightships on the coast of Scotland and the east coast of England, the results of which were embodied in a Report (noticed in NATURE, vol. xxii. p. 25), and showed that returns were obtained from nearly two-thirds of the English stations, and as regards the Scottish stations, from about two-thirds on the west and one-half on the east coast, thus proving the intelligent interest taken by the men employed in the inquiry. This single Report naturally did not throw any new light on the subject, but it would be contrary to all experience if a series of such reports would not, and he therefore strongly urged the Association to countenance the renewed attempts which Messrs. Brown and Cordeaux were making, and to encourage with its approval them and their fellow-workers, the men of the lighthouses and lightships, who could best answer the question whether knowledge of "the army of the birds" and its movements "cometh not with observation."

On Anthropological Colour-Phenomena in Belgium and elsewhere, by J. Beddoe, M.D., F.R.S.—In Germany, Switzerland, and Belgium, through Governmental assistance, the colours of the eyes and hair of all the children in the primary schools have been observed and tabulated. The writer is very desirous that our own officials should lend similar assistance to the Anthropometric Committee of this Association. The results hitherto obtained have been of considerable importance, and those for Belgium are well shown in the monograph and maps of Prof. Vanderkindere. These bring out a remarkable contrast between the Flemish and the Walloon provinces of Belgium, and tend strongly to prove the persistently hereditary character of even such physical characters as the colour of the hair and the iris.

Pocket Registrator for Anthropological Purposes, by Francis Galton, M.A., F.R.S.—The author exhibited a small instrument a quarter of an inch thick, four inches long and one and three quarters wide, furnished with five stops, each communicating by a ratchet with a separate index arm that moves round its own dial-plate. The registrator may be grasped and held unseen in either hand with a separate finger over each stop. When any finger is pressed on the stop below it, the corresponding index arm moves forward one step. Guides are placed between the stops to insure the fingers occupying their proper positions when the instrument is seized and used in the pocket, or when it is slipped inside a loose glove or other cover. It is possible by its means to take anthropological statistics of any kind among crowds of people without exciting observation, which it is otherwise exceedingly difficult to do. The statistics may be grouped under any number of headings not exceeding five. If it should ever be thought worth while to use a registrator in each hand, ten headings could be employed. The instrument that was exhibited worked well, but it was the first of its kind, and might be improved. It was made by Mr. Hawkesley, surgica linstrument maker, 300, Oxford Street, London. The author also drew attention to the ease with which registers may be kept by pricking holes in paper in different compartments with a fine needle. A great many holes may be pricked at haphazard close together, without their running into one another or otherwise making it difficult to count them afterwards. The mark is indelible, and any scrap of paper suffices. The needle ought to project a very short way out of its wooden holder, just enough to perforate the paper, but not more. It can then be freely used without pricking the fingers. This method, however, requires two hands, and its use excites nearly as much observation as that of a pencil.

