THURSDAY, JUNE 28, 1883

THE LINKS OF THE ANIMAL WORLD

Les Enchaînements du Monde Animal dans les Temps Géologiques. Fossiles Primaires. Par Albert Gaudry, Professeur de Paléontologie au Muséum d'Histoire Naturelle. (Paris: F. Savy, 1883.)

M. GAUDRY, a distinguished palæontologist, contributed five years ago a very interesting volume on the important and much debated question of the mammalia of the Tertiary epoch (see NATURE, vol. xviii. p. 537). The volume which he now publishes relates to the same *quæstio vexata*, but takes into consideration only the fossils that are to be found in primary strata. The author's proposed task is the same in both cases; he undertakes to find the links and connections that may exist between the animals which have successively or simultaneously inhabited the lands and seas of past epochs.

A great deal has been written on the transformism-theory of Lamarck and Darwin, and it must be expected that much more will be written. One of the principal objections made to it is that if man is really the descendant of the ape, and the ape that of other mammalia, if, generally, there exist links between all animals, living and extinct, so that all animals trace their origin to a common ancestor, how is it that no link really exists between man and ape, or between fish and frog, or between vertebrate and invertebrate? Embryological considerations, it is said, show a real connection between very different animals: a frog for instance is a fish for some time during its youth, and amphioxus looks very much like an ascidian.

But, notwithstanding numerous arguments to support Lamarck's theory, no transformist can show any species gradually losing its peculiar characters to acquire new ones belonging to another species, and thus transforming itself. However similar the dog may be to the wolf, no one has found any dead nor living animal or skeleton which might as well be ascribed to wolf as to dog, and therefore be considered as being the link between the two. One may say exactly as much concerning the extinct species; there is no gradual and imperceptible passage from one to another. Moreover, the first animals that lived on this earth are not, by any means, those that one may consider as inferior and degraded.

M. Gaudry in the first pages of his work states very clearly that he prefers the theory according to which links do exist between the extinct animals of different groups, but he does not show that facts support it yet very strongly.

The opinion one may entertain as to this question being entirely dependent upon facts and the manner of understanding them, let us now turn over the leaves of M. Gaudry's book and see whether we can find in it some firm support to Lamarck's and Darwin's theories.

According to J. Barrande's numerations the number of the species contained in the Silurian strata, comprising the Cambrian, is the following:—

	Species.
Sponges and Protozoa	153
Corals	718
Echinodermata	588
Worms	185
Trilobites	1579
Other Crustaceans	348
Bryozoans	478
Brachiopods	1567
Lamellibranchs	1086
Heteropods and Pteropods	390
Gasteropods	1316
Cephalopods	1622
Fishes	40
Of uncertain relations	4
	10,074

Thus, in the first of the primary strata nearly all the invertebrates are to be found—excepting insects—and the first vertebrate animals appear.

Generally speaking, and leaving *Eozoon canadense* and *Archæosphærina* out of the question, worms are the oldest fossils to be found in the Silurian strata. It is so in England (Caerfay), in Scandinavia, in France, in Bohemia (Przibram), in America (St. John). In Russia, Crustaceans (Obolus) are the first fossils found. It must be therefore acknowledged that life has not begun on earth with the lowest forms. M. Gaudry, it must also be said, does not believe that such has been the case. M. Gaudry's principal aim is to show that, for instance, all Polyzoa somewhat resemble each other, and that the species are so very similar that the links between them are evident; but he does not pretend to show the relations between Worms and Crustaceans for instance, and try to find links between them.

M. Gaudry shows easily enough that, according to Nicholson's, Verril's, and Moseley's views, the arrangement and classification of Polyp corals, Zoantharia, Tubipora, Tabulata, and Rugosa is a very difficult thing inasmuch as by some points of their anatomy the species under consideration should come in one group, and by others come in another group. The same thing may be said of Echinoderms.

Between Starfishes and Crinoids there are many links; others exist between Sea-urchins and Starfish, and Holothurians. As concerns Brachiopods, M. Gaudry remarks that the oldest species of animal on earth is the Lingula, so abundantly found in the Lingula Flags of the English Silurian. It exists to this day, being the best example of "fine old age" yet recorded. Links between the various genera of Brachiopods are not yet very firmly established. Mr. Davidson is opposed to the idea, but Mr. N. Glass's (of Manchester) researches give on the contrary some support to it, by showing how much the arms of the Brachiopods vary and differ in different animals of the same species. Mr. Davidson says that it is often very difficult to ascertain exactly the species of the individuals. Though not having seen, generally speaking, a great number of individuals of the same species, I may say however that of about twenty *Atrypa reticularis* often seen and handled by myself in one of the Parisian geological collections, not two were strictly alike. I have no doubt that the same is true of all, or at least most, species.

