THURSDAY, DECEMBER 6, 1883

THE GEOLOGY OF THE LIBYAN DESERT

Beiträge zur Geologie und Palæontologie der Libyschen Wüste und der angrenzenden Gebiete von Ægypten, unter Mitwirking mehrerer Fachgenossen, herausgegeben von Karl A. Zittel. I Theil und II Abtheilung, 1 Heft. (Contributions to the Geology and Palæontology of the Libyan Desert and of the Neighbouring Districts of Egypt. By Karl A. Zittel, with the assistance of several scientific men. Part I. and Part II., Section 1.) (Cassel: Fischer, 1883.)

IN NATURE, vol. xxii. p. 587, there appeared a notice of the anniversary address for that year to the Academy of Natural Sciences in Munich delivered by Prof. Karl A. Zittel, the well-known Professor of Geology and Palæontology at the Munich University. The address contained a preliminary sketch of the work, the complete account of which occupies the quarto volume and portion of a second volume now before us.

In the winter of 1873-74 a scientific expedition under the leadership of Gerhard Rohlfs was despatched with aid from the late Khedive of Egypt, Ismail Pacha, to explore the Libyan desert or north-eastern portion of the Sahara. The scientific results of this expedition are now being published in a series of separate volumes, of which the Geology and Palæontology will form two. The first of these lies before us, the second is as yet incomplete, and only one section containing a description of the Eocene Echinoidea, by P. de Loriol, has hitherto appeared. The first volume comprises the geological description of the country by Prof. Zittel himself, an account of the fossil wood from the Nubian sandstone and from the well-known "fossil forest" near Cairo (Cretaceous), by Dr. A. Schenk; of the Miocene fauna of Egypt and the Libyan desert, by Dr. Th. Fuchs; of the Tertiary (Upper Eocene or Oligocene) fossils from the western island in the lake of Birket-el-Qurûn (about fifty miles south-west of Cairo), by Prof. Karl Meyer-Eymar; of the Foraminifera (the Nummulites excluded) from the Eocene beds of the Libyan desert and Egypt, by Conrad Schwager; a monograph of the Nummulites from the same areas, by the late Dr. Phil. de la Harpe; and a description of the Eocene corals, by Magister E. Pratz. These palæozoic descriptions are illustrated by thirty-six plates.

The remaining portions of the second volume will include an account of the Eocene Mollusca, by Prof. Meyer-Eymar; of the Cretaceous fauna, chiefly by Prof. Zittel himself; and of a few other subjects. Amongst the contributors, besides those already enumerated, the names of Prof. Beyrich, the Marquis de Saporta, Prof. Haushofer, and Prof. Zirkel are mentioned in the preface to the first volume.

An array of scientific names like the above, chosen from amongst the most eminent specialists of Germany, Switzerland, and France, proves that this is a work of more than ordinary geological importance. The principal author and editor, Prof. Zittel, is both a good geologist and a good palæontologist, a much rarer combination than is usually supposed.

On the geological map in the first volume an area occupying rather more than 5° of latitude (25° to 30° N.) and above 8° of longitude (about 25° 30′ to 33° 40′ E.) is coloured. This country includes the Nile valley from Cairo to Edfu (the geology of the valley itself is shown as far south as Assuan), and extends eastwards to the shores of the Red Sea, and westward far into the great desert tract of Northern Africa. The whole area coloured geologically may be roughly estimated at between 150,000 and 160,000 English square miles.

It will easily be understood that the mapping is of a very rough description, a geological sketch in fact, but in desert countries, owing to the want of vegetation to conceal the rocks, and to the clearness of the atmosphere, it is remarkable with what accuracy geological formations can be traced by the eye to great distances. A considerable proportion of the area is coloured from the observations of other travellers, and especially of Schweinfurth. The routes of the expedition under Rohlfs and of other travellers are marked on the map, and show how much of the area has actually been examined.

Among the numerous points of interest presented by the volume it is difficult to select any one as superior to the others. In the former notice in NATURE the general characters of the geological systems observed (Cretaceous, Eocene, Miocene, and the so-called Quaternary and recent) were briefly described. To enter at any length into a notice of the palæontology would take too long. At the present time when the writings of F. von Richthofen and others have called especial attention to the subaërial or Eolian formations of the latest geological times and the present day, the description of the surface phenomena presented by the desert tracts of the Sahara, coming from so keen an observer as Prof. Zittel, are well worthy of attention, and a few remarks upon them may prove interesting.

The geological portion of the work is divided into two chapters: the first, containing forty-two pages, being devoted to the Sahara as a whole; the second to the geology of the Libyan desert and Egypt. In both of these chapters considerable space is devoted to the superficial characters of the desert. The surface of the Sahara is divided by Prof. Zittel, according to its characters, into four kinds:—(1) Plateau-desert or Hammâda, occupying the largest portion of the area, a level, hard, stony surface in general, without noteworthy elevations or depressions, but passing locally into (2) mountainous desert. The so-called (3) erosion-desert consists of depressions more or less occupied by salt-marsh. The last form of surface, the most remarkable and interesting of all, is the (4) sandy desert or Areg, composed of drift sand forming hills or downs (dunes).

Prof. Zittel shows, on what appears to be an overwhelming amount of evidence, that the popular idea of the Sahara having been the basin of a sea in Pleistocene times is without foundation. The greater part of the area has apparently been above water ever since the Cretaceous epoch; a comparatively small tract in the north-eastern portion was submerged beneath a Tertiary sea, whilst the only part that can have been under water in post-Tertiary times consists of a tract extending from the Nile delta to the oasis of Ammon, and to the so-called "Chotts" of Tunis, and even in this tract marine conditions in late

geological times are doubtful. But Prof. Zittel considers that the climate must have been damper, the rainfall heavier, and freshwater denudation more active in Pleistocene days than now, to account for the erosion that has taken place, the abundance of fulgurites, and the present distribution of the fauna and flora, especially in such cases as the occurrence of Central African crocodiles in the marshes and streams of the completely isolated Ahaggar Mountains. Reasons are also given for believing that the Nile was formerly a larger river than it now is. It is probable that Prof. Zittel's views on some of these points will be contested, but it is impossible to deny that his arguments are admirably expressed and clearly reasoned out.

Some very interesting details are given about the desert sand, and a careful description of its arrangement in the form of sandhills. The sand of the Sahara is considered to have been largely derived from the decomposition of the so-called Nubian sandstone, the original matrix of the well-known silicified wood. In the Libyan desert there are some remarkable anomalies in the arrangement of the sandhills, and it is clear that they cannot have been entirely formed by accumulation through the agency of the prevailing wind as it exists at the present day. It may here be remarked that very similar observations were made, a few years since, upon the sand ridges of the Indian desert east of the Indus. Some of the sand ridges, both in Africa and India, attain an elevation of about 500 feet, and in both areas the largest appear to have undergone no change within the memory of man, although in places, in both continents, moving tracts of sand occasionally overwhelm cultivated land and buildings.

One mistake in the book deserves notice. In the comparative table of Upper Cretaceous and Eocene beds in Europe, Asia, North Africa, and North America the position assigned to some of the Tertiary stages of the Indian rocks requires correction. The lower Nari beds in especial were never supposed to be so old as Middle Eocene (Parisian), and they are now known to be in all probability true Oligocene. But trifling mistakes of this kind are to be expected: it is surprising that more should not have been observed.

W. T. B.

APPLIED MECHANICS

Applied Mechanics. By H. T. Bovey, M.A., Professor of Civil Engineering and Applied Mechanics, McGill University, Montreal, Fellow of Queen's College, Cambridge. Part I., pp. 190. Part II., pp. 150. (Montreal: J. Lovell and Son, 1883.)

THIS work appears to be designed as a college text-book for somewhat advanced students, who have already received good training in mathematics (as far as the elementary parts of the integral calculus) and theoretical mechanics.

Part I. treats of the strength of materials, dealing with longitudinal stress, the strength of beams and pillars, torsion, and the strength of hollow cylinders and spheres.

In Part II. we have chapters on frames, roofs, bridge-trusses, suspension bridges, arched ribs, and in conclusion one on "details of construction," which includes a discussion of the strength of rivets and other fastenings.

In his exposition of these subjects the author manifests a power of clear and precise statement; and the treatment of the more difficult problems of the first part is perhaps as profound as could be attained without a knowledge of the general theory of elasticity. The numerous illustrations serve sufficiently well in Part I., where they consist chiefly of diagrams; but in Part II. they are on too small a scale for the complicated structures illustrated: and in clearness of detail are far below the standard reached in recent English books on the same subjects. Analytical methods are preferred throughout; and generally speaking geometry is used merely to illustrate results previously obtained in a symbolical form. Thus graphical statics is quite subordinate in Part II.; stress diagrams are introduced, but there are not sufficient instructions in the text to enable a student, who has not studied the subject independently, to construct them for himself.

In the extended treatment of a parabolic rib of uniform stiffness (pp. 101-120) the author follows very closely the lines in Rankine's "Civil Engineering," with some further consideration of the additional terms depending on change of temperature.

There is no acknowledgment in regard to this and other parts of the work where Rankine's influence is clearly apparent. But as no preface is given to the present volume, perhaps other portions of the great subject of applied mechanics are in course of preparation by our author; and till the completion of his work he is postponing the statement of his obligations to those who have gone over the ground before.

We have referred to the apparent excess of symbolical reasoning: but none of this is due to the introduction of investigations better left to treatises on pure mathematics and theoretical mechanics.

Difficulties special to the subject of the work, such as the equations of the "neutral axis" (so-called) for all the different modes of loading and supporting a beam, the theorem of three moments, the moments of inertia of complicated forms of section, the deflection of struts, are however treated with the fullness of detail required by ordinary students.

Such investigations constitute the best feature of the book. The detailed application to problems such as occur in actual practice is but slightly touched on; perhaps for this we are to look to the "Examples," of which some few are worked out in the text; appended to the several chapters, moreover, are close upon 400 proposed for the exercise of the student.

These form a very important collection. A great number involve numerical results, and unfortunately the answers are not given; this greatly lessens their value for private students at any rate. Several examples are taken from existing structures, and are liberally furnished with diagrams in illustration of the data.

Many are new to text-books, and the author has evidently taken great pains in collecting and arranging them.

A. R. WILLIS

LETTERS TO THE EDITOR

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

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

Meteors

HERE, November has generally been unpropitious for astronomical observations. However, during favourable intervals I have seen many brilliant meteors; from twenty to thirty on an average every night. They were principally seen with the face to the north, and glancing from shoulder to shoulder; but not a single Andromede did I see. I had the pleasure of seeing altogether about a score of Leonids before the 12th and after the 19th November. Leo Minorids and Arietids were plentiful, and a goodly number of Geminids were seen; but the richest field for meteors during the month was in the neighbourhood of the Plough. November 6, at 4.30 a.m., a large meteor passed from γ Ursæ Majoris right down to the horizon. From 4.35 to 5.15 three veritable Leonids proceeded from the Sickle; one dashed down to the right-hand, and another from the top of the Sickle to the left over the Lion's back. They were very large. November 10, at 8 p.m., a brilliant meteor started from a point nearly half way between Aldebaran and Saturn, and disappeared at a point down more than half way to the horizon. At 9.30 a very bright one appeared at a point about 1° above Castor and above Jupiter to the north. At 11.25 an exceedingly large and brilliant meteor burst out from $\frac{1}{2}$° below Menkar (in the Whale), and went down at right angles to the very horizon, leaving a long, bright streak behind. November 11, a large one, at 0.15 a.m., dropped down to the horizon from θ Ursæ Majoris. At 0.55 a.m. a very large one proceeded from $\frac{1}{2}$° to the right of α Lacertæ and disappeared at γ Cygni. November 18, at 1.40 a.m., a very large reddish meteor burst out from the top of Ursa Major's head, and passed right above Vega, and disappeared about 4° beyond it in a strange sparkling explosion. At 1.55 a.m. a very brilliant meteor dashed out about 2° above α Arietis, went through the Square of Pegasus, leaving a beautiful stream of blue fire behind, and lasting a few seconds. About 5.30 another large blue meteor passed from the centre of Leo's back through a point 4° above Denebola, and ended in a beautiful explosion 15° beyond. On the night of November 22 there was a fine display of (generally) large meteors from Taurus to Ursa Major; many of them proceeded from the Lion's Head. During the month a great number of meteors passed from some point in Scorpio, under Jupiter and Mars, right into the Lion's Head. They were all large and bright. During the last half of the month some fine displays of morning meteors were seen. At 4 a.m., November 29, I observed a very large and swift meteor. It blazed out from a point about 8° above Denebola, and dashed with great velocity up the heavens, passing 4° above δ Leonis and over the Lion's Head, and exploded about 5° beyond, leaving a stream of the most beautiful blue light in its wake that I ever witnessed. DONALD CAMERON

Mossvale, Paisley, December 3

As your columns frequently contain notices of meteors, I may mention that I observed one of unusual brilliancy last night (November 28) at 10.50. It appeared in the constellation Taurus, and, following the line of the ecliptic, disappeared about five to ten degrees above the eastern horizon. The meteor was visible for not less than fifteen seconds, had a brilliant train or cone of light of from two to three degrees in length, and outshone Jupiter, near which it passed. From the slow, angular movement of the meteor I feel certain that the train was not an optical impression, but a real luminous object. F.R.S.E.

Edinburgh, November 29

A FINE meteor was observed here by me at 10h. 38m. last night, Wednesday, November 28. Bursting into sight near h Ursæ Majoris, it passed in a course almost parallel to, but about 2° north of, a line joining α, δ, ϵ, ζ, and η Ursæ Maj., its light expiring near λ Boötis. Length of path = 40°. No train was observed; the only variation of uniformity of light being at about half-way of its passage, where it slightly paled for an instant and then as quickly recovered. Duration about four seconds. Brilliancy three or four times Venus at its brightest. Colour resembled that of magnesium light. W. WICKHAM

Radcliffe Observatory, Oxford, November 29

LAST night, about 10.30, I saw a magnificent bolide shoot across the sky in a northerly direction. It came from the middle star in Orion's belt, and disappeared at a point almost in a line with "the Pointers" in the Great Bear, and at a distance below the lower of the two stars almost equal to the distance between them. Its path was perceptibly arched, but not to any great extent, and, as far as I could judge, it was not parabolic. When the bolide first appeared, it seemed a mere luminous point moving with great rapidity, and without a tail. But about half way it suddenly grew large and brilliant, a tail shot out, and the path behind it remained luminous and distinct. I could compare the bolide at this point to nothing so much as to a red-hot cannon ball emitting sparks of fire. It was accompanied by no sound, and was gone in half a dozen seconds. During its passage the streets seemed to be lit up with the electric light. It was apparently so close that I should think a few miles would have made a very sensible difference in its apparent position in the heavens. J. B. OLDHAM

Stockport, November 29

LAST night at 11h. 20m. I saw in the north-west, near the horizon, one of those slow-moving balls of fire, not so bright as an ordinary meteor, and leaving no train. This seemed the size of a cricket ball; but I have seen one the size of a cheese-plate. A few flashes of lightning occurred soon after. From the slowness of the motion the phenomenon seemed to be wholly atmospheric. It was in sight for about three or four seconds. It instantly suggested an incandescent vortex whorl; but I cannot say whether the appearance confirmed the idea or not, for I do not know how such a meteor would look. Its red light might be due to its proximity to the horizon, perhaps 8°. Hence there is no dependence to be placed upon my impression that the light was the result of friction rather than of electricity. I have seen probably a dozen in the course of my life, always in the west or north-west, and always about the same height from the horizon, but never annular. HENRY H. HIGGINS

Rainhill, December 4

"Anatomy for Artists"

MAY I add a few more words on the subject of Mr. Marshall's book, and in answer to his letter in NATURE? Mr. Marshall says the reasons that led him to adopt the plan of omitting reference letters to his illustrations of the bones "still remain sound." Turning to p. 30 of the book to learn those reasons, I find he says that "The numerous minute points which demand the attention of the anatomist and the surgeon necessitate such aids; but the art-student's mind should be left unincumbered by such unnecessary details."

I cannot see that this is a reason; I wanted references to what is described in the text—to the necessary, not the unnecessary details.

Secondly, Mr. Marshall says, "The pure form of the bones, represented on so small a scale, in black and white, would have been seriously marred by such references." If this be "sound," may there not be more and equally sound reasons for opposing it? I think there are; and if Mr. Marshall will turn to p. 136 of the book, I will try to show him how his plan works. The student reads there that "All the bones of the hand are visible in the skeleton, on its palmar aspect (Fig. 58), carpal, metacarpal, and phalangeal;" he turns to Fig. 58, but where is it? It is mentioned in a list of figures under *three* illustrations. He has to make up his mind which of the three is 58, recalls that it is the palmar aspect, and goes on. He has no clue, let Mr. Marshall observe, by which to know which are the carpal, metacarpal, and phalangeal portions of the hand for which he originally looked at the palmar aspect of it. He hopes he may come to that; and, reading on, finds that the eight carpal bones are "in the carpus;" but then, which *is* the carpus? He does not know, and is not told. Never mind, he thinks, he will find that out by the description of the single bones, and, beginning with the first-mentioned, he reads that the semi-lunar bone ". . . . occupies the centre of the first row, and is crescentic

in shape." Looking again at the illustration, for "rows" he finds that the bones which seem to be arranged in rows are those which he may afterwards learn to be the metacarpals and phalanges. Supposing, however, that he guesses the carpus rightly, which of its bones is semi-lunar or crescentic in shape? I think if the picture were put before *any* ordinary observer, told to point out a crescentic bone, he would select the scaphoid. There is, thinks the student, still a clue left, for the semi-lunar "occupies the centre of the first row." But the first row contains *four* bones; at least he has read that "the eight bones are clustered together so as to form two groups," and he is not told that these groups are not the "rows" afterwards mentioned. He gives it up, and reads the other bones to learn them and find the semi-lunar by the exhaustive process. The guide he finds to the cuneiform bone is that it is "on the ulnar side of the semi-lunar," which he has perhaps failed to guess rightly, and articulates with certain other bones, which are to be afterwards described, and are unknown to him; and so on.

The mode of progression is like that I made once in Ireland, when on asking a peasant my way I was told to take the last turning before coming to the next milestone. There were a good many steps to retrace after finding the next milestone.

I have no doubt at all of the moral influence of Mr. Marshall's plan *if the student perseveres in using his book;* he will have exercised patience, attention, command of temper, and careful criticism of words, but I do not think his anatomical will equal his moral gain.

The process described above simply distracts the student's attention from the form of what he is studying. Would Mr. Marshall wish the Map of England taught in the same manner—no names or references given to the counties, and Hampshire to be recognised because it is in the last row and adjoins certain other counties, which in their turn adjoin it?

ART STUDENT

Barytes from Chirbury

I HAVE to thank Mr. Woodward for pointing out that the plane (412) has been established for barytes. It was first given by Helmhacker (*Denksch. der K. Akad. der Wiss. Wien.* vol. xxxii. 1872) as occurring on crystals from Svárov and Krušná hora in Bohemia, but is rejected by Schrauf as insufficiently determined. The distinguishing peculiarities of the Chirbury crystals are (1) the predominance of the plane E which does not truncate an edge as is the case in Carl Urba's crystals; (2) the frequent occurrence of ω and ξ; (3) the tendency of the face o to develop small faces on its edges which are inclined to o at angles near 3°. Such faces are Q and Y, and I have since determined a face Λ on the edge $o\mu$ with indices near (25.1.27).

British Museum, November 26 H. A. MIERS

THE ORIGIN OF CORAL REEFS[1]

II.