Dr. Phené, F.S.A., F.R.G.S., read a paper *On the Retention of Ancient and Prehistoric Customs in the Pyrenees*. He said he could now repeat more confidently the peculiar features which indicate beyond question that the customs of the Gallic population of the South of France agreed, so far as they might judge from their lithic monuments, with those who came farther north and settled in Britain. On the crests and sides of the mountains on both sides of the Pyrenees, *i.e.* in Spain and France, are found sepulchral arrangements of stones somewhat different to any distinctly recorded amongst our antiquities. These consist of a number of circles adjoining each other; in the centre of each is a cist with an urn, having burnt bones, and the form of the circle is that of a wavy or serpentine cross. The quaint old customs of early Celtic life are kept up all along the Pyrenees, but not in the towns, in the plains, or champagne country. One of these, which he described last year as still existing in Brittany, that of a wooden tally, in lieu of a bill or account, on which the baker marked by notches the number of loaves he supplied, and which attracted the attention of the President of the section last year, was also existent in the Pyrenees. He purchased a baker's bill at Perpignan a few months ago, and though not so rustic as that of Brittany, it approached more to our old Exchequer tally, and to the Welsh stick of writing described in "Bardas," as well as to some elaborate and really wonderful calendars, still to be seen in the Cheetham Museum at Manchester, than to the rustic tally of Brittany. On crossing into Spain and prosecuting inquiries, he found the serpent or dragon emblem everywhere prominent, and even learned that the Tarasque, the ceremony of which is performed at Tarascon, in Provence, was a well-known dragon with the Spanish people. He was told that, though used as a popular diversion at *fêtes*, it had always a religious meaning. At Luchon living serpents are consumed in the flames. The youths of the village had miniature cloven pines which they burn. These they brandish while flaming, in serpentine curves, and cry loudly, "hilla-hilla"—pronounced "*e*lla." But the Basque *l* often stands for *v*, and if we used it here, we had the old classic cry of the Bacchanals, who with serpents in their hands rushed about wildly crying "Eva, eva." The place where these cries are mostly practised has most remarkable sculptures of serpents. After the burning of the pine a rush is made by the more powerful, and the burning embers carried off in their hands regardless of pain. Pieces are then distributed to every household, and kept religiously during the year, as was the custom with the ancient Britons.

Mr. Thomas Plunkett contributed a paper *On an Ancient Settlement found about Twenty-one Feet beneath the Surface of the Peat in the Coal Bog near Bohoe, County Fermanagh.*—This interesting discovery consisted of the remains of two log huts found in a primitive crannage. Flint implements, handmade pottery, and other objects, but no metal of any kind, were found in connection with the huts, which, the author was of opinion, were formed before the age of bog pine, as no pine occurred below the level of the site on which the huts stood. The fact that twenty-one feet of dark, compact peat had grown since the structures were formed was substantial evidence of their great antiquity.

Prof. Dawkins remarked that this discovery did not stand alone, but in connection with others showed that in various parts of Ireland we might look for log houses in this way, pointing back to a series of ancient wooden houses which belonged to the Neolithic people.

Prof. Rolleston read papers *On the Structure of Round and Long Barrows*, his remarks being illustrated by a number of diagrams. Premising that one of his objects was to preserve barrows from being spoilt, and thus to prevent the destruction of certain links in the history of our species, he described the construction of barrows which he had explored, and urged the absolute necessity of very great care being exercised in such exploration. Speaking of urn burials in round barrows, the Professor briefly referred to the question of the cremation of bodies, and the idea of it. Why did the people burn their dead? He believed the idea was this—that all savage races, when they had to deal with an enemy, were exceedingly prone to wreak certain ignominies on dead bodies. Burning the bodies put it right out of the power of the enemy to do this, and the urn enabled people to carry away their friends who were so burnt. In time of pestilence it b came actually necessary for sanitary considerations to burn the dead, and it was only in time of plague or war that we found that cremation or burning became the order of the day, and that was readily explicable by the fact that men always did what they could on the principle of least action, because burning was a troublesome process. Any universality of burning was explained by the fact that ancient history was simply one great catalogue of plague and pestilence and war and the like. Of course he was an enemy to cremation, because it did a great deal of harm, preventing us from knowing what sort of people our predecessors were. Prof. Rolleston chronicled the finding in a barrow of the Bronze period of a man laid out at full length, the general rule being that of burial in a contracted position. As regarded the date to be assigned to these things, he might give it as his opinion that no Roman ever used a bronze sword, nor crossed swords with an enemy using a sword of that material. As regarded the long barrows, that mode of burial stretched all the way from Wales to the Orkneys, and in them was found not a scrap of metal. His opinion was that the idea of the construction of these barrows was taken from limestone mountain headlands projecting into the sea, such as might be seen by a little trip in their immediate locality. The men lived in caves, and the idea for the place of burial was taken from the place of living, it being often found that a man made the house in which he lived his burial-place.