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Of Mollusks and Crustaceans, M. Gaudry says what he has already said of Brachiopods and other animals. As Dr. Woodward remarks, although Trilobites are always easily distinguishable from other Crustaceans (extinct, of course), one wonders at the astonishing variety afforded by this group of animals.

Let us pass over the Mollusks to see what M. Gaudry says of fishes and other Vertebrates.

Fishes begin in the Upper Silurian strata; they are abundant enough in the Ludlow beds (Pteraspis), and in the Downton grit (bone-bed—Pteraspis, Thelodus, Plectrodus, and Ctenacanthus). The fishes of the first ages of our globe were very singular animals; for instance, *Didymaspis grindrodi* wore on the back a *scutum* very much like that of a queer little Crustacean—at present very abundant in some places around Paris—named *Apus productus*. Pterichthys wore a yet stranger *scutum* which has been ascribed to insects, to Crustaceans, and to turtles before one could understand its meaning; it was incased in a bony helmet, and its fore-fins were also incased in a similar envelope, somewhat like the limbs of a crayfish or a lobster. Those primary fishes were sometimes devoid of a vertebral column, and nothing similar to these animals can be found among the living species. It must be therefore conceded that some links are missing, or that they have not existed.

As to Reptiles, they begin after fishes, in the Carboniferous and Permian strata, at the same time that Batrachia appear. The first of these, *Protriton petrolei*, has been discovered by M. Gaudry in the Permian strata of Autun, in France. *Pleuronoura pellatii*, *Branchiosaurus*, *Apateon*, and many others resemble somewhat the Protriton, and M. Gaudry remarks that these little animals are generally abundant in the same strata where Labyrinthodonts and similar animals are to be found. It may be that some of them are young Labyrinthodonts. Among Reptilia M. Gaudry seems inclined to consider Archegosaurus and Actinodon as the primitive type. They had no real vertebral column, the brain was imperfectly developed, and the limbs were rather imperfect. It is easy to perceive, by careful study of other Reptilia, that they differ from these only very slightly in some cases.

M. Gaudry comes to the following general conclusions:—

There are certainly links between the Silurian, Devonian, Carboniferous, and Permian species, and links exist between these and the actually living species of the same groups. Primary Foraminifera, for instance, are very similar to the actual species of our seas and oceans. This is true also of Brachiopods, Polyps, Mollusks, and Trilobites, but less so of Echinodermata. Brachiopods perhaps llustrate this general theory best, since they are, of all animal groups, the only one that has lasted from the beginning of animal life (Lower Silurian) to the present day.

As d'Omalius d'Halloy says, "It is scarcely credible that the Almighty Being whom I consider as the Author of Nature has, at different times, killed all living animals, to give himself the pleasure of creating new animals, which, very similar to the preceding ones, present successive differences, and display a marked tendency to blend with the actually living forms."

HENRY DE VARIGNY

COLIN CLOUT'S CALENDAR

Colin Clout's Calendar; The Record of a Summer, April-October. By Grant Allen. (London: Chatto and Windus, 1883.)

OF all the writers in this country who seek to render the facts and the theories of modern science attractive to the general public, Mr. Grant Allen is in our opinion among the most successful. We know that he does not profess to be in any serious manner an original investigator of these facts, and we are far from being always ready to accept his theories; but in most of his writings we meet with a characteristic ingenuity of thought, and perhaps a still more characteristic grace of style, which together render his essays the most entertaining in the kind of literature to which they belong.