THE most detailed investigation of coral-reefs which has yet appeared has just been published by Prof. A. Agassiz.[2] This able naturalist is engaged in prosecuting a series of researches into the biological phenomena of the seas on the eastern side of the United States, under the auspices of the United States Coast Survey, and in the course of these explorations he has had occasion to devote himself to the detailed study of the coral-reefs of the Florida seas. For purposes of comparison he has likewise visited the reefs among the West Indian Islands, as well as those on the coast of Central America. His observations are thus the most exhaustive and methodical which have yet been published, and the deliberate conclusions to which he has come deserve the most attentive consideration. He traces the history of a coral-reef from its latest stages as dry land to its earliest beginnings, and even beyond these to the gradual evolution of the conditions requisite for the first starting of the reef. His familiarity with the nature of the bottom all over the area in question, and with the life so abundant in the tropical waters, gives him a peculiar advantage in this inquiry. The upheaval of recent coral-formations to considerable heights above the sea in various parts of the region enabled him to examine the inner structure and foundations of the reefs, and to obtain therefrom altogether new data for the solution of the problem. Following him in his induction we are led back to a comparatively recent geological period, when the site of the peninsula of Florida was gradually upraised into a long swell or ridge, having its axis in a general north and south direction, sinking gently towards the south, but prolonged under the sea as a submarine ridge. The date of this elevation is approximately fixed by the fact that the Vicksburg limestone was upraised by it, and this limestone is assigned to the Upper Eocene series. As a consequence of the elevation, a portion of the sea-bottom was brought well up into the waters of the Gulf Stream, which were probably shifted a little eastward.

No marine fauna yet explored equals in variety of forms or number of individuals that which peoples the waters of the Caribbean Sea and the Gulf of Mexico from the depth of 250 to about 1000 fathoms. This prolific life is traced by Prof. Agassiz to the copious food-supply carried by the warm tropical currents, combined with the food borne outwards from the sea-board of the continent. The corresponding abundant fauna found by the *Challenger* in the Japanese current may be regarded as its counterpart in the Pacific Ocean. Prof. Agassiz points also to the diminished richness of the fauna on the western side of the continents as being probably connected with the absence of those warm equatorial currents which bring such an abundant supply of food to the eastern shores. "No one," he remarks, "who has not dredged near the hundred-fathom line on the west coast of the great Florida Plateau can form any idea of the amount of animal life which can be sustained upon a small area, under suitable conditions of existence. It was no uncommon thing for us to bring up in the trawl or dredge large fragments of the modern limestone, now in process of formation, consisting of the dead carcasses of the very species now living on the top of this recent limestone." Molluscs, echinoderms, corals, alcyonids, annelids, crustacea, and the like, flourish in incredible abundance on the great submarine banks and plateaux, and cover them with a growing sheet of limestone, which spreads over many thousands of square miles and may be hundreds of feet in thickness. In these comparatively shallow waters, and with such a prodigiously prolific fauna which supplies constant additions to the calcareous deposit, the solvent action of the carbonic acid upon the dead calcareous organisms is no doubt reduced to a minimum, so that the growth of the limestone is probably more rapid than on almost any other portion of the sea-bottom.

From the charts we learn how extensively submarine banks are developed in the West Indian region in the track of the warm currents. East of the Mosquito Coast, in Central America, one of these banks may be said to stretch completely across to Jamaica. Similar banks rise off the Yucatan coast; likewise on the windward side of the islands, where the ocean currents first reach them.

That these banks lie upon volcanic ridges and peaks can hardly be doubted, though we have no means of telling what depth of recent limestone may have accumulated upon them. Among the islands, recent volcanic masses rise high above sea-level, in Martinique reaching a height of more than 4000 feet. And as usual in volcanic regions there are numerous proofs of recent upheaval, such as the Basse Terre of Guadaloupe, the successive terraces of recent limestone in Barbadoes, and the upraised coral-reefs of Cuba, which lie at a height of 1100 feet above sea-level.

The West Indian seas have long been famous for their coral-reefs. Prof. Agassiz insists that the distribution of these reefs is determined by the direction of the food-

[1] Continued from p. 110.

[2] "On the Tortugas and Florida Reefs." *Trans. Amer. Acad.* xi. (1883).

bearing ocean currents. They flourish on the windward side of the islands and along the whole eastern coast of Honduras, Venezuela, and Yucatan. But on the leeward shores they do not exist at all. Cuba is fringed both on the north and south side with reefs, but the southern reefs, directly bathed by the Gulf Stream and exposed to the prevailing winds, are more flourishing than the northern reefs, which are to some extent cut off from the equatorial current by banks and islands.

The depth at which corals will flourish in these seas has been found to be rather less than that which has been ascertained to be in general their downward limit elsewhere. Prof. Agassiz concludes that they do not thrive below a depth of six or seven fathoms in the Florida seas, though on the outer reef, directly exposed to the open currents and prevalent winds, they descend in scattered heads to about ten fathoms.

Each successive stage in the growth of an atoll seems to be laid open for study in the prolongation of the Florida reefs. The map of that region (Fig. 2) shows a remarkable broken line of islets and strips of land running parallel with the coast, first in a southerly direction, but gradually curving round until it takes a due westerly trend. This westward curve is attributed mainly to the influence of the strong counter-current which, with a width of ten to twenty miles, sweeps westward into the Gulf of Mexico along the left side of the Gulf Stream, and heaps up organic debris in its track. Florida is growing westward in the line of this current. Reef after reef is added to the land at the east end, while towards the west, new reefs successively begin on the bank, as its surface is gradually built up by the accumulation of organic debris.

The last and youngest of the reefs marked on the maps and charts is the group known as the Tortugas. But immediately to the west of this group Prof. Agassiz has found a prominence on the submarine bank, on which corals have begun to grow. Large heads of Astræans and Madrepores have fixed themselves at a depth of from six to seven fathoms, and Gorgoniæ are found a little lower. This is the beginning of an atoll. The Tortugas, which present a further stage of development, consist of an elliptical, atoll-shaped reef, in three chief parts, whereof the largest forms a crescent, fronting to the east

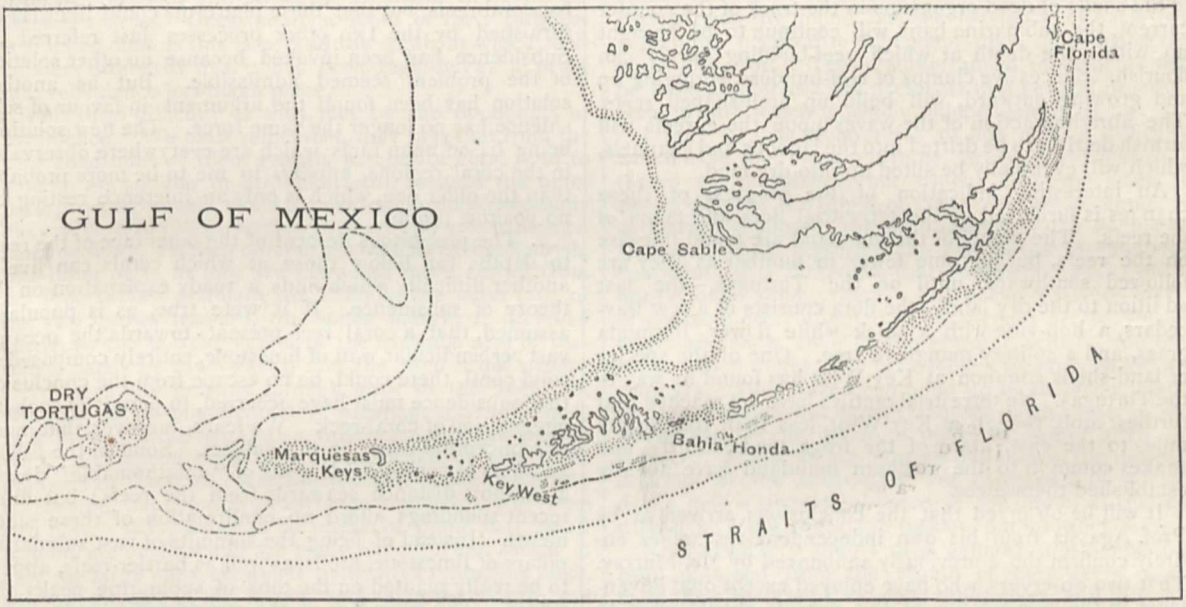

FIG. 2.—Map of the Florida Reef and Keys.

round the edge of the submarine bank, while the two other portions have grown south-westwards along the bank. Three channels between these portions allow powerful tidal currents to rush across the central chiefly submerged parts of the atoll. Seven islands have been formed at the higher parts of the reef by the accumulation and induration of calcareous debris tossed up on the reef by the waves. To the breakers and currents combined with the distribution and habits of growth of the reef-builders Prof. Agassiz entirely attributes the form and growth of the reef. The most important corals are the Madrepores, which flourish in extensive patches, two common species of *Porites* occurring in clusters over the shallow tracts of coarse sand, and *Mæandrina areolata*, growing between the marine lawns of *Thalassia*, with occasional patches of *Anadyomene*. Immense masses of nullipores and corallines grow on the tops of the dead branches of Madrepores which have been killed by exposure to the air during extreme low tides or when strong winds have blown the water off the flats. Large heads of Astræans and *Mæandrina* occur here and there towards the edge of the reef, which is occupied mainly by clusters of *Gorgoniæ*. The destruction of the reefs by the waves is very great, the sea being occasionally discoloured with the chalky sediment to a distance of from six to ten miles after a storm. Broken coral-heads, and branches, dead corallines, shells of mollusks, old serpulæ tubes, stalks of *Gorgoniæ*, and other organisms are thrown up in lines that consolidate into a low dyke, which in turn is pounded up and removed by the breakers. A prodigious quantity of calcareous sediment is thus produced, much of which is swept into the interior of the reefs, where it accumulates in flats of sand and silt. It is only on the outer edges of the reef, where the scour of the sea is greatest, that the corals can flourish; elsewhere they are choked and buried under the deposit of calcareous sediment. Some of this sediment accumulates in steep submarine banks, like sand-dunes, which shift to and fro as winds and currents vary; though by the action of the carbonic acid of the sea-water they are apt to be cemented into solid slopes, some of which have an angle of as much as 33°. So great is the destructive and transporting influence of the sea under the combined or antagonistic working of tides, currents, and wind-waves, that the whole mass of the reef as well as the flats and shoals inside may be said to be in more or less active movement. Hence none of the

landmarks furnished by the islands can be relied upon for the location of buoys.

A still more perfect example of an atoll formed under similar conditions is that of Alacran on the opposite coast of Yucatan. Its eastern face is a great arc of about 20 miles, where, exposed to the open sea and easterly winds, the corals flourish vigorously. On the eastern or interior face of the western chord of the reef, however, the silt derived from the pounding of the breakers to the eastward has already killed the corals. The lagoon is occupied by detached coral-heads with lanes of deep water between them [1]

To the east of the Tortugas, nearer the mainland of Florida, older stages of development among coral-reefs may be traced. By the westward drift of the calcareous sand and silt the lagoons have been converted into flats, and these in succession have been turned into more or less continuous dry land. There is no evidence of subsidence. The area seems to have remained stationary for a long period, or if there has been movement at all, it has been in an upward direction. Should the present condition of things be prolonged, there will be a further extension of the Florida coast-line. By the heaping up of the shells of dead organisms in the track of the counter current, the submarine bank will continue to be brought up within the depth at which reef-building corals can flourish. Successive clumps of reef-builders, springing up and growing outward, will build up atoll-shaped reefs. The abrading action of the waves upon these reefs will furnish detritus to be drifted into the lagoons and channels, which will eventually be silted up into dry land.

An interesting indication of the progress of these changes is furnished by the terrestrial flora and fauna of the reefs. The plants of the mainland are found likewise on the reefs, but become fewer in number as they are followed southward, until on the Tortugas,—the last addition to the dry land,—the flora consists of a few Bay-cedars, a hop-vine with a thick white flower, Bermuda grass, and a solitary mangrove tree. One of the species of land-shells common at Key West has found its way to the Tortugas. No terrestrial reptiles have yet reached that furthest atoll, though at Key West, less than 100 statute miles to the east, many of the frogs, toads, lizards, and snakes common to the southern mainland have already established themselves.

It will be observed that the conclusions arrived at by Prof. Agassiz from his own independent researches entirely confirm those previously announced by Mr. Murray. That two observers, who have enjoyed exceptional advantages in the investigation of this subject, should come to practical agreement must be admitted to be a strong argument in favour of the views which they have adopted.

Putting together all the data which have here been summarised, I think we are driven to admit that barrier reefs and atolls may be formed without subsidence of the sea-floor. Whether this has been the usual or only an exceptional manner of their origin is a question that will depend for its solution upon whether or not it can be shown that there are general phenomena which can only be explained by subsidence. Three such phenomena may be adduced: I am not aware of any others that deserve serious consideration.

1. One of the early difficulties which Darwin's explanation satisfactorily solved was the necessity for the existence of so many peaks, coming up from the depths of ocean just to the zone in which reef-building corals live. No cause was conceivable which should have so generally arrested the upward growth or upheaval of these submarine heights at the limit where coral-reefs might begin. And this difficulty has always been looked upon as furnishing one of the strongest arguments in favour of the theory of subsidence, for that theory completely removes it, by showing how, in a general submergence, peak after peak would sink, and come within the sphere of the operations of the reef-builders.

The difficulty is met in a totally different way by those who believe it to be more formidable in appearance than in reality. They contend that, while it must not be forgotten that many peaks do rise above the sea-level, and many submarine banks still fall far short of the coral-zone, two powerful causes conspire to bring submarine banks to a common uniformity of level at a short distance below the surface of the ocean. On the one hand, those portions of volcanic mountains that rise above the sea-level are worn down by the atmosphere and the waves, and unless otherwise preserved, must inevitably be reduced to the lower limit of wave-action, which is probably nearly coincident with the lower limit of reef-builders. On the other hand, submarine banks in tropical seas are built up towards the surface by the accumulation of the aggregated remains of plants and animals which live on the bottom or fall down to it from upper waters, and the magnitude of this upward growth is hardly yet adequately realised.

In balancing these opposite views, we must, I think, admit that subsidence is adequate to provide platforms for coral-reefs, but that these platforms could likewise be furnished by the two other processes just referred to. Subsidence has been invoked because no other solution of the problem seemed admissible. But as another solution has been found the argument in favour of subsidence has no longer the same force. The new solution, being based upon facts which are everywhere observable in the coral regions, appears to me to be more probable than the older one, which is only an inference resting on no positive proofs.

2. The precipitous descent of the outer face of the reefs to depths far below those at which corals can live is another difficulty which finds a ready explanation on the theory of subsidence. If it were true, as is popularly assumed, that a coral reef presents towards the ocean a vast perpendicular wall of limestone, entirely composed of solid coral, there could be no escape from the conclusion that subsidence must have occurred, to permit of such an aggregation of coral-rock. We learn, however, that much misconception exists on this subject. Some of the earlier accounts of coral-islands speak of "unfathomable" depths at a short distance seawards from the reefs; but more recent soundings afford no confirmation of these statements. Instead of being the summits of vast submarine pillars of limestone, atolls, as well as barrier-reefs, appear to be really planted on the tops of submarine peaks and ridges. The outer face of the reef is undoubtedly steep, in some places vertical. At Tahiti, for example, as shown in Fig. 2, the living face of coral may extend to a depth of 30 to 35 fathoms, beneath which huge detached blocks of coral are piled up and cemented together, forming a steep face, which descends to about 150 fathoms at a distance of 180 fathoms from the upper edge of the reef. The sea-bottom beyond that point is covered with coral sand and slopes at 25° to 30°, after which the angle lessens to 6°. By the abrading action of the breakers in tearing off blocks of coral, and strewing them down in steep talus-slopes, a platform is prepared on which the actually growing part of the reef can build outwards.

In Darwin's section of the Gambier Islands the thickness of the encircling reef is made to be about 2000 feet.[1] Prof. Dana by one estimate puts it at 1150, and by another at 1750 feet. He assumes that in general the thickness of solid coral must be considerable, though he admits that calculations based on the seaward continuation of the slope of the land are liable to error from many causes.[2] Even if we admit (what cannot be proved) that the calcareous mass of any coral-reef does attain a thickness of many hundred feet, it would not necessarily con-

[1] *Bulletin Mus. Comp. Zool.*, v. No. 1.

[1] "Coral Reefs," 2nd edit. p. 65.

[2] "Corals and Coral Islands," 2nd English edit. (1875), p. 126.

sist wholly of solid coral.[1] Prof. Agassiz has followed the growth of a reef upon a platform of calcareous organic debris, and he has found elevated coral-reefs which rest on such a platform. Mr. Murray's observations explain how a reef may grow outward on a talus of its own debris. There appears to be no reason, indeed, why a calcareous mass of almost indefinite thickness might not be formed without the aid of subsidence. Its upper zone might be directly due to coral growth, while the larger part of the mass might be composed of an aggregate of coral debris mixed with the remains of mollusks, echinoderms, and other calcareous organisms. So rapid is the destruction of organic structure through the solution and redeposit of carbonate of lime by infiltrating water, that a special and careful search might be required to determine the actual limits of the true reef and of its calcareous platform, and even such a search might not be successful.

After a full consideration of this second difficulty I feel compelled to admit that no valid argument in favour of subsidence can be based on the steepness of the seaward face of a reef and the thickness of the calcareous mass of the reef itself.

3. The depth of some lagoons and lagoon-channels furnishes probably the strongest argument in favour of Darwin's views. Occasionally a depth of forty fathoms is reached, and as this is beyond the depth at which reef-builders ordinarily live, it has been regarded as a proof that subsidence has taken place.

This third difficulty is thus met by the opponents of subsidence. We must remember, they say, that from the very conditions of their growth, patches of coral tend to assume an annular or atoll-like form, because the outer parts grow vigorously, while the central portions eventually die. Where the coral-patches coalesce and extend along a bank or shore, it is their outer or seaward faces that flourish. The inner parts, as they are more and more cut off from the food-supply, gradually die. While the outer face of the reef grows seaward, the inner margin is attacked partly by the solvent action of the carbonic acid of sea-water, partly by wind-waves, and the tidal scour sweeps away much fine detritus through gaps in this reef. In this way the lagoon-channel is widened and deepened. In a perfect atoll, that is, an unbroken annular reef of coral, the lagoon could not be deepened by any mere abrasion of the dead coral and removal of the detritus in suspension, but solution by carbonic acid would still come into play. It is further to be borne in mind that small lagoons are shallow and are being filled up, and that it is only the large ones, encircled by nearly continuous reefs, where the corals in the lagoon and along the margin are dead, and where the effects of solution may be conceived to have been longest in operation, that the depth of the lagoon descends below the limits at which reef-builders live.

I do not regard this solution of the difficulty as wholly satisfactory. Of the fact that dead calcareous organisms are attacked and carried away in solution by the carbonic acid of sea-water there cannot be any question, and this process must be of great geological importance. Whether the solvent action is sufficient to account for the exceptional depth of some lagoons, is still, I think, open to inquiry. It seems to me not improbable that these comparatively few deep lagoons may owe their depth partly to subsidence. But if this be the case it would lend, I am afraid, but slender support to a theory of wide oceanic depression. That there must be some areas of subsidence over the coral regions is almost certain, and the few scattered deep lagoons may possibly indicate some of these areas.