A short discussion having taken place on Prof. Rolleston's paper, Dr. Schaafhausen, of Bonn, exhibited the Neanderthal skull which was found in 1857, and which, he submitted, was not the skull of an idiot, but of a man of the lowest development. Prof. Rolleston agreed that the man whose skull it was was not an idiot, and said that the abnormal development in connection with it consisted in the frontal ridges.

A paper by Miss A. W. Buckland *On Surgery and Superstition in Neolithic Times* was read. Miss Buckland said it had been proved by the late Dr. Broca that the system of trepanning prevailed in Neolithic times, and the paper was to show the extent of the practice, the superstitions associated with it, and its connection with the use of cranial amulets. The surgical operation known as trepanning consisted in making an opening in the skull (chiefly of infants) in order to cure them of certain internal maladies, and the individuals who survived were considered to be endowed with properties of a mystic character. Dr. Broca stated that the custom died out with the introduction of bronze. Miss Buckland said the custom still existed among the South Sea Islanders, the Kabyles of Algeria, and the mountaineers of Montenegro. The other papers read in this department were: *On Bushmen Crania*, by Prof. Rolleston; *The Salting Mounds of Essex*, by Mr. H. Stopes; *The Hittites*, by Mr. W. St. C. Boscawen; *Further Researches on the Prehistoric Relations of the Babylonian, Chinese, and Egyptian Characters, and Languages, and Culture*, by Mr. Hyde Clarke;

The Mountain Lapps, by Lieut. G. T. Temple; *Note on a Chilian Tumulus*, by Mr. J. H. Madge; and *India the Home of Gunpowder on Philological Evidence*, by Dr. Gustav Oppert.

SECTION E.—Geography.

The President read some letters of a very interesting character from Mr. Joseph Thomson, received by the Royal Geographical Society's East African Expedition. The following are passages from this correspondence:—

"Karema, or Musamwira, Lake Tanganyika,
"March 27, 1880.

"I have failed in my attempt to reach Jendwe by way of the Lukuga and Kabuire. I left Kasenga (or Mtowa) on January 19, with all the confidence of a young lion which had not yet known a reverse, and six weeks after I returned to the same place as meek as a lamb. From the very first I had great difficulties with the men, as they believed I was taking them to Nanguema, where they would be eaten up. They tried every means in their power to throw obstacles in my way and retard my movements, two of them deserting near Meketo, and the others threatening to do the same. For six days I continued my course along the Lukuga, in spite of their opposition, but I was then obliged to give in. It flows in a general west-north-west direction to that place, and then about west into the great westerly bend of the Congo, all the way through a most charming valley, with hills rising from 600 to 2,000 feet in height. Above the lake the current is extremely rapid, and quite unnavigable for boats or canoes of any description, owing to the rapids and rocks. From Makalumbi I crossed the Lukuga into Urua, and struck south-west for the town of Kiyombo, who is the chief of all the Warna on the eastern side of the Congo." "We reached Mtowa on March 10, destitute of almost everything. To my delight, however, I heard that Mr. Hore was expected every day on his way by canoe to the south end of the lake. On the 23rd we started, crossed the lake to Kungwe, and reached Karewa on the night of the 26th. As we neared the shore, we were hailed by the jolly voice of Capt. Carter, whom we found gun in hand and bursting with stories of his wonderful adventures in sport and war, keeping us fixed on our seats all night in his tent as he launched them forth. We went over to visit the Belgian international party at their temporary quarters to-day. Capt. Carter had his elephant ready to take us across the marsh. Karema is one of the most extraordinary places for a station that could be found on the lake—a wide expanse of marsh, a small village, no shelter for boats, only shallow water dotted with stumps of rock, no room to be got, and natives hostile; far from any line of trade. The party have commenced building forts and walls, digging ditches in regular military fashion. At table there sat down an Englishman, an Irishman, a Scotchman, a Frenchman, a Belgian, and a German, representing five expeditions, and you will doubtless be pleased to learn that of all these (thanks to yourself) the Scotchman, though the smallest, and having to travel through entirely new country, had been the most successful of all. After leaving Karema we had a moderately good voyage across the lake to Jendwe, at which we arrived on April 7." "Passing round the south end of Tanganyika along the shore as far as the mouth of the Kilambo, then striking about N.N.E. through Ulungu and Fipa, we reached by easy ascents the town of Kapufi, situated in lat. 8° S. and long. 32° 25′ E. Best of all, however, while at this place, I had the honour to settle the problem of Lake Hikwa, or rather Likwa, and give it some shape and place in our maps. It has run itself in the hearsay accounts of successive travellers into various protoplasmic shapes, and, will-o'-the-wisp like, danced about on the map to the tunes of various geographers. I, of course, saw only a part of it, but from all I could gather it must be from sixty to seventy miles in length and fifteen to twenty in breadth. It lies two days east of Makapuli, in a deep depression of the Lambalamfipa Mountains. A large river called the Mkafa, which rises in Kawendi, and which by its tributaries drains the greater part of Khonongo and Fipa and all Mpimbwe, falls into it. I can almost say with certainty that it has no outlet, certainly not any towards the west. The Kilambo rises near Kapufi. I was surprised and pleased to find that my bearings and estimated distances, as laid down on my sketch map every two days, had actually brought me within one or two miles of Tabora as laid down by Speke and Cameron. I can hardly, however, call it anything but a curious coincidence."

The colleagues of Major Serpa Pinto in the Portuguese expedition to West Central Africa (Capt. H. Capello and Lieut. R. Ivens) were warmly received in the Geographical Section. They had thoroughly explored the elevated watersheds of Bihe. Major Serpa Pinto went on his famous journey towards Mozambique, and Messrs. Capello and Ivens struck towards the north-east, nearly reaching Congo. They descended the great tributary of the Congo till they reached more than 6¼° S. lat., where there is a great forest-belt inhabited by tribes of hostile and ferocious negroes. Not far from the shores of this river there dwells one of the most powerful potentates of this part of Africa, but the country is very unhealthy, and the people inferior in every respect to the Highlanders of Bihe. The President and Sir Henry Barkly and other members of the Section congratulated the Portuguese on their renewed geographical enterprise, and acknowledged in particular the indebtedness of geography to the explorers, from one of whom (Lieut. Ivens) the Section had heard an account of their travels.

Mr. Lawrence Oliphant described the results of his recent travels east of the Jordan, and particularly of his visits to labyrinthine subterranean cities. The object of his visit was described as that of selecting country for colonisation, and he reported that there was much pasture, wooded, and arable land capable of the highest degree of development.

Mr. Butler proposed a scheme for supplying pictorial aid to geographical teaching. The travels of a Jersey gentleman, Mr. W. Mesny (who was so useful to Capt. Gill in his journey across China), up the Canton River, and Mr. Carl Bock's account of his exploring expedition in Borneo for the Dutch-Indian Government, were other subjects before this Section.