Having thus fully examined the arguments on both sides of this interesting and important question, I feel myself reluctantly compelled to admit that Darwin's theory can no longer be accepted as a complete solution of the problem of coral-reefs. No one could be more impressed than myself with the simplicity of this theory, the brilliancy of its generalisation, its remarkable fitness in geological theory, and the grandeur of the conceptions of geographical revolution to which it leads. I am fully alive to the serious changes which its abandonment will make in some departments of geological speculation. But in the face of the evidence which has now been accumulated, I can no longer regard the accepted theory as generally applicable. That it may possibly be true in some instances may be readily granted. There may be areas of subsidence, as there certainly are areas of elevation, over the vast regions where coral-reefs occur. It may be conceded that subsidence may sometimes have provided the platform whereon coral-reefs have sprung up, and may have contributed to heighten some reefs and to deepen some lagoons and lagoon-channels. But I do not believe that we are now justified in assuming subsidence to have taken place, from the mere existence of atolls and barrier-reefs. Its occurrence at any locality must be proved by evidence of special local movement. It may have gone on at many localities where atolls and barrier-reefs are found, but the existence of such reefs is no more necessarily dependent upon subsidence than upon elevation. These subterranean movements must be looked upon as mere accidents in a general process of coral growth which is wholly independent of them.

I may in conclusion refer to one or two difficulties which have long been felt to be serious drawbacks to the theory of subsidence, but which disappear when the newer views of the origin of coral-reefs are accepted. If, as Darwin supposed, the coral-islands of the Pacific and Indian Oceans represent the last peaks of submerged continents, it is incredible that continental rocks should not be found among them. The oceanic islands (except of course those composed of coral-rock) are of volcanic origin and show none of the granites, schists, and other rocks which might have been looked for on such elevated summits. They have been piled up by the accumulation of lavas and tuffs discharged from the earth's interior, and, where they occur, point to upheaval rather than subsidence. Again, as Mr. Murray has shown, the inorganic deposits of the ocean-floor are composed of volcanic debris with a singular absence of the minerals that constitute the usual crystalline rocks of our continents.

No satisfactory proofs of a general subsidence have been obtained from the region of coral-reefs, except from the structure of the reefs themselves, and this is an inference only, which is now disputed. From the nature of the case, indeed, traces of subsidence can hardly be expected. A few examples have been cited, such as the occurrence of trunks of cedar-trees in a layer of red soil at Bermuda, lying between the calcareous deposits and at a depth of 42 feet below low-water mark. This indicates a recent subsidence of that tract; but it may be merely local, and may be due to the sinking down of the roof of one of the caverns into which the limestone is so abundantly honeycombed. Occasionally along the margins of lagoons trees are found at the water edge, in a position suggestive of subsidence. But the removal of the calcareous rock by solution or wave-action might equally account for their condition.

Of elevation in the region of atolls and barrier-reefs, there is almost everywhere more or lees distinct evidence. Prof. Dana has collected the facts which prove that recent elevatory movements of unequal and local extent have occurred in all parts of the ocean.[1] Upheaval has taken place even in areas where barrier-reefs and atolls are in vigorous growth. Such an association of upheaval with an assumed general subsidence requires, on the subsidence theory, a cumbrous and

[1] Prof. Dana (*op. cit.*) cites examples of raised coral-reefs 250 to 300 feet above sea-level; but we do not yet know how much of the rock is solid coral and how much may be formed of aggregated organic debris.

[1] Corals and Coral Islands," 2nd edit. p. 284.

entirely hypothetical series of upward and downward movements. These are unnecessary if we can be convinced that coral-reefs grow up independent of terrestrial movements, which may in one area be in an upward, in another in a downward direction. From this point of view the reefs stand up as the result of a complex series of agencies, among which the more important are on the one hand, the temperature, solvent power, currents, tides, and waves of the sea, and on the other hand, the amount and direction of the supply of pelagic food, the up-building of calcareous deposits to the zone of reef-builders, the outward vigorous growth of the coral-masses and their decay and death, and the solution of their skeletons in the inner parts of the reefs. All these causes are known and visibly active. Without the cooperation of any other supposed or latent force they appear to be entirely adequate to the task of building up the present coral-reefs of the oceans. ARCH. GEIKIE

DR. JOHN LAWRENCE LECONTE

INFORMATION has just been received in this country announcing the death of Dr. LeConte. He was born in New York on May 13, 1825, and was the son of a distinguished officer in the United States army, himself an entomologist. He adopted the medical profession, and during the secessionist war he entered as medical officer of volunteers. The foregoing necessarily brief, specially biographic account is chiefly derived from information furnished in Dimmock's "Special Bibliography of American Entomologists, No. 1."

LeConte could have been only nineteen years old when he published his first entomological paper on certain new species of North American *Coleoptera* (*Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. ii.). From that time forward a continuous series of works and papers on North American *Coleoptera* was produced by him until his death. He made a speciality of *Coleoptera*, and, with few exceptions, all his writings were devoted to that order of insects, and through his exertions the beetles of the United States are now almost as well known as are those of Europe. At the time of his death his published papers must have been nearly 200. Moreover he was the acknowledged authority in the United States on all matters coleopterological, a position which must naturally have caused him vast trouble and correspondence, sometimes with inadequate results. Latterly he worked greatly in company with Dr. G. H. Horn, of Philadelphia, a worthy follower of his tutor and a worthy successor. Their joint labours culminated *this year*, when was published ("Smithsonian Miscellaneous Collections," No. 507) a "Classification of the *Coleoptera* of North America," a volume extending to nearly 600 pages. It is needless here to refer to the revolution this work and other memoirs (chiefly by Dr. Horn) created in the minds of coleopterists as to the sequence of main divisions, &c. All working entomologists are sufficiently alive to the importance of the new ideas put forth. In fact this volume might have been considered a model of a special monograph were it not for a somewhat crude "Introduction" on insects in general that precedes the systematic portion.

In the present condition of entomological science in the United States the loss of Dr. LeConte seems almost irreparable. He and his coadjutor, Dr. Horn, and one or two others, stood almost alone amongst the prominent American entomologists in holding no special official position in connection with their subject.

LeConte once made a lengthy stay in Europe, and was well known personally in this country to all the prominent Coleopterists. Moreover he was honorary member of several of the European entomological societies, including the Entomological Society of London; his personal friends in this country were numerous. Since the death of Say (whose scattered works were carefully collated and re-edited by the subject of this notice) entomological science in America has not had to deplore so severe a loss, and Say's death was not fraught with the same significance.

R. MCLACHLAN

THE LATE MR. DARWIN ON INSTINCT

AT the meeting of the Linnean Society this evening (December 6) a highly interesting posthumous paper on Instinct, by Charles Darwin, will be read and discussed. We have been favoured with an early abstract of the same, which we here present to our readers.

After detailing sundry facts with reference to the migratory instincts of different animals, Mr. Darwin proceeds to suggest a theory to account for them. This theory is precisely the same as that which was subsequently and independently enunciated by Mr. Wallace in NATURE, vol. x. p. 459. Thus, to quote from the essay: "During the long course of ages, let valleys become converted into estuaries, and then into wider and wider arms of the sea; and still I can well believe that the impulse [originally due to seeking food] which leads the pinioned goose to scramble northward, would lead our bird over the trackless waters; and that, by the aid of the unknown power by which many animals (and savage men) can retain a true course, it would safely cross the sea now covering the submerged path of its ancient journey."

The next topic considered is that of instinctive fear. Many facts are given, showing the gradual acquisition of such instinctive fear, or hereditary dread, of man, during the period of human observation. These facts led Mr. Darwin to consider the instinct of feigning death as shown by sundry species of animals when in the presence of danger. Seeing that "death is an unknown state to each living creature," this seemed to him "a remarkable instinct," and accordingly he tried a number of experiments upon the subject with insects, which proved that in no one case did the attitude in which the animal "feigned death" resemble that in which the animal really died; so that the instinct really amounts to nothing else, in the case of insects at all events, than an instinct to remain motionless, and therefore inconspicuous, in the presence of danger. From the facts given with regard to certain vertebrated animals, however, it is doubtful how far this explanation can be applied to them.

A large part of the essay is devoted to "Nidification and Habitation," with the object of showing, by an accumulation of facts, that the complex instincts of nest-building in birds and of constructing various kinds of habitations by mammals, all probably arose by gradual stages under the directing influence of natural selection.

The essay concludes with a number of "miscellaneous remarks" on instincts in general. First the variability of instinct is proved by sundry examples; next the fact of double instincts occurring in the same species; after which, "as there is often much difficulty in imagining how an instinct could first have arisen," it is thought "worth while to give a few, out of many cases, of occasional and curious habits, which cannot be considered as regular instincts, but which might, according to our views, give rise to such." Finally, cases of special difficulty are dealt with; these may be classified under the following heads:—(1) Similar instincts in unallied animals; (2) dissimilar instincts in allied animals; (3) instincts apparently detrimental to the species which exhibit them; (4) instincts performed only once during the lifetime of an animal; (5) instincts of a trifling or useless character; (6) special difficulties connected with the instinct of migration; (7) sundry other instincts presenting more or less difficulty to the theory of natural selection.

The "Conclusion" gives a summary of the general

principles which have been set forth by the whole essay. This, therefore, we shall quote *in extenso*:—

"We have in this chapter chiefly considered the instincts of animals under the point of view whether it is possible that they could have been acquired through the means indicated on our theory, or whether, even if the simpler ones could have been thus acquired, others are so complex and wonderful that they must have been specially endowed, and thus overthrow the theory. Bearing in mind the facts given on the acquirement, through the selection of self-originating tricks or modification of instinct, or through training and habit, aided in some slight degree by imitation, of hereditary actions and dispositions in our domesticated animals; and their parallelism (subject to having less time) to the instincts of animals in a state of nature: bearing in mind that in a state of nature instincts do certainly vary in some slight degree: bearing in mind how very generally we find in allied but distinct animals a gradation in the more complex instincts, which shows that it is at least possible that a complex instinct might have been acquired by successive steps; and which moreover generally indicate, according to our theory, the actual steps by which the instinct has been acquired, in as much as we suppose allied instincts to have branched off at different stages of descent from a common ancestor, and therefore to have retained, more or less unaltered, the instincts of the several lineal ancestral forms of any one species: bearing all this in mind, together with the certainty that instincts are as important to an animal as their generally correlated structures, and that in the struggle for life under changing conditions, slight modifications of instinct could hardly fail occasionally to be profitable to individuals, I can see no overwhelming difficulty on our theory. Even in the most marvellous instinct known, that of the cells of the hive-bee, we have seen how a simple instinctive action may lead to results which fill the mind with astonishment.

"Moreover, it seems to me that the very general fact of the gradation of complexity of instincts within the limits of the same group of animals; and likewise the fact of two allied species, placed in two distant parts of the world and surrounded by wholly different conditions of life, still having very much in common in their instincts, supports our theory of descent; for they are explained by it: whereas if we look at each instinct as specially endowed, we can only say that it is so. The imperfections and mistakes of instinct on our theory cease to be surprising: indeed it would be wonderful that far more numerous and flagrant cases could not be detected, if it were not that a species which has failed to become modified and so far perfected in its instincts that it could continue struggling with the co-inhabitants of the same region, would simply add one more to the myriads which have become extinct.

"It may not be logical, but to my imagination it is far more satisfactory, to look at the young cuckoo ejecting its foster-brothers, ants making slaves, the larvæ of the Ichneumonidæ feeding within the live bodies of their prey, cats playing with mice, otters and cormorants with living fish, not as instincts specially given by the Creator, but as very small parts of one general law leading to the advancement of all organic bodies—Multiply, Vary, let the strongest Live and the weakest Die."

PORTO RICO

THROUGH the courtesy of Sir Joseph Hooker, we are able to publish the following interesting communication from Baron Eggers on the island of Porto Rico:—

St. Thomas, October 22, 1883

DEAR SIR JOSEPH HOOKER,—It is a long time since I wrote you last. I have meanwhile at last accomplished my long-cherished design, partly at least, of exploring the Luguillo Mountains in Porto Rico, which island I visited during April and May this year.

I spent about five weeks there, living for some time in the hut of a "fibaro" or native labourer on the Sierra, at an altitude of about 2200′, on the edge of the primeval forests that still cover all the higher part of the mountain range.

Since my return I have been busy arranging my collections, the greater part of which appears in the ninth and tenth century of my "Flora Indiæ Occidentalis Exsiccata."

As for the general character of the Sierra forests, they of course resemble in their main outlines those of the other West India Islands. There is, however, especially one feature that strikes me as being peculiar to this mountain ridge compared with the woods of other islands, for example, of Dominica. Whilst the climate is just as moist in the Sierra of Porto Rico as in that of Dominica, the forests of Porto Rico seem nearly entirely *destitute of epiphytes* with the exception of some few Bromeliads and a very rarely occurring stray orchid. But orchids in general and epiphytical ferns, such as *Trichomanes* and *Hymenophyllum*, &c, are conspicuous by their absence. Of palms I found but one species, which I have distributed in my "Flora," I believe it is a *Euterpe*, grows gregariously at an altitude from 1500′ to 3000′. No Cycads were seen at all.

On the other hand, I found several interesting trees, especially a beautiful *Talauma*, with immense, white, odorous flowers and silvery leaves, which would be very ornamental. The wood is used for timber, and called Sabino. A *Hirtella* with crimson flowers I also found rather common; it is not described in any of Grisebach's publications. An unknown tree with beautiful, orange-like foliage, and large, purple flowers very similar in shape to those of *Scævola Plumieri*, split along one side, a tall *Lobeliacea*, a large *Heliconia*, nearly allied, it seems, to *H. caribbæa*, Lam., and several other as yet undetermined trees and shrubs, are among the most remarkable things found.

On the whole I was somewhat disappointed with regard to the result of the voyage, as I had expected a greater number of novelties, as well as a richer vegetation in general, at least something like the Caribbean Islands. But these partly negative results may no doubt be of some value also in forming an idea of the West Indian flora in general. Of tree-ferns, *Cyathea Serra* and an *Alsophila* were not uncommon.

One of the most conspicuous trees in some parts is the *Coccoloba macrophylla*, which I found on my first visit to Porto Rico. This tree is found up to an altitude of 2000′, but chiefly near the coast, where it forms extensive woods in some places, which at the time of flowering, with immense, purple spikes more than a yard long, are very striking. The tree is named Ortegón by the inhabitants; it does not seem to occur on any of the British islands, but to be confined to Porto Rico and Hayti; at least I do not see it mentioned in Grisebach's "Cat. Plant. cubensium."

The people cultivate sugarcane in the plains, which are very fertile, yielding three hogsheads on an average per acre without any kind of manure. Besides this staple produce, a very good coffee is produced; it does not appear that any blight has as yet perceptibly affected the shrubs here. Rice is very commonly cultivated on the hills in the Sierra. I suppose it must be a kind of mountain variety, as no inundation or other kind of watering is used. Rice is in fact the staple food of the labourers, together with plantain and yaŭdia, *i. e. Caladium esculentum*. Immense pastures of *Hymenachne striatum* (Malahojilla) occupy a part of the lowland, and feed large herds of cattle of an excellent quality. St. Thomas and the French islands all obtain their butcher's meat from

Porto Rico; I believe even Barbados comes to Porto Rico for cattle.

The island is very richly endowed by nature, but miserably governed, and the people themselves not worth a much better government, being given to gambling in the extreme throughout, thus squandering away every dollar, from the rich planter and priest down to the lowest labourer and beggar. Yet they are hospitable and very polite to strangers, with that remarkable, unchanging, inbred Spanish politeness.

It may finally interest you to hear, from the fact that you take a prominent part in the advancement of the material progress of the English West India Islands, how we are working in that respect here in St. Thomas.

I have on my estate now about 4000 Divi-Divi trees growing and doing well, except for the deer, which do much damage. On the coasts I have over 2000 cocoa-nut trees planted; cultivation of the *Sanseviera guineensis* is going on for making fibres; a large tract of land stocked with *Hæmatoxylon* I have now preserved, and try to make it a regular forest, to be cut down gradually.

In company with an engineer here I have now ordered a machine from England, Smith's fibre machine, which is being used in the Mauritius, in order to work up our immense quantity of *Agave* and *Fourcroya*, the raw material being close at hand in unlimited quantity near the sea.

I have published a couple of articles on the material resources of these islands in one of the largest Danish newspapers, of which I beg to send you a copy, in order to make private persons and Government move. Among the former a good many have started on, but, as you may perhaps have heard, governments are sometimes slow in moving, representing, as they do eminently, that great law of nature, *vis inertiæ*.

However, so far, and considering the short space of time, I am very well satisfied. I think there is a fair chance now of the West Indies in general entering upon a new prosperous career.

I am also going to try experiments with the manufacture of tannin extracts from bark of *Coccoloba*, *Rhizophora*, and the pods of the various Acacias, which are a great nuisance here on account of their rapid growth.

The *Aloe sempervirens* will also be made useful in a similar manner as in Barbados and Curaçoa, it growing here spontaneously on barren rocks. H. EGGERS

THE REMARKABLE SUNSETS

UNDER the headings of "Cloud-Glow" and "Optical Phenomena" we have published several letters already on the recent remarkable sunsets; we have received many others, the most important of which we bring together here:—

PERHAPS it will interest you and your readers to hear that the phenomenon called "cloud-glow" in your last numbers, was seen also at Berlin on the three evenings of November 28, 29, and 30. As far as I could overlook the sky, the details were almost the same as your correspondents describe them: A greenish sunset at 3.50, an unusually bright red sky with flashes of light starting from south-west. An interesting physiological phenomenon which we call "Contrast-Farben," was there beautifully illustrated by some clouds, no longer reached by direct sunlight; they looked intensely green on the red sky. At 4.30 the streets were lighted by a peculiarly pale glare, as if seen through a yellow glass. Then darkness followed, and the stars became visible. But half an hour afterwards, at 5 o'clock, the western sky was again coloured by a pink or crimson glow. Persons who were not quite sure about its direction mistook it for a Polar aurora; others spoke of a great fire in the neighbourhood. If atmospheric refraction could be neglected, the matter (whatever it may be) thus illuminated by the sun one hour after sunset and 45° above the horizon, would be found to be at a height of about forty miles! At 6 o'clock all was over. The first day (November 28) this glow was still stranger, because the lower western sky was covered by a large, dark cumulus-cloud; but besides this the three remarkable evening skies were quite like each other. ROBERT VON HELMHOLTZ

N.W. Berlin, Neue Wilhelmstrasse 16, December 1

P.S.—To-day it rains; nevertheless an unusual brightness was to be seen in the west till 7 o'clock, which perhaps may be attributed to the same "glow."—R. v. H.

THE red glow described by your correspondents continued to be visible here every evening until yesterday (2nd inst.), and there was another fine display of *rayons du crépuscule*. Is not "cloud-glow" a misnomer as applied to what is seen in perfection only when there are no clouds, and is invisible when the clouds are thick? "After-glow" is too comprehensive an expression, as it embraces the usual effects of a brilliant sunset, and too limited, as it could not be applied to the phenomenon as recently seen before sunrise. In the absence of a scientific title for something which has been but little investigated, might not the name "upper-glow" be adopted, in contrast to the under-glow which is the predominant feature of ordinary effective sunsets. The red colour of the reflected light is in both cases I suppose equally due to diffraction, particles suspended in the air obstructing the rays of least wave-length. But in the "upper-glow" the reflecting matter is at a great height above the cloud-level, in the "under-glow" it consists of the lower surface of the clouds themselves. ANNIE LEY

December 3

Erratum.—In the first paragraph of my letter of the 27th ult. (p. 103) 2600 should be 26,000.

THE following extracts from my observations at York may assist in determining the cause of the extraordinary series of sunrise and sunset effects during the past month:—November 24: Unusual cloud tinge in morning. November 25: Similar effect in morning. From 2.45 to 3 p.m., blue sky from 10° to 25° or 30° from the sun, of a delicate rose pink. This noticed by several, when asked to say if they saw anything peculiar. It gave a greenish-gray cast to cirro-cumuli through which it was seen. Round the sun the sky looked yellowish. 5.30 p.m., "the west ruddy as from glare of fire;" not entirely gone till 6. Time of local sunset 3.38, calculated from almanac and observed sunrise on 28th.