Col. Tanner read some interesting *Notes on the Dara Nur, Northern Afghanistan, and its Inhabitants*. He described the inhabitants of the Dara Nur valley as differing little in appearance from the Afghans. "Their features are softer, and they are more trustworthy and less given to fanatical outbreaks than the Pathans, and though they continually fight among themselves, they have never given us trouble in Afghanistan. The forts of the Dara Nur were similar to those of the Jellalabad plain, and the interior arrangement the same. The people still retain the custom of sitting on stools, and, as a rule, are not at home when squatting on the ground. Among the Kohistanis and Kafirs stools are in general use." Then followed a description of a people residing in the upper part of this valley called the Chuganis. "They live in the highest habitable parts of the Kund range. East and west they are hedged in by the powerful race of Safis, their hereditary enemies, and peace is seldom known between them. The appearance of a Chugani is quite different from that of an Afghan or a Dar Nuri. He is shorter in stature, and has more pleasing features. The Chuganis are the only Mohammedans I know who allow to the women perfect and unconstrained freedom. Young and old, married and single, they go about as they do in Europe, without any of the false modesty of the ordinary Indian and Afghan females. The wife of my host and her daughters used to ask me every morning how I fared, and became at last quite friendly. In one other place only have I been allowed to converse without restraint with the women, and that was in a remote and wild part of the Brahti country, where mollahs are unknown and the tenets of the Prophet but imperfectly understood. The Chugani young lady takes a pride in her appearance. . . . . The town of Aret is one of the most remarkable collections of houses I have ever seen. It is built on the face of a very steep slope, and the houses, of which there must be 600, are ranged in terraces one above another. From the roof of one of the lower ones I gazed with astonishment at a vast amphitheatre of carved wood, there being in sight thousands of carved verandah posts, and tens of thousands of carved panels, with which the upper storeys of the houses are constructed. These panels, which are arranged similarly to the shutters of Indian shops, are ornamented with every conceivable variety of carved patterns. The carving completely covered the woodwork of the upper storey of every house. . . . . From one of the numerous native visitors I heard much about the Sanu Kafirs, with whom the Kordar Chuganis carry on much traffic. The little-known people whom the Afghans are pleased to call Kafirs are now confined to a tract bounded on the north and north-west by the Hindu-Kush, on the east by the Hindu range, and on the south and south-west by the Kund range, and by the Laghman. The tribes are very numerous, and speak many different languages. The great tribe of the Katawas live in a country sufficiently open and level to admit of their becoming good horsemen. The Samus number some five or six hundred families, and live at the upper end of the Pech Dara. They are described as a merry people, given much to dancing, singing, music, and wine-bibbing. At their meals they sit in a circle and eat sedately, and with dignity, the silver wine goblet placed in a stand conveniently near being passed round the company from time to time. They shake hands in the English fashion. The women tie up the hair with a silver band. Long massive silver chains presented by the tribe are worn over the shoulders of warriors who have deserved well of their clan. Their religion is simple; the men invoke the aid of their gods in battle, vowing offerings if they are successful in the fight, and these offerings are stored up in the temples. The Kafirs are being continually encroached upon by the surrounding Afghans. Raids on a large scale are constantly made into their mountain valleys, partly to secure the women as slaves, and partly by fanatical Mohammedans on religious grounds."

A Visit to the Galapagos Islands in H.M.S. "Triumph," 1880, by Capt. Markham.—Capt. Markham gives an account of a visit he paid to the Galapagos Islands on board H.M.S. *Triumph*, in the beginning of the present year. The Admiralty chart, compiled from a rough survey made nearly half a century ago, is not very accurate, so that it was not safe for a large ironclad like the *Triumph* to extend the cruise in the numerous channels between the islands. Her visit was therefore confined to Post Office Bay in Charles Island, and the paper records the observations that were made during several inland excursions.

The Galapagos Islands, being 600 miles from any other land, have a peculiar fauna, and Capt. Markham devoted all the time at his command to the collection of birds, skins, insects, and shells. These specimens have been placed in the hands of Mr. Salvin, and it is anticipated that they will form an addition to our knowledge of the natural history of this isolated archipelago.

In our report of Mr. Weldon's paper, read before the Chemical Section of the British Association, it is stated:—"Molecular heats of formation of elements of the same group divided by the atomic volumes of the electro-negative elements give numbers either identical with, or bearing some simple relation to, each other." This should read:—"Molecular heats of formation of *compounds* of positive elements of the same group with the same electro-negative element, divided by the atomic volumes of the positive elements, give quotients either identical with, or bearing some simple relation to, each other. Thus:—

$$\frac{\text{Mol. heat of formation of } PbCl_2, PbBr_2, PbI_2, PbO}{\text{Atomic volume of Pb}} : \frac{\text{Mol. heat of formation of } Cu_2Cl_2, Cu_2Br_2, Cu_2I_2, \text{ and } Cu_2O}{\text{Atomic volume of Cu}}$$

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SCIENTIFIC SERIALS

Rivista Scientifico-Industriale, No. 13, July 15.—Water in alcoholic fermentation, by Prof. Pasqualis.—On animals which exhale an odour of musk.—New observations and note on Crookes' apparatus, by Prof. Serpieri.—On automatic geodetic instruments, by Prof. Vecchi.

American Journal of Science, July.—Contributions to meteorology, by E. Loomis.—Geological relations of the limestone belts of Westchester county, New York, by J. D. Dana.—Observations on Mount Etna, by S. P. Langley.—Antiquity of certain subordinate types of freshwater and land mollusca, by C. A. White.—Description of a new position micrometer, by L. Waldo.—Boltzman's method for determining the velocity of an electric current, by E. H. Hall.—Mineralogical notices, by C. U. Shepard.—Improvement in the Sprengel pump, by O. N. Rood.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, September 6.—M. Wurtz in the chair.—The following papers were read:—Researches on basic salts and on atakamite, by M. Berthelot.—Contributions to the history of ethers, by the same.—On the etiology of anthracoid affections, by M. Pasteur. He cites some facts in support of his theory. On a spot in a meadow where an anthracoid cow had been buried in 1878, a small enclosure was formed, and four sheep put in it; in another enclosure, a short way off (3m. or 4m.), four other sheep. In seven days one of the former set died of the disease; none of the latter set were affected. (Germs of *charbon* had been found on the ground over the buried cow, but not a few metres off.) M. Pasteur differs from M. Toussaint's opinion that acute septicæmia is identical with chicken cholera.—M. Bouley gave some account of recent experiments of M. Toussaint, apparently showing the efficacy of preventive inoculation of sheep and rabbits against *charbon* by his method. He hopes that once preventive inoculation has become practical, it will be possible to make, not races, but generations, refractory to the disease, by inoculating the mothers during the last period of gestation.—Planet (217), discovered by M. Coggia at the Observatory of Marseilles, on August 30, 1880, by M. Stephan.—On the part taken by Claude Jouffroy in the history of the applications of steam, by M. de Lesseps. This refers to a regret expressed by the granddaughter of the inventor that M. de Lesseps had not, at the inauguration of Papin's statue, recalled the services of Jouffroy, who, in 1783, invented the pyroscaph, which steamed on the Saone sixteen months, making two leagues per hour. M. de Lesseps had thought it his *rôle* only to recall the inventions anterior to Papin, and those of Papin himself.—The enemies of the gallicolar phylloxera, by M. Coste.—Observations of solar protuberances, faculæ, and spots, during the first half of 1880, by P. Tacchini. The increase of solar activity is evident. The observations as to distribution agree well with those of previous quarters. The maximum of frequence of groups of faculæ is nearer the equator than that of protuberances. There are more groups of faculæ in the north than in the south hemisphere (nearly double the number); the protuberances are equally distributed in the two hemispheres. The maximum of frequence of spots and faculæ is produced in the same zones in the two hemispheres.—On the law of magneto-electric machines, by M. Joubert.—On the variations of fixed points in mercury thermometers, and on the means of taking account of them in estimation of temperatures, by M. Pernet. He confirms M. Crafts' views, and gives a formula for calculating the minima of zero, &c. He states that he can restrict to $\frac{1}{100}$ of a degree for several hours the variations of zero in a thermometer whose zero has undergone a depression of 0°·8 C. after determination of the 100° point.—On borodecitungstic acid and its salts of sodium, by M. Klein.—Inoculation of the rabbit with glanders; destruction of the virulent activity of the matter of glanders by desiccation; transmission of glanders by inoculation with the saliva, by M. Galtier. This points to the possibility of healthy cavalry horses being contaminated by drinking from the same trough with horses in which the disease is present in a latent state. M. Larrey called attention to a disease that was once very common in the army, where soldiers ate out of a common porringer; it is an inflammatory and ulcerous affection of the mouth. The disease disappeared after the practice was given up in 1852.

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