A letter from my father, Street, Somerset, 26th, evening, speaks of "a wide arc above the sunset lit up with the most glorious pink shade. The clouds low in the horizon a stone-gray; but the most remarkable of all was a longish cloud to the north of sunset and above and beyond the circle of pink; that was a bright sage green. I never before saw such a colour in any cloud. . . . Later, rays shot up from the sun like the rays of aurora."

28th: Same pink halo at noon. Cloud-glare on morning of 26th and 27th; to-day, about 6 a.m. (sun rose at York 8.0, set 3.35). Sunset most striking; pink above, orange lower at 4.20; grass appeared of brownish sage green. At 5 p.m. lit up all over like red aurora. 29th: Same red glare, like that of a fire, at 6.20 a.m. Glare gone by 6.35; cirri in east-south-east lit up by 6.45. True sunrise glow 7.10; orange at base turned to yellow-green at 7.25, and cirri again black; relit at 7.35, with rosy tinge. Sun seen to rise clear of horizon at 8.2; Jupiter visible among faint haze until 8.13. 9.45 a.m., rosy glow round sun; 4.30 p.m., a fading ordinary sunset; 4.45, glare reappearing; 5 p.m., "finer than ever," as observed by Mrs. Clark. December 3: Remarkable lurid effects, 4.30 to 5.0 p.m. Letters from Street and Birmingham mention similar effects on the 28th and 29th. A para-

graph in the *Daily News* reports them from Bideford, Devon, on Monday, 26th, soon after 5 p.m.; 27th, a.m.; and from 9.45, a "dusky orange and rosy band round the sun," till hidden by clouds at noon; 28th, p.m., 29th, a.m., and coloured "bands" again round the sun at 11 a.m. To me the glare never seemed as if reflected from cirrus clouds; it was much more like that from the smoke-originated clouds of manufacturing districts. The day effect was evidently from the same cause as the after-glow. May it not help us to connect it with the "green sun" phenomenon of India? In that case the possible connection of the latter with the volcanic eruptions of Java assumes special interest, and may give us a new insight into the upper currents of wind. We have already heard how ashes fell at great distances to windward, reckoning by the surface currents. The same upper winds, in the time that elapsed, seem to have carried lighter ashes, projected still higher, over India. May not the lightest and highest-projected, almost impalpable dust have been spread over the greater part of our hemisphere, or at any rate as far as England, whose distance from Calcutta is not double the distance from Calcutta to Java? The recent Greenland expedition has enforced the lesson of ocean soundings on the wide prevalence of such material. If this suggestion has any foundation, then the comparison to the lurid glare over cities may be a true analogy. Just as frozen fog particles form around solid nuclei of smoke, so the impalpable dust may have formed centres for cloud-formation in air strata above the normal range of clouds.

York, December 3 J. EDMUND CLARK

P.S.—December 4: My observations on last night's sunset were from hurried glances indoors. I find from Mrs. Clark that the appearances differed from the general character, being like those of Sunday evening, the 25th. She noticed, as did also another lady, the curious *green* colour of the moon. This fact was recalled to my mind to-night, when yesterday's sunset effects were repeated, the moon, to my surprise, having a most striking green tint. This was about 4.25, and it was still noticeable at 4.45.—J. E. C.

THIS singular atmospheric aspect prevails here daily at sunrise and sunset, though there seem to be indications that its splendour is on the wane. It has been visible for nearly a month, prolonging daylight upwards of an hour. At sunrise, on the 28th, the rich colours of the phenomenon again suffused the sky, and at sunset and for upwards of an hour afterwards the sky was effulgent with all the prismatic colours. The sunrise of the 29th surpassed all previous ones in magnificence, spread, and duration of colour. The day being favourable for observation, it was possible to detect a mass of attenuated, white, nebulous vapour surrounding the sun for a distance of some 30° or 40°. The sunset was less remarkable for tone and brilliancy of colour. Pearly-whites and steel-grays mostly prevailing at 4.15 p.m., a faint rosy colour suffused the whole sky. At 4.30 p.m. a band of glowing orange-coloured light, about 23° in altitude, stretched from north-west to a point near the south, and at 5.15 p.m. a remarkable body of rosy light formed in the west above the orange-coloured mass, and separated from it by a dark slate-coloured space, about 2° wide, small and pillar-shaped at first, with the apex pointing north, but soon spreading north and south. This nebulous body deepened in colour as it grew in mass till it became a remarkable volume of vivid crimson light some 5° or 6° in height, and 25° or 30° in length. At 6 p.m. the colour of the western sky had changed to orange; afterwards the colour slowly died out, and night prevailed. On the morning of the 30th ult. the glow was indistinctly apparent. In the afternoon there was a dense cloud canopy and considerable rainfall, but an orange coloured glare at sunset was discernible through the clouds. On the 1st inst. the radiance of the glow was conspicuous, and the sky richly coloured just before sunrise. At 4 p.m. the glare in the west was brilliant, with golden carmine and green colours. At 4.15 the carmine colour disappeared, the greater part of the sky became of a delicate blue, and long streaks of cirri of changeful colour lay across the sky. After many changes of tints and the appearance of the usual glow like that of a second daylight, at 5.15 p.m. the usual fiery glow rose in the west to an altitude of 25°, and continued till 6 p.m. On the 2nd, the sky was cloudy before sunrise, but the radiance was visible all the same, showing carmine and golden hues. On that morning a pale yellow coloured the sky till 11 a.m. At sunset the iridescent display was less brilliant than usual, and commenced later. But there were fiery reds, glowing yellows, and olive-greens in a sky with a detached cloud canopy. The usual fiery glow appeared at about 5.50 and prevailed till 6 p.m. On the morning of the 3rd, before sunrise, the coloured radiance reappeared in great beauty, and a yellow tint pervaded the sky throughout the day. The wind on this day was rough from the north-west. The thermometer at midday was 51°. At sunset the glow was less splendid than heretofore, and the fiery reds were dilute and diffuse. The sky was cloudy. The glow lighted up the heavens till 6 p.m. as usual. This morning (4th) the sky before sunset was resplendent with rich masses of prismatic colour. Suddenly, at 8.30 a.m., when the brilliant colours had vanished, a halo of iridescent colours encircled the sun for a short time, as though a body of vapour was swiftly traversing the sky. In a moment afterwards the colour of the sun changed to an exquisite emerald hue, staining the landscape and investing houses, buildings, glazed windows, and greenhouses with a remarkably weird aspect. Before there was well time to notice how things appeared in a bright green light, the rays of the sun changed to a deep yellow, and in a moment afterwards, as though some obscuring medium had been withdrawn, the ordinary daylight reappeared. At sunset to-day the display was magnificent in variety and tint of colour. At 4.15 the usual orange-colour bank of glowing, luminous vapour appeared in the west, extending to north-west and south-west, having above it a system of rays of a dull, fiery red. The sky was clear, flecked here and there with cirro-cumulus. At 4.45 the crescent of the moon, being just above the fringe of red light, assumed a lively green hue, and continued to exhibit the novelty of an emerald crescent till 5 p.m., when, the colour passing away, the satellite resumed its silvery hue and shone in the blue sky, while the fiery glow still lighted up the west and north-west. It seemed to me that the moon's rays neutralised in the neighbourhood the fiery tints which characterise this peculiar glow, as in the vicinity of the crescent blue sky prevailed. It may be mentioned that foreign particles are traversing the atmosphere. On July 14 black rain fell at places round this city, and some was collected at Crowle. A good observer, Mr. J. S. Haywood, the hon. secretary of the Naturalist Field Club, noticed the black sediment which the rain had deposited on the leaves of the plants and shrubs in his nursery. At the time I drew attention to the rainfall, and ventured to ascribe the discoloration to the presence of volcanic dust. It has since transpired that Krakatoa was in violent eruption from May 20 down to the fatal 26th of August, throwing up vast masses of dust. Discoloured rain again fell in the vicinity of this city on the 17th ult.

J. LL. BOZWARD

Worcester, December 4

THE ruddy glow near the sun, so well described by J. Ll. Bozward in your last number (p. 102), was most conspicuous here on the 30th ult. both at sunrise and sunset. It should be examined with a spectroscope. Here there were neither clouds nor cirri visible. Yesterday it rained the whole day; towards evening the sky

became clear near the zenith, heavy clouds clustering all round the horizon; above them the unexplained glow was very remarkable at sunset. If it has been observed in England on the same days, at a distance of 10° in latitude, its cause must be high in the atmosphere. Would it not be interesting to ascertain how far it has been seen, at least throughout Europe?

ANTOINE D'ABBADIE

Abbadia, near Hendaye, December 2

DURING the latter half of November we have had here also a constant succession of remarkable sunsets, and at least one sunrise of the same character. But here the effects have been accurately described by the expression "cloud-glow." Masses and streamers of cirro-cumulus vapour have hurried up from the west, evening after evening, as sunset approached, at a rate greatly in excess of the wind below, and then as the sun sank the whole sky has shone with a lurid coppery light which I have only very occasionally and partially seen before. Even when the dusk was early and thick, the same lurid glare has shone as it were behind the clouds.

HENRY CECIL

Bregner, Bournemouth, December 1

I SHOULD not have troubled you with a letter respecting the wonderful after-glows which have presented such magnificent displays during all the past week, especially on the 26th, and which have attracted such universal attention, had I not observed that no one has alluded to their appearance in the spectroscope. I made some observations on the 26th and 27th about 4.30 p.m., when the colour was at its greatest brilliancy, and was struck with the following particulars:—(1) The ordinary delicate tints of the spectrum were merged into two, a deep red and a peculiar blue-green; (2) in the middle of the red was a strong dark band; (3) on the green side of the D line, and separated from it by the light band so often conspicuous, was another band of deep citrine. The only *line* clearly distinguishable was one at the extreme end of the red.

E. BROWN

Further Barton, Cirencester, November 30

THE following note of observations of the western sky made with a pocket spectroscope on the evenings of Wednesday, November 28, and of the 4th and 5th inst., may be of interest. At about 4 o'clock—just after sunset—the band which Mr. Piazzi Smyth has termed the "low sun band," was abnormally strong, so was the line he calls *a*. The lines constantly seen in the "rain band" were not visible, and C_1 was very slight. In place of the ordinary "rain band"—a band of absorption shading off from D towards the less refrangible end of the spectrum—there was a broad band of absorption which extended nearly three-fourths of the way from D towards *a*, or nearly half way to C, its darkest part being at rather less than one-third of its width from D. From this darkest part it shaded off in both directions. In a short time this band gradually nearly disappeared, the low sun band also diminishing in intensity, while *a* became extraordinarily prominent—very dense in the middle, and slightly shaded off at both edges. At this time the yellow and orange of the spectrum seemed nearly to have disappeared, the green apparently extending to a considerable distance on the less refrangible side of D. This evening (the 5th), as Mr. Lockyer pointed out, there was also a strong band of absorption between *b* and F. I had not remarked this on the 28th or the 4th, and believe it is unusual or unusually strong.

December 5 J. F. D. DONNELLY

AN optical phenomenon has appeared at Hunstanton each afternoon commencing Sunday, the 25th ult., at about 4.30 p.m., up to and including to-day. The first appearance was a brilliant yellow light in the west, which, after a few minutes lit up the whole western horizon, the upper sky being a beautiful azure blue, showing up in contrast a few fleecy dark stratus clouds; after a few minutes the yellow light gradually turned to pink, and the horizon all round was tinged with this colour, eventually a crimson arch formed in the west, and gradually the whole thing disappeared. From the position of Hunstanton, facing west and north, remarkable and beautiful sunsets are of frequent occurrence. This morning as the sun was rising a thin layer of clouds pervaded the whole of the heavens, which were tinged with pink in every direction.

CHARLES W. HARDING

The Chase, King's Lynn, December 1

There has been much correspondence in the daily papers on the subject, and it may be useful to give here the leading points in these communications.

The phenomenon has not been confined to this country. The *Times* Rome correspondent telegraphs under date November 30:—"Yesterday evening the population of Rome was struck with admiration, mingled with awe, at the sight of a splendid phenomenon. From fifteen minutes after sunset until more than an hour later the north-western hemisphere was tinged with crimson, gradually increasing in intensity until it had the appearance of the reflection of an extensive conflagration, in front of which the tower of the Castle of Saint Angelo, the cupola of St. Peter's, and the outline of Monte Mario, as seen from the Pincio, stood out in prominent relief. Immediately above the horizon there was a broad belt of orange red, and above that another of green, surmounted by the crimson glare of the aurora. The sky of the eastern hemisphere presented a uniform sea-green tint. The phenomenon was repeated again this morning, and again this evening. A strong north wind blew all day yesterday; the sky was exceptionally clear, and the temperature was gratefully warm and balmy."

Again, an observer at Viareggio, Italy, near the Carrara Mountains, writes:—"At sunset the whole horizon, from Corsica to the Bay of Spezia, is literally bathed in a flood of red light, which, during the last few evenings, has been intensified in a remarkable degree, and prolonged till about 6 p.m., when the glow spread over the whole cloudless firmament, and was reflected on the Carrara Mountains—a truly glorious phenomenon, produced by the more than usually rarefied condition of the atmosphere under the influence of the low temperature which has prevailed for some days, the wind being north-north-west."

At the Cape also they have attracted attention. "A. D. S.," writing to the *Times* of December 4, says:—"The phenomenon in question seems to have been first noticed in this country on the evening of the 9th ult., and it recurred on several evenings during last week. A lady, who has lately been an early riser, informs me that the sky has had the same unusual light at sunrise. We have just received a letter from the Cape of Good Hope, dated November 2, in which the following passage occurs:—'We have had such extraordinary lights nearly every evening for the last five weeks. Shortly after sunset a red or yellow glow appears in the west, and it gets quite light again, and remains so for some time, and then it dies away. During the time it lasts all the flowers seem of such very brilliant colours, the pink roses especially. They look as bright as they are painted on Christmas cards, and the green of the oak trees is something wonderful. The lights appear sometimes in the morning also, an hour before sunrise, when it is generally pitch dark here.'"

So Mr. C. J. Thornton writes to the *Standard*, under date November 28, as follows:—"This afternoon I received a letter from Monghyr, Bengal, dated November 5,

in which was the following passage : 'Have you seen any unusual appearances in the sky lately? For some time past in this country an extraordinary red glow has been seen in the sky just before sunrise and just after sunset. It seems to have been noticed all over India and in Egypt also, but I do not know if it has been seen in Europe. The natives are full of superstitious fears on account of it. No one, so far as I know, has been able to account for it, but several theories, more or less absurd, have been started, one trying to connect it with the eruption in Java, another with the spots on the sun, and so on. I do not know what it can be, but it is certainly very remarkable, and I never saw anything like it before.' "

A correspondent of the *Times* sends the following extract from the *Gold Coast Times* of September 14. The phenomena alluded to were seen at Cape Coast Castle:—"On the 1st or 2nd of this month the sun was described as being blue in the morning. It seems it rose as usual, and that the clouds which passed over it, from their greater rarity or density, gave it different apparent shades of rose colour, pink, and so on. After the passage of the clouds its appearance through the haze was white like the moon. In fact, an Englishman is said to have taken it for the moon."

In Paris also, and elsewhere in France, the phenomenon has been very striking.

A correspondent writing from Croydon to the *Standard*, under date November 26, says:—"At half-past three this afternoon the sky in the west quickly assumed a deep red colour, which, after some minutes, spread over the sky to a considerable distance, tinging it with a pale pink colour. This, again, in a few minutes, disappeared, and the sky assumed its normal condition."

Another correspondent on the same date, from Derby, states:—"This evening we have witnessed a most remarkable sunset, the sky being lit up with a pale bluish-yellow light, changing to orange and red."

Again, a correspondent to the same paper writing on November 28 from Skegness, Lincolnshire, says:—"Here, in the fens of Lincolnshire, where gorgeous sunsets are the rule, the phenomenon has been most remarkable, and each evening since Sunday last the heavens have presented an appearance both interesting and awe inspiring. On Monday evening last, when the sun set at 3.57, the western heavens were all aglow until 6.30, and the rich, lurid glare of the 'after-glow' had all the appearance of an immense illumination, the rays of which, starting from the direction of the setting sun as a centre, extended well towards the zenith. The most remarkable thing was the fact that whilst the western sky was thus all aglow the stars in the northern heavens were shining as brilliantly as at midnight. The 'blood-red' appearance has been repeated during the rest of this week. The effect was altogether different from the 'Aurora Borealis,' there being an utter absence of the peculiar scintillation common to that phenomenon."

From Eastbourne, according to a correspondent there, "a considerable space above the hills where the sun had disappeared was a clear sky with no tinge of red in it, but a pale greenish-blue transparency, to describe which I can find no precise words. Across this there floated three or four opaline cloudlets, while a great mass of violet-coloured vapour lay piled up in the south-west. Above the pale and clear transparency was a broad zone of rose-colour, which seemed denser here and there, and also appeared to shoot upwards in tongue-shaped undulations. As the evening advanced, and the true sunset, at 3 57, took place, the clear sky disappeared, as if drawn down behind the hills, which the rosy zone now touched, and was gradually drawn down in its turn, but remained unfaded to the last."

Mr. Sydney Hooper, writing to the *Standard* from Ealing, says:—"In none of the correspondence on the subject of the remarkable sunsets we have had lately have I seen any reference to what strikes me as the most curious fact in connection with them, and which in my experience is quite unique. I have observed sunsets carefully for the last thirty years, and I have invariably found that the crimson glow is the last; coming usually a considerable time after the yellow glow has faded. The crimson light is always followed by the cold gray which precedes the night, as many must have observed when the rosy light dies out from an Alpine peak. For the last few evenings, however, notably on Wednesday night, there has been a reversal of this rule. A yellow glow has first overspread the sky, extending almost to the zenith. This has gradually deepened to orange, then to crimson. The crimson has then gathered in intensity towards the horizon until it has become a deep, rich, horizontal bar, lingering long after sunset. Then came the effect which I refer to as unique. After the crimson had died away, the west was again lit up by a deep orange glow extending over half the sky, so intense in colour that the lamps showed as white light against it. This second glow is to me unaccountable, and indicates a very peculiar condition of the atmosphere. Another fact, equally remarkable, was that the whole effect was reproduced the following (Thursday) morning, but the order of the tints was, of course, reversed. At a quarter to six an exact reproduction of the orange tint of the previous evening was seen in the south-eastern sky. This was followed by the deep crimson bar low down in the horizon. Then the crimson gradually passed upwards, giving place finally to the greenish yellow with which the phenomena commenced in the evening."

NOTES

IT is proposed to hold, during the year 1884, an International Exhibition, which shall also illustrate certain branches of health and education, and which will occupy the buildings at South Kensington erected for the International Fisheries Exhibition. The object of the Exhibition will be to illustrate, as vividly and in as practical a manner as possible, food, dress, the dwelling, the school, and the workshop, as affecting the conditions of healthful life, and also to bring into public notice the most recent appliances for elementary school teaching and instruction in applied science, art, and handicrafts. The influence of modern sanitary knowledge and intellectual progress upon the welfare of the people of all classes and all nations will thus be practically demonstrated, and an attempt will be made to display the most valuable and recent advances which have been attained in these important subjects. The Exhibition will be divided into two main sections, Division I. Health, Division II. Education, and will be further subdivided into six principal groups. In the first group it is intended specially to illustrate the food resources of the world, and the best and most economical methods of utilising them. For the sake of comparison, not only will specimens of food from all countries be exhibited, but the various methods of preparing, cooking, and serving food will be practically shown. The numerous processes of manufacture connected with the preparation of articles of food and drink will thus be exemplified; and, so far as the perishable nature of the articles will admit, full illustrations will be given of the various descriptions of foods themselves. In the second group, dress, chiefly in its relation to health, will be displayed. Illustrations of the clothing of the principal peoples of the world may be expected; and a part of this Exhibition, which, it is anticipated, will be held in the galleries of the Royal Albert Hall, will be devoted to the history of costume. In the third, fourth, and fifth groups will be comprised all that pertains to the healthful construction and fitting of the dwelling, the school, and the workshop; not only as respects the needful arrangements for

sanitation, but also the fittings and furniture generally in their effect on the health of the inmates. The most improved methods of school construction will be shown, and the modes of combating and preventing the evils of unhealthy trades, occupations, and processes of manufacture will form portions of the Exhibition. The sixth group will comprise all that relates to primary, technical, and art education, and will include designs and models for school buildings; apparatus and appliances for teaching; diagrams, text-books, &c. Special attention will be directed to technical and art education, to the results of industrial teaching, and to the introduction of manual and handicraft work into schools.

ON the 22nd ult. the remainder of the furniture and stores for Ben Nevis Observatory were carried to the top under great difficulties. The party had intended to make the ascent at the beginning of the week, but, owing to the state of the weather, they could not think of it. On Thursday morning, however, although the weather was not very favourable, it was decided to make the ascent, and at 9 a.m. Mr. James M'Lean, contractor, and Alex. Turban, who is in charge of the stores, along with two assistants, started with some chairs and other stores. The first part of the journey was easily accomplished. The snow lay pretty heavy down to within a mile of Achintee farmhouse, and several deep wreaths were encountered before reaching the lake. On reaching the Red Burn they came upon a long wreath of about fourteen feet deep. The snow being somewhat soft, the party had to cut a passage through, which was a rather difficult task. Determined if possible to reach the top, they proceeded slowly, and, as they ascended, the snow was found to be deeper, in which they sometimes sank to their shoulders. Parts where the wind had driven off the snow were covered with ice, rendering the path difficult and dangerous. Their efforts were, however, ultimately crowned with success, for at 2.30 p.m., five and a half hours after starting, the party reached the Observatory. The average depth of snow on the level parts on the summit was about six feet, and round about the Observatory it was eight feet. Mr. Omond and his assistants were in excellent spirits, are very comfortable, and now feel quite at home. The party started on the return journey at 3.30, and Fort William was reached at 6.30 p.m., the whole journey, including a stay of an hour at the Observatory, occupying nine hours.

WE regret to learn of the death, on the 30th ult., of the celebrated Swedish zoologist, Prof. Sven Nilsson, of the Lund University, at the age of ninety-seven.

M. RENARD has communicated recently (November 3) to the Royal Academy of Brussels the results of a chemical and microscopic examination of the ashes from the great eruption of Krakatoa, which fell at Batavia on August 27 last. He finds that the volcanic dust consists mainly of glassy particles, among which may be distinguished crystals of plagioclase, often in rhomboidal lamellæ, augite, rhombic pyroxene, and magnetite. The rock which has been blown into this finely divided state presents the general mineralogical composition of the augite-andesites, but with a rather higher proportion of silica, which, on analysis, was found to amount to 65 per cent. of the whole.

A MEETING will be held on Friday at the rooms of the Royal Society, Burlington House, Piccadilly, when it will be proposed to appoint a Committee, and to make such other arrangements as may be considered necessary for the successful promotion of the William Spottiswoode Memorial Fund. The chair will be taken by Prof. Huxley, President of the Royal Society, at four o'clock precisely.

THE members of the Polar meteorological station which Denmark maintained at Godthaab in Greenland under the international scheme, have just returned to Copenhagen. The chief of the expedition, Lieut. A. Paulsen, reports that, having left Copenhagen on May 18, 1882, in the sailing ship *Ceres*, they arrived at Godthaab on June 14. On the voyage out observations of the temperature of the sea and air were made every hour. On the arrival out the expedition had to select the most suitable spot for the erection of the four wooden buildings brought with them, in which the magnetic and astronomical observations were to be made. A small mountain ridge near the church in the colony was chosen for this, as the preliminary researches in its neighbourhood showed that the influence of iron strata on the magnetic current was here very small. The buildings were then erected and the pillars raised on which the transit instrument, the great astronomical clock, and the eight different magnetical instruments were mounted, and simultaneously the instruments for the meteorological observations were also placed so that the weathercock and the anemometers, as well as the thermometer hut, were situated as free as possible. On August 1 the meteorological observations could be commenced, but the magnetic ones were through an accident delayed until the 7th. From that date complete observations were made in exact accordance with the international programme without interruption every hour until August 31 this year, and the expedition has thereby fully accomplished its object, viz. of obtaining a full year's magnetical and meteorological observations in this locality. A number of other scientific researches have also been pursued, of which those on the aurora borealis should particularly be mentioned. This phenomenon was frequently observed and studied during the winter, while some exceedingly valuable statistics were obtained as to the altitude of the aurora borealis above the earth's surface by measurements effected simultaneously in various places by light signals. The measurements of atmospheric electricity have also led to valuable results. It is stated to have been the best equipped Polar expedition ever despatched from Denmark. We hope soon to give further details.

THE following communication from Mr. Charles Ford, of the Botanic Garden, Hong Kong, dated October 3, 1883, has been forwarded to us from Kew for publication:—"By the s.s. *Laertes* which left this place for London last week I have sent two Wardian cases of live plants, one case of living orchids, and a case of herbarium specimens, which I brought back from the Lo-Fan Mountains up the East River, and distant about sixty miles from Canton, where I spent about three weeks in August. On this excursion I travelled over about eighty miles of country after leaving the river, and consequently had a considerable amount of trouble when the natives knew I had no boat to fall back upon, and was therefore very much in their hands. I intended to make another trip up the North River during this month, but that is now impossible, as Dr. Hance, who is Acting Consul at Canton, will not apply to the Viceroy for passports for any one, and he says he is afraid it will be a long time before he will feel at liberty to do so. You have no doubt heard of the very serious trouble at Canton, in which a riot occurred and nearly twenty European residences were attacked and burnt down by the Chinese and the valuable contents of the houses carried off by the mob. There is a very hostile feeling to foreigners prevailing now amongst the Chinese, and it is considered quite unsafe to travel in the country. I was in the Lo-Fan Mountains when the trouble at Canton commenced, but no one attempted to molest me, and I returned to Canton in a passage junk with 150 Chinese on board, and no foreigner besides myself; since then, however, matters have become much worse. Mr. Sampson's herbarium and house were burnt when his house was set fire to, and Dr. Hance's, which was not more than fifty yards off, might easily have shared the same fate, but very fortunately it was spared. Dr. Hance is extremely busy with official matters, and he thinks it will be a long time before he can resume botanical work. There is an encampment of 1000

Chinese troops in the foreign settlement at Canton, and five foreign and about a dozen Chinese gunboats in the river opposite to it: all these for the protection of the foreign residents and their property. The missionaries have left the country districts, and do not expect to be able to return for many months. These things will prevent any botanical work being done in China for some time. I hope something may be done in Formosa in the beginning of next year."

LARGE use is made at the Forth Bridge Works of electricity for lighting purposes. At South Queensferry the workshops are it up by sixteen arc lights, supplemented by a certain number of movable small incandescent lights. Outside twelve large arc lights serve to illuminate the various lines of rails and the approaches to the workshops. The offices, canteen, and other buildings are lighted throughout with Swan incandescent lights of 20-candle power, over 200 being there alone required for the purpose. The staging, which, beginning near the Hawe's Pier, extends for nearly half a mile into the Firth, has, with its approaches, twelve large lights devoted to its illumination. On the island of Inch Garvie in mid channel, four large arc lights are in use outside, and small incandescent lights in the offices and workshops, in the old castle, and in the neighbouring buildings. At North Queensferry six large arc lights serve for the outside illumination, and a number of incandescent lights for that of the interior of the offices and workshops. Nowhere is a dangerous degree of electric pressure allowed; and in all interiors, workshops, or operations under water the limit is but little more than one-half of that permitted by the Board of Trade in their provisional orders for dwellings in towns.

THE mathematical magazine conducted under the name of the *Analyst* for the past ten years, by Mr. J. E. Hendricks, will, we learn from *Science*, be continued under the editorial charge of Ormond Stone, Professor of Astronomy, and William M. Thornton, Professor of Engineering, with the title, *Annals of Mathematics, Pure and Applied*. The numbers will be issued at intervals of two months, beginning February 1, 1884. In scope the journal will embrace the development of new and important theories of mathematics, pure and applied; the solution of useful and interesting problems; the history and bibliography of various branches of mathematics; and critical examinations and reviews of important treatises and text-books on mathematical subjects. The office of publication will be at the University of Virginia.

DR. HOLUB has left England on his expedition to the interior of Africa. He leaves for this journey of a year accompanied by his wife and eleven good servants, including a carpenter, a waggonmaker, a blacksmith, a gunmaker, a tailor, and a butcher, besides his black servant-girl and a dog. In South Africa he will increase his staff by nineteen, and afterwards in Central Africa by forty more black servants.

IT is reported from the Storelvdal, a valley in Central Norway, between 61° and 62° N. lat., that the snow during the night of November 17 became covered with a gray and black layer of dust. No scientific investigation of the phenomenon has as yet been effected.

THE report of the death of Julius Payer, the discoverer with Weyprecht of Franz Josef Land, is, we are glad to say, without any foundation.

THE Annual Report for 1882–83 of the Liverpool Geological Association reports favourably, we are glad to see, on the position and work of that society.

THE Report of the Smithsonian Institution for 1881 shows how admirably that many-sided organisation continues to carry on its invaluable work. The museum in its various departments is constantly increasing; the library will soon be almost without a rival; while a successful chemical laboratory has been added to the other resources of the institute. The appendix, containing as it does a record of progress in all departments of science by specialists, is of great utility; while the special papers on anthropology continue to be a well-known feature of the Report. The Report, like the Institution, reflects the greatest credit on its secretary, Prof. Spencer Baird.

THE additions to the Zoological Society's Gardens during the past week include a Moorhen (*Gallinule chloropus*), British, presented by Mr. T. E. Gunn; two Common Wolves (*Canis lupus* ♂ ♀), European, a Dufresne's Amazon (*Chrysotis dufresniana*) from South-East Brazil; a Bell's Cinixys (*Cinixys belliana*) from West Africa, two Carp (*Cyprinus carpio*) from British fresh waters, purchased; an Indian Gazelle (*Gazella bennetti*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—The following are Greenwich times of geocentric minima of *Algol*, during the first quarter of 1884: the later observations of Prof. Julius Schmidt have been brought to bear upon the predictions.

	h. m.		h. m.		h. m.
Jan. 10 ...	13 35	Feb. 2 ...	12 9	March 13 ...	15 38
13 ...	10 24	5 ...	8 58	16 ...	12 28
16 ...	7 13	8 ...	5 47	19 ...	9 17
30 ...	15 19	22 ...	13 53		
		25 ...	10 43		
		28 ...	7 32		

According to Mr. Knott's observations of U Cephei, 1881-1883, a minimum is indicated on January 5 at 15h. 21m. G.M.T., the period being 2d. 20h. 48·9m. The ephemeris published in the *Vierteljahrsschrift* gives it 1h. 10m. earlier; but it is not stated upon what elements this rests.

Minima of S Cancri occur on December 31 at 8h. 41m., January 19 at 7h. 57m., February 7 at 7h. 12m., and February 26 at 6h. 28m. G.M.T.

The fine variable R Leonis will be due at maximum on February 23, and *Mira Ceti* on March 11.

THE FIRST COMET OF 1798.—A recalculation of the elements of the orbit of this comet, made by Mr. Hind from Messier's observations on April 12, 13, 14, May 1, 2, 3, and May 20, 21, 22, as they are given in Zach's *Allgemeine Geographische Ephemeriden*, vols. i. and ii., does not lead to any suspicion of ellipticity, which is rather confirmatory of the view taken by Dr. Harzer as to its non-identity with the greatly perturbed comet of Brorsen (1846 III) to which reference was lately made in NATURE. The new orbit is as follows:—

Perihelion passage 1798, April 4·51482 Paris M.T.

Longitude of perihelion	105	5	43	Mean
,, ascending node	122	7	22	Equinox
Inclination	43	48	1	1798·0
Log. perihelion distance	9·6857689			

Motion—direct.

The error in longitude for the second normal is − 19″; the latitudes agree.

THE GREAT COMET OF 1882.—We do not hear that this comet has been recognised since its conjunction with the sun. As was pointed out in this column, it was just possible that it might have been re-observed as the earth somewhat overtook it in its orbit, between the beginning of September and the end of last month. On November 30 the distance was at a minimum of 5·708, and is once more on the increase.

The comet was seen at the Observatory of Cordoba until June 1; the last complete observation for position was made there on May 26, when the distance from the earth was 5·048. There is no parallel to this in the whole history of cometary astronomy, except in the case of the very exceptional comet which was observed in 1729 and 1730; at the time of Cassini's last observation this body was distant from the earth 5·135.

Between the first accurate observation at the Royal Observatory, Cape of Good Hope, on September 7, 1882, and the Cordoba observation above referred to on May 26, 1883, the

comet described an orbital arc of more than 340°. The ellipse deduced by Kreutz from observations to November 14 assigns a period of 843 years; that by Fabritius, from observations to March 3, one of 823 years; but we may soon hope to see the result of a definitive discussion of the whole series of observations.

THE ANNIVERSARY MEETING OF THE ROYAL SOCIETY

THE Anniversary Meeting of the Royal Society took place as usual on St. Andrew's Day, November 30, when the President, Prof. Huxley, delivered his address; after which the Fellows elected the officers of the Society for the year, whose names we have already given in NATURE, Nov. 8, p. 43. The following is Prof. Huxley's address:—

It will be as much in consonance with your feelings as it is with my own that the first sentences of this address should give utterance to our sense of the calamity which befell us during the recess.

On June 27 our honoured and loved President, William Spottiswoode, fell a victim to that cruel malady, typhoid fever, which is at once the scourge and the reproach of modern civilisation; and we were bereaved of a chief of whom all those who had the highest interests of this Society at heart hoped that he would continue for many a year to discharge the responsible and laborious duties of his office with that broad intelligence, that faithful diligence, that inexhaustible patience and courtesy, which were so characteristic of the man.

Every one of the Fellows of the Society in whose hearing I speak knows that these are no words of conventional eulogy, as of a customary epitaph. But it is only those of us who worked with our late President in the Council, or as officers of the Society, who are in a position fully to appreciate his singular capacity for the transaction of business with clear judgment and rapid decision, and yet with the most conscientious consideration of the views of those with whom he was associated.

And I may add that it is only those who enjoyed Mr. Spottiswoode's intimate friendship, as it was my privilege to do for some quarter of a century, who can know how much was lost when there vanished from among us that rare personality, so commingled of delicate sensitiveness with marvellous self-control, of rigid principle with genial tolerance, of energetic practical activity with untiring benevolence, that it always seemed to me the embodiment of that exquisite ideal of a true gentleman which Geoffry Chaucer drew five hundred years ago:—

> "... He lovede chyvalrye,
> Trouthe and honour, fredom and curtesie.
>
> And though that he was worthy he was wys,
> And of his port as meke as is a mayde.
> He never yit no vilonye ne sayde
> In al his lyf unto no maner wight.
> He was a verray perfight gentil knight."

It is not for me to pass any judgment upon Mr. Spottiswoode's scientific labours; but I have the best authority for saying that having occupied himself with many branches of mathematics, more especially with the higher algebra, including the theory of determinants, with the general calculus of symbols, and with the application of analysis to geometry and mechanics, he did excellent and durable work in all; and that, in virtue of his sound and wide culture, his deep penetration, and the singular elegance with which he habitually treated all his subjects, he occupied a place in the front rank of English mathematicians.

The interment in Westminster Abbey of one who, though compelled to devote a large share of his time to business, was a born man of science, and had won himself so high a place among mathematicians, was doubtless grateful to us as men of science; it could not but be satisfactory to us as Fellows of the Royal Society that, on the rare occasion of the death of our President in office, the general public should show its sympathy with our bereavement; yet as men I think it is good to regard those solemn and pathetic obsequies as the tribute which even our busy, careless, cynical, modern world spontaneously pays to such worth and wisdom, to such large humanity and unspotted purity as were manifested in the "very perfect gentle knight" who so well represented the chivalry of science.

The total number of Fellows deceased during the past year amounts to twenty; a large inroad upon our ranks in mere numbers, an exceptionally severe mortality if we consider the scientific rank of many names in the death-roll. Almost at the same time with Mr. Spottiswoode's untimely death we lost, at the ripe old age of ninety, a very distinguished Fellow and former President of this Society, Sir Edward Sabine. It is said that the average age of Fellows of the Royal Society is greater than that of any body of men in Europe; and it is certainly a remarkable fact that one who so long presided over us in this generation should, as a man of thirty years, have been the contemporary of Sir Joseph Banks, who became our President more than a century ago. And nothing can give a more striking exemplification of the gigantic progress of physical science in modern times than the fact that the discovery of oxygen by Priestley, and that of the composition of water by Cavendish, fall within the period of Sir Joseph Banks's presidency, while Black's work was but a score years earlier. We are as it were but two Presidents off the budding of modern chemistry, as of many another stately growth of the tree of natural knowledge.

Sir Edward Sabine's long services to this Society, first as Treasurer and then as President, deserve more than a passing allusion; but for a due appreciation of them, no less than of his great labours in terrestrial magnetism, I must refer you to our obituary notices.

By the unexpected death of Prof. Henry John Stephen Smith the University of Oxford lost one of the most distinguished, as he was one of the most influential, among those who have guided its destinies during this generation, and a capacity of the first order, not yet weakened by the touch of time, has disappeared from the ranks of the foremost mathematicians of Europe.

As Chairman of the Meteorological Committee, Prof. Smith rendered invaluable services to that body; and we have all a grateful recollection of the readiness with which his knowledge and sagacity were brought to our aid in Council and in Committee.

For the rest, I dare add nothing to that which has been said of him by our late President in that just and loving appreciation of his friend, which is now touched with a sadder gravity and a deeper pathos.

It is difficult to say of Prof. Smith whether he was more remarkable as a man of affairs, of society, of letters, or of science; but it is certain that the scientific facet of his brilliant intelligence was altogether directed towards those intelligible forms which people the most ethereal regions of abstract knowledge. In Sir William Siemens, who but the other day was suddenly snatched from among us, we had a no less marked example of vast energy, large scientific acquirements, and intellectual powers of a high order, no less completely devoted, in the main, to the application of science to industry.

I believe I am expressing the opinion of those most competent to judge, when I say that Sir William Siemens had no superior in fertility and ingenuity of invention; that hardly any living man so thoroughly combined an extensive knowledge of scientific principles with the power of applying them in a commercially successful manner; and that the value of his numerous inventions must be measured, not merely by the extent to which they have increased the wealth and convenience of mankind, but by the favourable reaction on the progress of pure science which they, like all such inventions, have exerted, and will continually exert.

Time permits me to be but brief in alluding to the remainder of our long list of deaths. But I may not omit to mention that we have lost a distinguished mathematician in Prof. Challis; in Mr. James Young, a chemist whose skilful application of theory to practice founded a new industry; in Mr. Cromwell Varley, an ingenious inventor; in Lord Talbot de Malahide, a warm friend of science and a zealous promoter of archæological research; in Mr. Walker, an eminent engineer; in Mr. Howard, an eminent quinologist; and in the Rev. Dr. Stebbing, an accomplished and amiable man of letters, who for very many years filled the honourable, but not very onerous, office of Chaplain to the Society.

And it would ill become us, intimately connected as this Society always has been, and I hope always will be, with the sciences upon which medicine bases itself, to leave unnoticed the decease of the very type of a philosophical physician, the venerable Sir Thomas Watson.

Two well-known names have disappeared from among those of the eminent men who are enrolled upon our foreign list; the eminent physicist, Plateau, and the no less distinguished anatomist and embryologist, Bischoff.

I now beg leave to bring under your notice a brief general review of the work of the Society during the past year.

The papers printed in the *Transactions* for 1882 and 1883 will occupy two volumes, of which three parts, containing 1038 quarto pages and fifty-two plates, have already been published. Two parts more, to complete 1883, will shortly be published.

The *Proceedings*, which steadily increase in size from year to year, amount during the past year to 780 octavo pages, with four plates and numerous engravings.

You are aware that nothing is printed in the *Proceedings* or in the *Transactions* except by the authority of the Council, which, in the latter case, calls in the assistance of at least two carefully-selected and independent referees, by whose advice it is in practise, though not necessarily, guided. I am inclined to think that Fellows of this Society who do not happen to have served on the Council, are little aware of the amount, or of the value of the conscientious labour which is thus performed for the Society by gentlemen whose names do not appear in our records. And I trust I may be forgiven for stepping beyond precedent so far as to offer our thanks for work which is always troublesome and often ungrateful; but, without which, the contributions to our pages would not maintain the high average of excellence which they possess.

Among the points of importance, by reason of their novelty or general significance, which have been laid before us, much interest attaches to the result brought out in Prof. Osborne Reynolds's "Experimental Investigation of the circumstances which determine whether the motion of water shall be direct or sinuous, and of the law of resistance in parallel channels;" which shows that when the conditions of dynamical similarity are satisfied, two systems, involving fluids treated as viscous, may be compared (as regards their effects) even when the motions are unstable; and that if any one of the two systems is in the critical state separating stability from instability, so will be the other.

Last December, Dr. Huggins presented a note on "A Method of Photographing the Solar Corona without an Eclipse," which had so far proved successful, under the unfavourable circumstances in which he had put it in practice, as to lead to the hope that, under better conditions of atmosphere and elevation, the corona might be photographed, from day to day, with so much accuracy as to preserve a clear record of the changes which it undergoes. And, as the photographs taken during the eclipse at Caroline Island show a condition of the corona, intermediate between those exhibited by Dr. Huggins's photographs at periods antecedent and subsequent to the Caroline Island observations, there is reason to believe that this hope is well based, and that a new and powerful method of investigation has been placed in the hands of students of solar physics.

Lord Rayleigh and his sister-in-law, Mrs. Sidgwick, have made a very elaborate determination of the relation between the ohm and the British Association standard of electrical resistance.

With respect to those branches of knowledge on which I may venture to offer an opinion of my own, I may say that, though our records show much useful and praiseworthy work in biological science, the only event which appears to me to call for special remark is the opening of an attack upon a problem of very great interest, one which, in fact, goes to the root of the question of the fundamental unity of the two great embodiments of life—plants and animals.

The well-known phenomena presented by many plants, such as the sensitive plant and the sun-dew, our knowledge of which was so vastly extended by Darwin, abundantly prove that the property of irritability, that is, the reaction of a living part, by change of form, upon the application of a stimulus to that part, or to some other part in living continuity with it, is not confined to animals.

But, in animals, the connection of the part irritated with that which changes its form is always effected by a continuity of more or less modified protoplasmic substance, and reaction takes place only so long as that continuity is unimpaired; while, hitherto, the protoplasmic cell-bodies of plants have appeared to be isolated from one another by the non-protoplasmic cell-walls in which they are inclosed.

It is as if, in the one case, there was a continuous bond of conducting substance between the point of irritation and the point of contraction; while, in the other, there was a chain of pellets of protoplasmic substance, each inclosed in a coat of a different nature.

Now, Mr. Gardiner, in his paper "On the continuity of the Protoplasm through the Walls of Vegetable Cells," brings forward evidence, based chiefly upon the careful use of special reagents, that, in the sensitive cushions of certain plants and in other situations, the vegetable cell-wall is pierced by minute apertures, and that these are traversed by threads of protoplasm, which connect the cell-body of each cell with those of its neighbour, and thus establish, as in animals, a continuity of protoplasmic substance between different parts. Other observers are working at the same subject, and we may hope that, before long, great light will be thrown upon many hitherto puzzling questions in vegetable physiology.

The Committee of the Royal Society, in the hands of which the Lords of the Treasury have placed the administration of the funds devoted to the publication of the work of the *Challenger* expedition, report that, under the careful and vigorous direction of Mr. Murray, this great undertaking is making rapid progress.

Mr. Murray informs me that thirty-eight reports have, up to this time, been published, forming eight large quarto volumes, with 4195 pages of letterpress, 488 lithographic plates and other illustrations. Thirty-four of these memoirs are on zoological, four on physical subjects. Nine reports are now nearly all in type, and some of them partly printed off. These will be published within three months, and will form three zoological volumes, with 230 plates and many woodcuts, and one physical volume, with many diagrams and maps; this latter volume will contain the report on the composition of ocean water, the specific gravity and temperature observations.

A considerable part of the general narrative of the cruise is now in type, and nearly all the illustrations are prepared. The narrative will extend to two volumes, and it is expected they will be ready for issue in May or June, 1884.

The work connected with the remaining forty-two special reports is, in most instances, progressing satisfactorily. Portions of the manuscript for three of the larger memoirs have been received and put in type, and the manuscript of many others is in a forward state. For these memoirs, 386 lithographic plates have been printed off and delivered to the binders; 404 others are now on stone, and the drawings for many more are being prepared. It is estimated that the whole work connected with the Report will be completed in the summer of 1887.

In his Address, last year, the President gave the Society a full account of the changes which had taken place in the administration of the Government Fund—technically termed a grant in aid of this Society—though, as you are aware, the Royal Society, while willingly accepting the burden and the responsibility of administrator of the aid granted by the State to science, is in no sense pecuniarily benefited by the grant.

A somewhat novel and extremely useful employment has been given to part of the fund by deciding to defray the expenses of adequately skilled persons who have undertaken to visit distant countries for the purpose of investigating certain interesting biological questions on the spot, and of procuring and transmitting to observers at home specimens prepared and preserved by those refined modern methods which can be satisfactorily carried out only by persons who are well versed in the practice of such methods.

Mr. Adam Sedgwick has thus been enabled to proceed to the Cape of Good Hope for the purpose of completing our knowledge of the singular genus *Peripatus*, so well studied by Prof. Moseley, and afterwards by our lamented Fellow, Balfour; and Mr. Caldwell, similarly aided, is now in Australia, devoting himself to the elucidation of the embryology of the marsupial quadrupeds of that region, a subject of which at present we know little more than was made known in the *Transactions* of this Society half a century ago by Prof. Owen.

It certainly was high time that British science should deal with a problem of the profoundest zoological interest, the materials for the solution of which abound in, and are at the same time almost confined to, those territories of the Greater Britain which lie on the other side of the globe.

Many years ago the late Mr. Leonard Horner communicated to the Society the results of a series of borings which he had caused to be made in the upper part of the delta of the Nile, with a view of ascertaining the antiquity of the civilisation of Egypt. Since that time Figari Bey, an Italian geologist in the service of the Egyptian Government, made and published the results of a large series of borings effected in different parts of the delta, but his work is hardly on a level with the requirements of modern science.

It has been thought advisable therefore to take advantage o

the presence of our troops in Egypt in order to carry out a series of borings across the middle of the delta, in the full expectation that such borings, if made with proper care and carried down to the solid rock, will afford information of the most important character, and will throw a new light upon the natural and civil history of this unique country. I am glad to say that the representations which the President and Council made to the War Office on this subject were most favourably received, and that instructions were at once sent to the officer commanding the Engineers to undertake the operations which they recommended. I trust that, before long, information will reach us which will be of no less interest to the archæologist than to the geologist.

While I am speaking of Egypt, I may perhaps be permitted to express a regret that the admirable energy of the Government in taking measures to make the recent advances of medical science available during the late outbreak of cholera in that country, was not extended beyond the purely practical side of the matter, or, perhaps, not so far as the practical side in the proper sense; for until we know something about the causes of that terrible disease, our measures for prevention and for cure will be alike leaps in the dark.

Those who have looked into the literature of cholera may, perhaps, be disposed to think that a new search after its cause will add but another to the innumerable wild hypotheses which have been set afloat on that topic; and yet devastating epidemics, like the pebrine of the silkworm, so similar in their fatality and their apparently capricious spread, that careful investigators have not hesitated to institute a detailed comparison of the phenomena of this disease with those of cholera, have been proved by Pasteur to be the work of microscopic organisms; and hardly less fatal epidemics, such as splenic fever, have been traced to similar agencies. In both these cases, knowledge of the causes and of the conditions which limit the operation of the causes, have led to the invention of effectual methods of cure. And it is assuredly, in the present state of science, something more than a permissible hypothesis, that the cause of cholera may be an organic living *materies morbi*, and that the discovery of the proper curative and prophylactic measures will follow upon the determination of the nature and conditions of existence of these organisms.

If this reasoning is just, it is certainly to be regretted that the opportunity of the outbreak of cholera in Egypt was not utilised for the purposes of scientific investigation into the cause of the epidemic. There are able, zealous, and courageous young pathologists in this country who would have been willing enough to undertake the labour and the risk; and it seems a pity that England should leave to Germany and to France an enterprise which requires no less daring than Arctic or African exploration, but which, if successful, would be of a thousand times more value to mankind than the most complete knowledge of the barren ice wastes of the Pole or of the sweltering barbarism of the equator.

It may be said that inquiries into the causation of cholera have been for some years conducted in India by the Government without yielding any very definite result. But this is perhaps rather an argument in favour of, than against, setting fresh minds to work upon the problem.

In December last year the President received from the Lords of the Treasury a letter, addressed to their Lordships by the Lords of the Committee of the Privy Council on Education, recommending to the favourable consideration of the Treasury a memorial from the Solar Physics Committee, suggesting the organisation of an expedition for the purpose of making observations during the solar eclipse of May 5, 1883; and the President was requested to communicate his views upon the subject to the Treasury.

After careful consideration, the President and Council reported in favour of the projected expedition; but they added that they did so on condition of its being possible to find some one, whose position in the scientific world would command the confidence of the public, to take charge of the expedition. Unfortunately, for one reason or another, none of the men of science who fulfilled this condition were able to go; and, at the meeting of Council of January 18, the projected expedition was abandoned. The President was, however, requested to place himself in communication with the American authorities, and to ascertain from them whether a photographer and assistant could be allowed to accompany their expedition to Caroline Island. On doing so, he at once received an invitation for two observers; who were accordingly sent out, their expenses being defrayed, partly by a contribution from the Government grant, and partly by a special sum of 500*l.* provided by the Treasury.

I am indebted to Mr. Lockyer for the following list of photographs taken by the observers:—

1. Six good photographs of the corona, exposures varying from two to sixty seconds, giving coronal detail from near the limb to end of streamers. That the limit of the corona has been photographed is shown by the manner in which the light of the sky has impressed itself on the plate.

2. Three large photographs showing the details of the corona close to the limb.

3. Good photographs of the spectrum of the corona, showing a great number of coronal lines and very faint Fraunhoferic lines.

4. Photographs taken on a moving plate in integrating spectroscope, from one minute before to one and a half minute after totality, showing the most prominent lines of the reversion spectrum. These lines belong mainly to hydrogen.

5. Photographs taken with first-order grating, before, during, and after totality. These show H and K, near the limb, throughout the whole of totality.

6. Photographs taken with a dense prism spectroscope before, during, and after totality. These photographs also give some of the prominent lines of the reversion spectrum.

7. Two photographs taken in the prismatic camera on plates sensitive to ultra-red rays. Results comparatively indifferent on account of the absence of prominences.

The arrangements made for obtaining a series of circumpolar observations in meteorology and magnetism were fully described in the Presidential address of last year. I am glad to be able to report that the English party, under Capt. Dawson, has successfully achieved its mission and has returned to this country. Capt. Dawson speaks very gratefully of the efficient assistance which he received from the Canadian authorities and from the Hudson Bay Company.

The responsibility for the transaction of the ordinary work of the Society rests with the Council and the officers, of whom the President is only one, and I may be allowed to say by no means the most important, the heaviest part of the burden of the executive resting upon the Secretaries. But your President is, in virtue of his office, a member of two public bodies whose functions in relation to science are of great importance; and I follow the excellent precedent set by my predecessor in considering it my duty to acquaint the Fellows of the Society with any occurrence, bearing on the interests of science, which has come under my cognisance, as a Trustee of the British Museum and as a member of the Council and Executive Committee of the City and Guilds Institute.

In the first-named capacity, I am glad to be able to announce that the transference of the vast zoological, botanical, geological, and mineralogical collections from Bloomsbury to the New Natural History Museum is now accomplished; and that it has been effected to the great credit of all concerned, with no greater mishap than the fracture of a bottle or two.

The advantages which will accrue to zoologists, botanists, and mineralogists from the re-arrangement of this vast assemblage of the objects of their studies, in such a manner as to be accessible to every investigator, cannot be over-estimated. The Natural History Museum at South Kensington is, in fact, a library of the works of nature which corresponds in value, in extent, and in the purposes to which it should be applied, to the vast library of the works of men which remains at Bloomsbury.

In making this collection of use to the world of science by the publication of complete catalogues of its contents, and of systematic monographs upon particular groups; and to the nation at large, by the composition of guide books calculated to afford the ordinary visitor an insight into the plan of the mighty maze of nature, the officers in charge of the Natural History collections have before them a task, the due performance of which, whatever their abilities, or their number, or their industry, will tax their energies to the utmost. It is in this way that, in the discharge of their proper duties, they may render services of the highest value alike to pure science and to the diffusion of knowledge among the people, out of whose resources the great institution to which they belong is supported. And I trust that no mistaken view of the functions of the officers of the Museum, which no more embrace oral instruction in science than those of the officers of the Library comprehend oral instruction in literature, may lead to the imposition of duties, foreign to their

proper business, upon the already overburdened staff of keepers and their assistants.

In Francis Bacon's apocalypse of science, the "New Atlantis," the Father of Solomon's House—he, whose countenance was "as if he pitied men,"—declares that the end of that foundation is "the knowledge of causes and secret motions of things, and the enlarging of the bounds of human empire to the effecting of all things possible."

I think that the Chancellor would have acknowledged the New Natural History Museum to be a goodly wing of such a House, devoted to the former of the objects which he mentions; but, it may be, that his practical mind, looking always to fruit, and caring for light chiefly as something essential to fruit-bearing, would have been even better satisfied with another building hard by, which has been devoted to the encouragement of those applications of science through which human empire is directly extended, by the well-directed munificence of the City and Guilds of London.

This building, destined for a central institution in which ample provision shall be made for thorough and practical training in so much of the principles and the methods of the physical sciences as is needful for those who aspire to take part in the development of arts and manufactures, has been completed at a cost of more than 70,000*l*., while 20,000*l*. has yet to be spent upon fittings and appliances, and the working expenses, if the scheme is to be fully developed, cannot be estimated at less than 10,000*l*. a year.

Having already been called upon to take an active part in the deliberations of the committees charged with the carrying out of this great work, I think I am justified in expressing the hope, and indeed the confident expectation, that, before long, this new Technical College will be in full activity; and that, for the first time in our history, there will be called into existence an institution in which, without leaving this country, masters, managers, and foremen of works will be enabled to obtain thorough instruction not only in scientific theory, but in the essential principles of practice; and a machinery will be created, by which the poorest working lad in a manufacturing town, if he have ability and perseverance, may be brought within reach of the best technical education that is to be had.

There can be no doubt that the founders of the Royal Society had prominently before their minds the intention of promoting the useful arts and sciences "that so (in the language of the draft of the preamble to the first charter, which is said to have been drawn up by Sir Christopher Wren) by laying in a stock, as it were, of several arts and methods of industry, the whole body [of the nation] may be supplied by a mutual commerce of each other's peculiar faculties, and, consequently, that the various miseries and trials of this frail life may be, by as many various expedients ready at hand, remedied or alleviated, and wealth and plenty diffused in just proportion to every one's industry, that is, to every one's deserts." It was the wish of King Charles the Second that all patents for inventions should be examined by the Royal Society; and, so late as the reign of George the Second, the Society actually performed this duty. The steam-engine itself may be said to have made its *début* before the Royal Society, when Savery exhibited his working model to the Fellows in 1699.

But the subsequent history of natural knowledge has shown that, as in the moral world, those who seek happiness through well-doing are less likely to obtain that reward than those who try to do well without thinking what may come of it; so, in the world of science, those whose vision is fixed on useful ends are often left poor and bare, while those who strive only after the advancement of knowledge, scatter riches along their path, for the whole world to pick up. The Royal Society has chosen the latter course, and I trust it may never swerve from it. But I think that our warmest sympathy is due to the efforts of those who translate the language of the philosopher into that of the workshop; and by thus ameliorating "the miseries and toils of this frail life," and "diffusing wealth and plenty," are executing that part of the first design of this Society, with which we, as a body, have long ceased to occupy ourselves.

It was not as your President, but as one of the Special Commissioners appointed by the Government, that I had some slight share in another considerable undertaking directed towards the improvement of industry. But the future of the fisheries is so closely connected with the advancement of certain branches of zoological science, that I may be permitted to advert to the great success of the International Fisheries Exhibition; and to express my belief that, in accordance with the intimation contained in the speech of H.R.H. the Prince of Wales at the closing of the Exhibition, there will grow out of it an organisation which will provide for the application of science to the improvement of the fisheries.

In conclusion, gentlemen, I think that it is proper on my own behalf, as it is certainly due to you, that I should advert to the exceptional circumstances which have brought about my present occupation of the Presidential office.

The eleventh section of the sixth chapter of the statutes provides for the occurrence of a vacancy in the Chair, whether by death or by resignation, as follows:—

"Upon any vacancy in the President's place occurring in the intervals of the anniversary elections, the Treasurer, or in his absence one of the Secretaries, shall cause the Council to be summoned for the election of a new President, and the Council meeting thereupon in the usual place, or any eleven or more of them, shall proceed to the said election, and not separate until the major part of them shall have agreed upon a new President."

This statute is substantially, and, to a great extent, verbally, identical with the twelfth section of the seventh chapter of the original statutes of 1663.

Before the present year, five occasions had arisen on which it became necessary to put the provisions of the statute into effect.

Sir Isaac Newton died while President in 1727; the Earl of Morton in 1768; Mr. West in 1772; and Sir Joseph Banks in 1820; while Sir Humphry Davy resigned in 1827. On each of these occasions a new President was at once appointed by the Council, endowed with all the privileges and powers of the office; and, like every other officer, however appointed, he vacated his office on November 30 following, when the Fellows sometimes elected him for the succeeding year, and sometimes did not.

These precedents were strictly followed on the present occasion. A Council had been summoned, in ordinary course of business, for June 28; but, as the President died on the 27th, it was deferred until the following Thursday, when it was supposed the interment would have taken place. In consequence of the delay inseparable from a public ceremony, however, it so happened that the funeral did not take place until noon of July 5; and I have known few sadder scenes than the gathering of the Council, fresh from the unclosed grave of their President, for the performance of the duty, imposed upon them by the statutes, of choosing his successor from their own number, before they should separate.

The Council did me the great honour of selecting me for the office; and now, on this next following St. Andrew's Day, my tenure, like that of the Treasurer and Secretaries, lapses, and it is for the Fellows of the Society to say who shall be their officers until the next Anniversary Meeting.

Having served several years, in another capacity, with three out of four of my present colleagues, and having every reason to believe that the Fellows of the Society, at large, see good reason to set the same high value upon the services of all of them as I do, I do not find myself able to imagine that you will fail to desire that those services shall be continued; but I have not the least difficulty in conceiving that the Fellows of the Society may think many of their number better fitted for the eminent place of the President than myself.

I should be extremely ungrateful to my colleagues of the Council, who have again honoured me by presenting me for election by the Fellows, if I were to let fall even a hint of the extent to which I share that opinion; but I think it may be permitted me to say that, should you think fit to give effect to it, there is no one who will more cheerfully acquiesce in your decision than I shall.

To a man like myself, who neither possesses, nor seeks, any other distinction than that of having done his best to advance knowledge and to uphold the dignity and the authority of science against all comers, the Presidency of this Society is the highest dignity which he can attain, whatever else may befall him.

But, gentlemen, as men of science, you know better than I can tell you, that there are things of more worth than distinction. I am within measurable distance of the end of my career; and I have long looked forward to the time when I should be able to escape from the distractions and perturbations of the multitudinous affairs in which I have been so long entangled, to that student life from which the Fates have driven me, but to which I trust they may, for a little space, permit me to return.

So that I am sure you will neither misunderstand me, nor mislike my directness of speech, when I say that, if it please you to believe that the interests of science and of the Royal Society will be advanced by maintaining me in the very distinguished position which I at present occupy, I will do my best to justify your confidence; but if, as may well be, you think that some other Fellow of the Society will serve these interests better, I shall, with a light heart, transfer to him the honourable burden, which I have already borne long enough to know its weight.

I now proceed to the presentation of the medals which have this year been awarded by the Council.

The number, the variety, and the importance of Sir William Thomson's contributions to mathematical and experimental physics are matters of common knowledge, and the Fellows of the Society will be more gratified than surprised to hear that the Council have this year awarded him the Copley Medal, the highest honour which it is in their power to bestow.

Sir William Thomson has taken a foremost place among those to whom the remarkable development of the theory of thermodynamics and of electricity in the last forty years is due; his share in the experimental treatment of these subjects has been no less considerable; while his constructive ability in applying science to practice is manifested by the number of instruments, bearing his name, which are at present in use in the physical laboratory and in the telegraph office.

Moreover, in propounding his views on the universal dissipation of energy and on vortex motion and molecular vortices, Sir William Thomson has propounded conceptions which belong to the *prima philosophia* of physical science, and will assuredly lead the physicist of the future to attempt once more to grapple with those problems concerning the ultimate construction of the material world, which Descartes and Leibnitz attempted to solve, but which have been sedulously ignored by most of their successors.

One Royal Medal has been awarded to Dr. T. Archer Hirst, F.R.S., for his investigations in pure geometry; and, more particularly, for his researches into the correlation of two planes and into the complexes generated by them.

The other Royal Medal has been awarded to Dr. J. S. Burdon Sanderson, F.R.S., for the eminent services which he has rendered to physiology and pathology; and, especially, for his researches on the electrical phenomena exhibited by plants, and for his investigations into the relation of minute organisms to disease.

In making this award, the Council desire not merely to recognise the merit of Dr. Burdon Sanderson's researches, especially those on the analogy between the electrical changes which take place in the contractile tissues of plants and those which occur in the like tissues of animals; but to mark their sense of the important influence which Dr. Sanderson has exerted upon the study of physiology and pathology in this country.

The Davy Medal has this year been again awarded in duplicate, the recipient being M. Marcellin Berthelot, Member of the Institute of France, and Foreign Member of the Royal Society, and Prof. Julius Thomsen, of Copenhagen.

The thermo-chemical researches of Berthelot and Thomsen have extended over many years, and have involved an immense amount of work, partly in the application of established methods to new cases, partly in devising new methods and applying them to cases in which the older methods were not applicable. Chemists had identified a vast variety of substances, and had determined the exact composition of nearly all of them, but of the forces which held together the elements of each compound they knew but little. It was known that certain elements combine with one another with great evolution of heat-forming products in which they are firmly united; while other elements combine but feebly, and with little evolution of heat. But the materials for forming any general theory of the forces of chemical combination were but scanty and imperfect.

The labours of Messrs. Berthelot and Thomsen have done much towards supplying that want, and they will be of the utmost value for the advancement of chemical science.

THE JAVA DISASTER

THE following letter from the Liverpool *Daily Post*, received from Capt. W. J. Watson, of the British ship *Charles Bal*, contains a graphic and interesting account of the recent terrible volcanic outburst in Sunda Straits. Capt. W. J. Watson was himself an eye-witness of what he describes. His vessel was actually within the Straits, and not far from Krakatoa when that island had become an active volcano:—

"*August* 22, 15° 30′ S., 105° E.—About 7 p.m. the sea suddenly assumed a milky-white appearance, beginning to the east of us, but soon spreading all round, and lasting till 8 p.m. There were some clouds (cumulus) in the sky, but many stars shone, and in the east to north-east a strong, white haze or silvery glare. This occurred again between 9 and 10 p.m., the clouds also appearing to be edged with a pinkish coloured light, the whole sky also seeming to have extra light in it, similar to when the aurora is showing faintly. On the 24th, in 9° 30′ S. 105° E., we had a repetition of the above. On the night of the 25th, standing in for Java Head, the land was covered with thick, dark clouds and heavy lightning. On the 26th, about 9 a.m., passed Prince's Island, wind south-west, and some heavy rain; at noon, wind west-south-west, weather fine, the Island of Krakatoa to the north-east of us, but only a small portion of the north-east point, close to the water, showing; rest of the island covered with a dense black cloud. At 2.30 p.m. noticed some agitation about the Point of Krakatoa; clouds or something being propelled from the north-east point with great velocity. At 3.30 we heard above us and about the island a strange sound as of a mighty, crackling fire, or the discharge of heavy artillery at second intervals of time. At 4.15 p.m., Krakatoa north half east, ten miles distant, observed a repetition of that noted at 2.30, only much more furious and alarming, the matter, whatever it was, being propelled with amazing velocity to the north-east. To us it looked like blinding rain, and had the appearance of a furious squall of ashen hue. At once shortened sail to topsails and foresail. At five the roaring noise continued and increased; wind moderate from south south-west; darkness spread over the sky, and a hail of pumice-stone fell on us, many pieces being of considerable size and quite warm. Had to cover up the skylights to save the glass, while feet and head had to be protected with boots and southwesters. About six o'clock the fall of larger stones ceased, but there continued a steady fall of a smaller kind, most blinding to the eyes, and covering the decks to three or four inches very speedily, while an intense blackness covered the sky and land and sea. Sailed on our course until we got what we thought was a sight of Fourth Point Light; then brought ship to the wind, south-west, as we could not see any distance, and we knew not what might be in the Straits, the night being a fearful one. The blinding fall of sand and stones, the intense blackness above and around us, broken only by the incessant glare of varied kinds of lightning and the continued explosive roars of Krakatoa, made our situation a truly awful one. At 11 p.m., having stood off from the Java shore, wind strong from the south-west, the island, west-north-west, eleven miles distant, became more visible, chains of fire appearing to ascend and descend between the sky and it, while on the south west end there seemed to be a continued roll of balls of white fire; the wind, though strong, was hot and choking, sulphureous, with a smell as of burning cinders, some of the pieces falling on us being like iron cinders, and the lead from a bottom of thirty fathoms came up quite warm. From midnight to 4 a.m. (27th) wind strong, but very unsteady, between south-south-west and west-south-west, the same impenetrable darkness continuing, the roaring of Krakatoa less continuous, but more explosive in sound, the sky one second intense blackness and the next a blaze of fire, mastheads and yardarms studded with corposants and a peculiar pinky flame coming from clouds which seemed to touch the mastheads and yardarms. At 6 a.m., being able to make out the Java shore, set sail, passing Fourth Point Lighthouse at 8; hoisted our signal letters, but got no answer. Passed Anjer at 8.30, name still hoisted, close enough in to make out the houses, but could see no movement of any kind; in fact, through the whole Straits we have not seen a single moving thing of any kind on sea or land. At 10.15 a.m. passed the Button Island one-half to three-quarters of a mile off; sea like glass round it, weather much finer looking, and no ash or cinders falling; wind at south-east, light. At 11.15 there was a fearful explosion in the direction of Krakatoa, now over thirty miles distant. We saw a wave rush right on to the Button Island, apparently sweeping right over the south part, and rising half way up the north and east sides. This we saw repeated twice, but the helmsman says he saw it once before we looked. The same wave seemed also to run right on to the Java shore. At the same time the sky rapidly covered in; the wind came strong

from south-west by south; by 11.30 we were inclosed in a darkness that might almost be felt, and at the same time commenced a downpour of mud, sand, and I know not what; ship going north-east by north, seven knots per hour under three lower topsails; put out the side-lights, placed two men on the look-out forward, while mate and second mate looked out on either quarter, and one man employed washing the mud off binnacle glass. We had seen two vessels to the north and north-west of us before the sky closed in, adding much to the anxiety of our position. At noon the darkness was so intense that we had to grope our way about the decks, and although speaking to each other on the poop, yet could not see each other. This horrible state and downpour of mud, &c., continued until 1.30, the roarings of the volcano and lightnings being something fearful. By 2 p.m. we could see some of the yards aloft, and the fall of mud ceased. By 5 p.m. the horizon showed out in the north and north-east, and we saw West Island bearing east and north, just visible. Up to midnight the sky hung dark and heavy, a little sand falling at times, the roaring of the volcano very distinct, although in sight of the North Watcher, and fully sixty-five or seventy miles off it. Such darkness and time of it in general few would conceive, and many, I dare say, would disbelieve. The ship, from truck to water-line, is as if cemented; spars, sails, blocks, and ropes in a terrible mess; but, thank God, nobody hurt or ship damaged. On the other hand, how fares it with Anjer, Merak, and other little villages on the Java coast?"

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The Natural Science Scholarships at Christ Church have been awarded after examination to Mr. R. E. Scholefield, of Leeds Grammar School, and Mr. H. Bankes Price, of Christ's College, Brecon. The Brakenbury Natural Science Scholarship at Balliol College has been awarded to Mr. R. P. Baker, of Clifton College. The following gentlemen were distinguished in the examination:—Mr. W. H. Littleton, Royal School of Mines, Mr. T. H. J. Watts, of Llandovery School, and Mr. C. E. Rice, of Derby Grammar School.

An examination will be held on January 29 at Queen's College for the election of a scholar in Natural Science.

CAMBRIDGE.—The Special Board for Mathematics, in publishing, after the lapse of two-thirds of the present term, a list of professorial lectures on Mathematics, with a list of College lectures open to all members of the University, states that six associated Colleges, Peterhouse, Pembroke, Corpus, Queens', St. Catharine's, and Downing, provide no lectures on higher Mathematics this term, while none will be given during the year at Jesus, Trinity Hall, Magdalen, Sidney, Cavendish, and Selwyn. St. John's does not as yet open any of its advanced lectures to other than its own students. Trinity, on the contrary, has five advanced courses this term open to the University, viz. Mr. Thomson on Electrostatics and on Statics and Attractions, Mr. Ball on Higher Differential and Integral Calculus, Mr. Glazebrook on Geometrical Optics, and Mr. Glaisher on Elliptic Functions. At King's Mr. Stearn is lecturing on Electrostatics, at Christ's Mr. Hobson on Magnetism, at Clare Mr. Mollison on Fourier's Theory and Heat. Several subjects in higher Mathematics are unrepresented by lectures this year, such as Differential Equations, Calculus of Finite Differences, Calculus of Variations, Theory of Probability, Lagrange's and Bessel's Functions, Higher Dynamics, Newton's "Principia," Planetary Theory, and Precession. The Board regret that no conference of mathematical lecturers has been held, and that there is no uniformity of procedure between the different Colleges. In all the other chief departments of study, programmes of advanced lectures for the whole year were published last June. It is somewhat of a reproach to Cambridge mathematicians that no such list is published in regard to what was once so distinctively the characteristic study of Cambridge.

The following are the examiners for the Natural Sciences Tripos of 1884:—Prof. A. M. Marshall (zoology), Dr. F. Darwin (botany), Mr. Langley (physiology), Dr. R. D. Roberts (geology), Mr. L. Fletcher (mineralogy), Mr. W. N. Shaw (physics), Mr. A. Hill (human anatomy), Mr. Pattison Muir (chemistry).

The recommendations of the General Board of Studies as to the Professor of Pathology, new readers, University lecturers, demonstrators, grants for apparatus, &c., will be voted on December 6 at noon.

Prof. Foster has been appointed on the University Library Syndicate; Prof. Foster and Dr. Vines, the Botanic Garden Syndicate; Revs. Coutts Trotter and E. Hill, the Museums and Lecture Rooms Syndicate; Messrs. H. Darwin and J. J. Thomson, the Observatory Syndicate; Prof. Cayley, the University Press Syndicate; Dr. Gaskell and Mr. A. S. Lea, the Oxford and Cambridge Examinations Syndicate; Prof. Foster, the State Medicine Syndicate; Prof. Stuart and Mr. J. Ward, the Teachers' Training Syndicate.

The following appointments on Special Boards have been made:—Mr. A. S. Lea (medicine), Dr. Ferrers (mathematics), Prof. Stokes (physics and chemistry), Mr. J. E. Marr (biology and geology).

Prof. Macalister has been appointed Examiner in the 2nd M.B. in place of the late Mr. James Shuter.

Mr. W. Gardiner of Clare College has been approved as a Teacher of Botany for the purposes of medical study.

SCIENTIFIC SERIALS

THE *Journal of Anatomy and Physiology*, vol. xviii. part 1, October, 1883, contains:—On the development of the suspensory ligament of the fetlock in the fœtal horse, ox, roe deer, and sambar deer, by Prof. Dr. J. Cunningham, M.D. (plate 1).—On the action of infused beverages on peptic digestion, by Dr. J. W. Frazer (plate 2).—On a method of promoting maceration for anatomical museums by artificial temperature, by Prof. Struthers, M.D.—On the wax-like disease of the heart, by Prof. D. J. Hamilton, M.D. (plate 3).—On the relations of the dorsal artery of the foot to the cuneiform bones, by A. Hensman.—Researches into the histology of the central gray substance of the spinal cord and medulla oblongata, by Dr. W. Ainslie Hollis, part 2 (plate 4).—On some points in the anatomy of the chimpanzee, by J. B. Sutton.—Observations upon the osteology of *Podaxocys montanus*, by Dr. R. W. Shufeldt (plate 5).—Short notes on the myology of the American black bear, by Prof. F. J. Shepherd, M.D.—Total absence of the left lobe of the thyroid body, by Dr. W. J. Gow.—Note respecting the course of the flexor longus digitorum pedis, by Dr. Sinclair White.—On the os centrale in the human carpus, by Prof. W. Gruber.

THE *Quarterly Journal of Microscopical Science* for October, 1883, contains:—Observations on the genus Pythium, by H. Marshall Ward, M.A. (plates 34 to 36).—On budding in Polyzoa, by Prof. A. C. Haddon, M.A. (plates 37, 38).—On the structure and relations of Tubipora, by Sydney J. Hickson, B.A., B.Sc. (plates 39, 40).—On the malleus of the Lacertilia and the malar and quadrate bones of the mammalia, by M. L. Dollo (plate 41).—Notes on Echinoderm morphology, No. 6; on the anatomical relations of the water-vascular system, by P. Herbert Carpenter, M.A.—Recent researches upon the origin of the sexual cells in hydroids, review by A. G. Bourne, B. c.—On the osteology and development of *Syngnathus peckianus* (Storer), by J. Playfair McMurrich, M.A. (plates 42, 43).

THE *American Journal of Science*, November, 1883.—Results of some months' examination of the spectra of sunspots with an instrument of high dispersion, by Prof. C. A. Young.—On the meteoric iron mass found by F. M. Anderson near Dalton, Whitfield County, Georgia, in 1879 (two illustrations), by Charles Upham Shepard, sen. The analysis gave iron 94·66, nickel 4·80, cobalt 0·34, with traces of phosphorus, chromium, and manganese.—Notice of some varieties of corundum recently found at Sungchang, Zanskar district, Western Himalayas, by the same author.—Phenomena of the Glacial and Champlain periods about the mouth of the Connecticut Valley, that is, in the New Haven region (two maps), by James D. Dana. The author concludes that two simultaneous movements existed in the glacier ice—a lower along the valley, an upper crossing it obliquely; that both transported drift material, and that on reaching Long Island Sound the lower changed its own direction of flow for that of the general glacier mass across the Sound and Long Island.—On a variety of descloizite from Zacatecas, Mexico, by Samuel L. Penfield.—On Hybocrinus, Hoplocrinus, and Bærocrinus (two illustrations), by Charles Wachsmuth and Frank Springer.—Note on Mr. Nipher's papers on the evolution of the American trotting horse (one illustration), by W. H. Pickering. The author holds that we may foretell the speed attained for a few years in advance, but not the

ultimate s eed, nor when it will be reached.—On the discovery of Utica slate graptolites on the west side of the Hudson River, a few miles north of Poughkeepsie, by Henry Booth.—On Becraft's Mountain, near Hudson, Columbia County, New York (one illustration), by William Morris Davis. After describing the district formations, and their relative and absolute positions, the author deals with the question of nonconformity between the Lower and Upper Silurian systems of the locality and the relations of these systems elsewhere. In another communication he discusses the question of nonconformity at Rondout, New York.—Notice of agricultural, botanical, and chemical results of experiments on the mixed herbage of permanent meadows, conducted for more than twenty years in succession on the same land, by D. P. Penhallow. The results are tabulated, and are valuable as showing the influence of different fertilisers upon the character of vegetation and the total produce.—Note on Mr. Backhouse's observations on physiological optics, by W. Le Conte Stevens.

Bulletin of the Belgian Académie Royale des Sciences, des Lettres, et des Beaux Arts, August 5, 1883.—Report on M. Gravis' anatomical researches on the vegetative organs and structure of the *Urtica dioica*, by MM. Ed. Morren and Gilkinet.—Report on M. Paul Albrecht's work on the pelvisternum of the Edentates, by MM. P. J. Van Beneden and Van Bambeke.—Note on a thunderbolt which fell near Gougnies on July 11, 1868, by M. D. Van Bastelaer.—Report on M. Delaey's steam engine of universal application, by M. Maus.—Remarks on some new fossils found in the Belgian Tertiary formations, by M. P. J. Van Beneden.—Note read to the Academy on presenting the two first parts of his work on the theory of the diurnal, annual, and secular movements of the axis of the globe, by M. F. Folie.—Observations on a recent note by M. P. J. Van Beneden, touching the discovery of the Bernissart fossil iguanodons, by M. E. Dupont.—Note on the influence of respiration on blood-pressure, by MM. Em. Legros and M. Griffé.—Report on M. G. Tiberghien's philosophic dissertation on time, by M. A. Le Roy.—Note on M. de Sonnaz's historical studies on the county of Savoy, by M. Rivier.—Communication on some autographs of Grétry, by M. Stanislas Bormans.

Archives Italiennes de Biologie, tome iv. fasc. 1, October 31, 1883, contains:—On the zoological station at Naples, by C. Emery.—On le charbon in birds, by E. Perroncito.—On a true diffused kidney in certain mollusca, by S. Trinchese.—On the optic lobes of birds, by J. Bellonci.—On the oscillations of the typhoid fever epidemic at Paris in connection with the rainfall and sewage of that city, by L. Pagliani.—On paraldehyde as antagonistic to strychnine, by V. Cervello.—On the active properties of *Nigella sativa*, by P. Pellacani.—On the genesis of Ptomaines, by F. Coppola.—Researches as to the poison of *Triton cristatus*, by A. Capparelli.—Embryological researches as to the mammalian kidney, by C. Emery.—Histological researches as to the nervous centres, by C. Golgi.—Obituary notices of P. Pacini, N. A. Pedicino, and Victor Colomiatti.

Zeitschrift für wissenschaftliche Zoologie, Bd. xxxix., Heft 1, September 28, 1883, contains:—Researches on the interstitial connective tissue in mollusca, by Dr. J. Brock (plates 1 to 4).—On the germinal layers of the tail end of *Lumbriculus variegatus*, with a contribution to the anatomy and history of this worm, by Dr. C. Bulow (plate 5).—On the histogenesis of the bones in Teleostei, by Carl Schmid-Monnard (plates 6 to 9).—Remarks concerning the blood lacunæ and the connective tissue in Najadæ and Mytilidæ, by W. Flemming.—Contributions to the histology of the Echinoderms, No. 1, the Holothuria (Pedata) and the nervous system of the Asteridæ, by Dr. Otto Hamann (plates 10 to 12).

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, November 15.—Sir John Lubbock, Bart., F.R.S., president, in the chair.—Messrs. Philip Crowley and J. Murray were elected Fellows of the Society.—Mr. Charles B. Plowright exhibited a young pear tree showing *Ræstelia cancellata*, Jacq., produced from *Podisoma sabinæ*, therefore supporting the observations of A. S. Œrsted in *Botaniska Notiser* for 1865; also examples of *Puccinia graminis* on wheat produced from Œcidium on *Mahonia aquifolia*; the Œcidiospores were sown June 2, 1883, the Uredospores were sown June 10, and the ripe *P. graminis* was gathered September 10, 1883. He likewise called attention to examples of *Œcidium rumicis* on *Rumex obtusifolius*, *R. hydrolapathum*, *R. conglomeratus*, and *Rheum officinale*, the same being produced from *Puccinia phragmitis*.—Prof. P. Martin Duncan showed a specimen of coral (*Desmophyllum crista-galli*) which had grown upon an electric telegraph cable off the shores of Spain; it possessed radicles, apparently due to the presence of a worm close beneath the base of the coral.—Mr. E. P. Ramsay exhibited a series of rare New Guinea birds, and Mr. R. B. Sharpe made remarks thereon.—Mr. T. Christy exhibited a fine living and healthy specimen of *Trevesia sundaica*, Miq. (the so-called *Gastonia palmata*), or probably a new species. This peculiar and handsome plant has rarely been seen in this country, and of late years almost been lost sight of.—Dr. J. Murie showed and made remarks on specimens of *Ascaris bicolor* from the living walrus at the Westminster Aquarium.—Mr. F. I. Warner drew attention to a series of specimens of *Orchis incarnata* from Hampshire.—A paper was read by Mr. A. W. Bennett, on the reproduction of the Zygnemaceæ, as a solution of the question, Is it a sexual character? De Bary twenty-five years ago, and since then Wittrock, have instanced what they have deemed sexual differences between the conjugating cells, though most later writers rather ignore essential physiological distinctions. Mr. Bennett has directed his investigations chiefly to the genera *Spirogyra* and *Zygnema*, and from these he supports the inference of the above-mentioned authors. He finds there is an appreciable difference of length and diameter in the conjugating cells, that deemed the female being the larger. The protoplasmic contents he also finds pass only in one direction, and change first commences in the chlorophyll bands of the supposed male cells, with accompanying contraction of the protoplasmic material. The genera *Mesocarpus*, *Staurospermum*, and the doubtful form *Craterospermum* have likewise been examined, and, though showing differences, yet on the whole substantiate the view above enunciated of cell sexuality.—There followed the reading of notes on the antennæ of the honey bee, by Mr. T. J. Briant, in which he describes the minute structure of the segments, the joints and certain rod and cone like organs, previously referred to by Dr. Braxton Hicks, of highly sensitive function.—A paper was read on the Japanese Languriidæ, their habits and external sexual characteristics, by Mr. G. Lewis. He remarks that a representative of the family has been found in Siberia, lat. 46° (*L. menetriesi*); there are none in Europe, and one is known from Egypt. Others inhabit the Malay Archipelago, Ceylon, and the American continent. The author infers from the geographical distribution of these beetles that they have emanated from a tropical area. Some in the imago state cling to the stems of brushwood; others sit on the leaves of the moist shade-loving plants in the forests, while still others frequent debris on hill sides. Their colours are all dull, their bodies elongate and not structurally adapted for boring. The sexes show peculiar differences in size, and monstrous enlargement and obliquity of the head, volume of tibia, &c.—A paper was read by Prof. P. Martin Duncan on the replacement of a true wall or theca by epitheca in some Serial Coralla, and on the importance of the structure in the growth of incrusting corals. After alluding to the discussions which have taken place regarding the value of epitheca in classification, the author states that one form of this structure is simply protective, and that another form is of high physiological value, for it replaces entirely the usual theca or wall. The anatomy of the hard structures of a Cœloria illustrates the second proposition, for the broad base is covered by an epitheca, within which is no wall or "plateau commun," the septa, remarkable nodular walls (described in detail), and the columellæ arise from the epitheca directly, and it limits the interseptal loculi inferiorly. In a Leptoria the same replacement of a wall by epitheca is seen. In incrusting Porites and such Astræidæ as Leptastræa the majority of the corallites of the colony arise from this basal epithecate structure, and grow upwards, budding subsequently from their sides.

Royal Meteorological Society, November 21.—Mr. J. K. Laughton, F.R.A.S., president, in the chair.—The Earl of Dalhousie, K.T., T. H. Davis, D. C. Embleton, J. Hargreaves, and J. L. Lewington were elected Fellows of the Society.—The following papers were read: Report on temperatures in two different patterns of Stevenson screens, by E. Mawley, F.R.Met.Soc. The screens employed were an ordinary Stevenson screen obtained from Casella, and a new Stevenson screen made in accordance with the recommendations of a committee appointed by the Council of the Society. The new screen is two

inches wider and deeper than the old screen. It has also an upper sloping roof, and, at a little distance below, a flat, inner roof pierced with holes for ventilation; while the old screen has a single flat roof with only a narrow slit beneath on each side for ventilation. Observations were made during the three months July to September, and the results are given in the paper. From these it appears that the new screen is, of the two, slightly cooler and better ventilated, and retains the heat of the sun for a less time than the old screen; also, having a double roof and overlapping boards below, it is bettter suited for extreme climates.—On the storm which crossed the British Isles between September 1 and 3, 1883, and its track over the North Atlantic, by C. Harding, F.R.Met.Soc., of the Meteorological Office. This storm caused considerable havoc in the south-west and south of England, owing not only to its exceptional violence, but also to its occurrence before the completion of the harvest. The storm is traceable, in the first instance, to two centres of disturbance, one being first shown at about 450 miles to the south of Bermuda on August 26, and the other to the east of the Rocky Mountains on the 27th; these two disturbances afterwards merged on the 29th, at about 300 miles to the north of Bermuda, and formed one great and destructive gale, which continued to grow in violence as it crossed the Atlantic until it reached the coasts of the British Islands. The average speed at which this storm crossed the Atlantic was fully forty miles an hour, which is more than double the usual speed of storms which traverse that ocean.—On the influence of the moon on the height of the barometer within the tropics, by Robert Lawson, Inspector-General of Hospitals.—The great ice-storm of July 3, 1883, in North Lincolnshire, by J. Cordeaux. The direction of the storm was nearly south-east to north-west, and travelled from Caistor along the higher ridges of the hills to Barton-on-Humber. The storm commenced at about 9.20 p.m. with heavy drops of rain, and increased to a downpour, speedily followed, amidst the blaze of lightning and the constant roll of thunder, by the rush of hail, or rather lumps of ice. An eye witness remarked that they were not like hailstones, but "salt-cellars"; another that they resembled "ducks' eggs"; in fact they were solid lumps of ice of every shape and size, weighing from two to six ounces, and some were measured six inches in circumference. The injury done to the growing crops cannot be estimated at less than 20,000*l*.

Physical Society, November 24.—Prof. R. B. Clifton in the chair.—Prof. Reinold read a paper by Mr. J. W. Clark, on the purification of mercury by distillation in vacuo. The advantages of Mr. Clark's apparatus are—the small quantity of mercury in use at a time, and the fact that no auxiliary Sprengel pump is required. This is avoided by having a movable reservoir of mercury, on raising which the distiller is filled with mercury. The apparatus was described in detail, and illustrated by a figure. It is probable that zinc, cadmium, magnesium, &c., may be distilled and thus purified by the same apparatus.—Mr. A. P. Chattock then read a paper on a method of determining experimentally the constant of an electrodynamometer. In existing methods it is necessary to measure the areas of the coils, which is a difficult matter to do with a finished instrument; by the new method this is unnecessary. It depends on the accurate determination of the speed of the movable coil. Mr. Chattock exhibited an instrument whose constant had been determined by him in the laboratory of Prof. Foster, University College, with the assistance of Mr. Grant.—Prof. G. C. Foster then took the chair, and Prof. R. B. Clifton, president, read a paper on the measurement of the curvature of lenses. With very small lenses the spherometer cannot be used, and the author's method is based on the Newton's rings formed between the lens and a plane surface, or a curved surface of known radius. From the wave-length of the light employed in observing, and the diameter of a ring, the radius of curvature can be determined. He places the lens on a plane or curved surface under a microscope, and lights it by the sodium flame (wave-length 5892×10^{-7}); he measures the approximate diameters of two rings a distance apart (in practice the tenth and twentieth rings are found convenient), takes the difference of their squares, and divides it by the wave-length, and the number of rings in the gap between to find the radius of the lens. The formula is—

$$\rho^1 m\lambda = \left(x^2_{m+n} - x^2_n\right)$$

where x_{m+n} and x_n are the diameters of the nth and $(m+n)$th rings; λ is the wave-length of the light, and ρ^1 the radius of curvature of the lens. The method with proper care gives accurate results. Prof. Clifton has also used it to determine the refractive index of liquids in small quantities; Mr. Richardson having found it for water = 1·3335 by this method, which is usually correct to two places of decimals. It can also be used to determine if the lens is uniformly curved and spherical. Prof. Perry suggested that it might be also used to measure a surface without touching it, say the surface of a water drop, or a strip of glass when bent. In this way it might throw light on the laws of capillarity or bending.

Manchester

Literary and Philosophical Society, October 2.—H. E. Roscoe, F.R.S., president, in the chair.—On the change produced in the motion of an oscillating rod by a heavy ring surrounding it, and attached to it by elastic cords, by James Bottomley, F.C.S.

October 16.—H. E. Roscoe, F.R.S., president, in the chair.—On the leaves of *Catha edulis*, by C. Schorlemmer, F.R.S.—Dr. Schuster, F.R.S., gave an account of meteoric dust, and exhibited some specimens found in Himalayan snow.—On the duality of physical forces, by James Rhodes, M.R.C.S.

October 30.—J. P. Joule, F.R.S., vice-president, in the chair.—On the action of water upon beds of rock salt, by Thomas Ward.

Cambridge

Philosophical Society, October 29.—On the structure of the cells of secretory glands, by Mr. J. W. Langley.—Note on the fibrin-ferment, by Messrs. A. S. Lea and J. R. Green.—On the structure of the epidermis of the ice-plant (*Mesembryanthemum crystallinum*), by Mr. M. C. Potter.—On the physiological significance of water-glands, by Mr. Walter Gardiner.

Paris

Academy of Sciences, November 26.—M. Blanchard, president, in the chair.—On the treatment of plague-stricken swine by vaccination with the fatal virus itself in an attenuated form, by M. Pasteur and the late M Thuillier.—On the hydratation of crotonic aldehyde, by M. Ad. Wurtz.—Propagation across the Indian and Atlantic Oceans of the great earthquake wave caused by the recent disturbances at Java, by M. de Lesseps. From the observations taken at Colon by the engineers engaged on the Panama Interoceanic Canal, the wave would appear to have made its way in about thirty hours from Java, round the Cape of Good Hope to the east coast of Central America.—Theoretical considerations on the action of floats kept in tow at divergent angles, by M. E. de Jonquières.—On the secular variation in the direction of the terrestrial magnetic force at Paris, by M. L. Descroix.—On the successive parthenogenetic reproduction of phylloxera for nine generations, and on the results obtained by various methods of treatment of vines attacked by phylloxera made by M. P. Boiteau.—Observations of the planets 233 and 234 at the Paris Observatory (equatorial of the west tower), by M. G. Bigourdan.—On a formula of M. Tisserand connected by the celestial mechanism, by M. O. Callandreau.—On the algebraic integration of linear equations, by M. H. Poincaré.—On an induction magnetic needle, by M. Mascart.—On the electric synchronism of two relative movements, and its application to the construction of a new electric compass, by M. Marcel Deprez.—A study of earth-currents, by M. E. E. Blavier.—Measurement of the differences of potential of electric layers on the surface of two liquids in contact (four illustrations), by MM. E. Bichat and R. Blondlot.—Wave-lengths of the optical rays A and *a*, by M. W. de W. Abney.—Description of a micro hermometer for gauging very slight variations of temperature, by M. F. Larroque.—Studies on the chemical action of light; decomposition of oxalic acid by the perchloride of iron (three illustrations), by M. G. Lemoine.—Dissociation of the anhydrous carbonate of ammonia caused by excess in one or other of its elements, by M. Isambert.—On the fusibility of salts; nitrates, by M. E. Maumené.—On hydronicotine and oxytrinicotine, by M. A. Étard.—On the relative velocity of the sensations of sight, hearing, and touch, by M. A. Bloch. This paper consists of three distinct parts, each dealing with the comparison of two sensations—(1) hearing and touch; (2) hearing and sight; (3) sight and touch. The author concludes that of the three sensations sight is the most rapid; then hearing, the transmission of which sensation lasts 1/72 of a second longer than that of

sight; lastly, touch, the transmission of which takes 1/21 of a second more than sight.—On the nervous system and the classification of the Phyllodoceæ, a hitherto little-studied family of Annelidæ, by M. G. Pruvot.—On the axis of *Œnanthus crocata* and *fistulosa*, and on abnormal vegetable productions in general, by M. R. Gérard.—On the propagation of the earthquake waves caused by the late volcanic eruption at Java, by M. Bouquet de la Grye.—A contribution to the volcanic theory, by M. Stan. Meunier.

BERLIN

Physiological Society, November 9.—Dr. Friedländer two years ago had communicated to the Society how in eight different cases of genuine croupous pneumonia, which ended fatally on the disease reaching its height, he had constantly found in the lungs a micrococcus, mostly in the form of diplococcus, which seemed to be a characteristic of genuine pneumonia. Since then the cases of croupous pneumonia he had examined amounted to over fifty, and with but very few exceptions the same description of cocci had been found in all the lungs affected. The few cases in which pneumonic cocci failed to show themselves were regularly such in which death had set in after the eighth day of the disease, that is after the disease had finished its course. In all other kinds of pneumonia, such, for example, as follow in the train of typhus, or attack old persons, &c., diplococci did not appear. It was beyond doubt, therefore, that they were a characteristic of genuine croupous pneumonia alone. That micrococci had not been perceived by many observers in the case of genuine pneumonia was owing to the fact that it was difficult to make them visible in the tissues; for only when they were highly coloured while the surrounding tissue remained colourless did they become distinctly visible. To render them apparent it was of advantage to colour thin sections of the lungs with methylic-violet or gentian-blue, and then to apply a diluted solution of iodine by means of which the tissues which were at first also coloured would become clear and so bring out the strongly-coloured cocci. Quite recently two cases had been published in which pneumonic cocci had been found *intra vitam*—one case by Prof. Leyden, the other by Dr. Günther. The latter observer invariably found the cocci inclosed in a pale and sharply-defined envelope, which, on the application of colouring-matter, likewise became highly coloured. Cocci having in both the cases referred to been obtained by means of punction, and thus their presence in the fluid of the lungs demonstrated, Dr. Friedländer set himself also to examine the fluid of the lungs in the bodies of persons who had died from pneumonia, and found there large quantities of pneumonic cocci, which were particularly well adapted for examination, being in a free state. He was now in a position to prove that they all possessed envelopes, which, by their reactions (they came out most distinctly on being subjected to acids, and disappeared under distilled water or an alkali), appeared to consist of mucin, and to be very essential to the life and activity of the cocci. According to the experience acquired down to the present date, the pneumonic cocci were the only ones which possessed this kind of slimy capsule. The problem now presented was, by means of experiments in the way of cultivation and inoculation, to determine the distinguishing characteristics and the pathogenic nature of these cocci. This task Dr. Friedländer, in conjunction with Dr. Frobenius, had undertaken with positive results. According to the methods of Prof. Koch, the cocci taken from the lungs of persons who had died from genuine pneumonia were disseminated on stiffened gelatine (consisting of gelatine, an infusion of flesh and common salt). From these proceeded invariably and in all generations perfectly characteristic organisms distinguished from all other fungous products of cultivation by their peculiar nail-like shape. No other kind of micro-organism showed the same nail-like form under cultivation as did that taken from persons pneumonically affected who had died on the disease reaching its acme, and whose lungs were afterwards examined; nor did any other species of pneumonia ever yield this form of cultivated organism. Experiments in the way of inoculation had been made on mice, guinea-pigs, rabbits, and dogs. The mice were subjected to injections either of cultivated cocci which had been obtained by dissemination of fresh lung-fluid containing cocci. Almost all these mice died after twenty to twenty-eight hours, under symptoms of violent dyspnœa; and on a section being made, extensive pleurisy and pneumonia were observed in each case; in the blood, likewise, diplococci were found to be very abundant, as also in the pleural exudations and in the tissues of the lungs. Were the cocci thus found disseminated on gelatine, they then yielded the nail-like cultivated organisms already referred to, exactly in the same way as did the cocci of genuine pneumonia in the case of man. Were again these cultivated cocci injected into other mice, these mice died of pneumonia on the second day after the inoculation. If, however, the fluid containing cocci were heated to about 70° C. before being injected into the mice, it was thereby rendered inefficacious, and the mice received no harm from it. On the pleural cavity of the mice being examined, many cocci were indeed still found in the fluid, but when these were strewn on gelatine they either remained sterile or developed other than the nail-like cultivated organisms. Not only, however, by injection of pneumonic cocci through Pravaz's syringe could pneumonia be produced in mice, but likewise also by means of inhalation. If mice, shut up in a chest, were compelled to breathe an atmosphere saturated by means of a spray with pneumonic cocci, then did a number of the mice die under the same symptoms as followed injection, though in this case not till the fourth or fifth day after the operation; the blood in the lungs of those mice who had died from experimental genuine pneumonia also contained characteristic pneumonic cocci. The results obtained from analogous experiments in inoculation with guinea-pigs were less decisive. About a half of the guinea-pigs inoculated by means of injection of pneumonic cocci remained in a perfectly healthy state, showing that they were proof against cocci. The other half, however, perished of dyspnœa, and their blood, lungs, and pleural exudations were found to contain double micrococci, which being sown on gelatine produced the characteristic nail-like organisms, and on being injected gave rise to pneumonia in the creatures so inoculated. The same experiments were next tried on five dogs. Four of them remained unscathed, but one sickened and died of dyspnœa. On a postmortem being made, this last dog showed symptoms of pneumonia and the presence of the characteristic diplococci in its blood and lungs. In the four healthy dogs, on the other hand, the injected cocci had all suffered destruction. In the case of the rabbits the experiments in inoculation were wholly without effect. They showed themselves completely proof against pneumonic cocci, and the cocci injected into their lungs were, after a few days, no longer traceable. From the invariable discovery of diplococci in the lungs of bodies that had died of genuine pneumonia before the disease had run its full course, and from the experiments with cultivated cocci, as also by inoculation of mice, Dr. Friedländer drew the conclusion that the cocci found by him were the cause of the genuine croupous pneumonia which had also before been recognised as infectious. On a future occasion Dr. Friedländer will again take up this subject, so important both from a scientific and a practical point of view.

CONTENTS