It has recently been said in these columns, with express reference to Mr. Allen, that this kind of literature does more harm than good to the cause of science and to the advancement of the theory of evolution. But here, we think, the most that can be fairly said is that his zeal may sometimes be in danger of outrunning his discretion, so inducing him to trespass upon the domain of scientific questions which a more technical biologist would feel to be precarious ground. We should remember, however, that the function of a popular writer is to make his material attractive to the general reader, and if he succeeds in doing this for science, we think that he deserves to be encouraged by scientific men, even if they find that in running somewhat too fast over the grounds of theory he occasionally trips over matters of fact. Now, as we have said, Mr. Allen, considered as a literary man, is certainly a man of unusual ability, and he devotes his ability to diffusing an interest in biology among readers of periodical literature, who certainly could not be reached by any less attractive means. Moreover, he is a man of originality, both as regards thinking and observing, and if he were to devote less time to spreading out the sweets of science for popular consumption, there can be little doubt that he might do good work in collecting them.

But, be this as it may, we think that there should be no difference of opinion touching the service which Mr. Allen has rendered in his own province, even if we do not all go so far as to say with Mr. Wallace that he "certainly stands at the head of living writers as a popular exponent of the evolution theory." The book which we have now to notice is restricted to this province, and in its main features resembles those previous volumes which from time to time have been favourably reviewed in these pages. It consists of thirty-nine short papers republished from the *St. James's Gazette*, the greater number of which are devoted to botanical subjects. As the title of the collection suggests, these papers embody a number of observations and reflections on the natural history of plants and animals commonly met with in English country life; and as the essays are written in the least technical and most graphic language, they might be read with profit by all who take any intelligent interest in these things.

We may now give a few quotations, which will serve to show the general nature of the book:—

"But what is most interesting of all about the butterwort is the fact that it is peculiarly adapted for attracting insects from two distinct points of view—for food, and as fertilisers. While it lays itself out to catch and eat miscellaneous small flies with its gummy leaves, it also lays itself out to allure bees with its comparatively large and handsome mask-shaped flowers. . . . Why should these totally distinct plants [butterwort and sundew], living in precisely similar circumstances, have acquired this curious and uncanny habit of catching and devouring live flies? Clearly, there must be some good reason for the practice: the more so as all other insect-eating plants —Venus's fly-traps, side-saddle flowers, pitcher-plants, bladderworts, and so forth—are invariably denizens of damp watery places, rooting as a rule in moist moss or decaying loose vegetation. Now, in such situations it is difficult or impossible for them to obtain those materials from the soil which are usually supplied by constant relays of animal manure; and under such circumstances, where the roots have no access to decaying animal matter, those plants would flourish best which most utilised every scrap of such matter that happened to fall upon their open leaves."

"The bird which came northward at the close of the glacial period, to inhabit the now thawed plains of northern Europe, much as the American partridge might take possession of Greenland if all its glaciers were to clear away in a more genial era, was doubtless a more or less southern and temperate type of grouse-kind. Coming into Britain, it would soon be entirely isolated from all its allies elsewhere; for it is of course a poor flyer for distance, and it inhabits only the northerly or westerly parts of our island which lie furthest from the Continent, separated from Holland and Scandinavia by a wide sea. Here it could not fail to be subjected to special conditions, differing greatly from those of the European mainland, partly in the equable insular climate, partly in the nature of the vegetation, and partly in the absence of many mammalian foes or competitors. These conditions would be likely first to affect the colouring and marking of the feathers, the spots on the bill, the naked scarlet patch about the eye, and so forth: for we know that even freer-flying birds in the south, which cross often with Continental varieties, tend slightly to vary in such ornamental points; and a very isolated group like the red grouse would be far more likely to vary in similar directions. Meanwhile, the main branch of the family, separated on the great continents from this slightly divergent group, would probably acquire the habit of changing its plumage in winter among the snows of the north, by stress of natural selection, just as the Arctic fox and so many other northern animals have done; for in a uniform white surface any variation of colour is far more certain to be spotted and cut off than in a many-coloured and diversified environment. Thus it would seem probable that the Scotch grouse has slowly become accommodated to the heather, among which it is so hard to discover; while the willow-grouse has grown to resemble the snow in winter, and the barer grounds of its northern feeding-places in the short Scandinavian and Icelandic summer.

"If this be so, we must regard both birds as slightly divergent descendants of a common ancestor, from which, however, our grouse has varied less than its Continental congener. Of course, it is just possible that the common ancestor had already acquired the habit of changing its coat in winter before the divergence took place; and if so, then it is the Scotch grouse which has altered most: but this is less probable, because the usefulness of the change would certainly be felt even in a Scotch winter, and the white suit is not, therefore, likely ever to have been lost when once acquired. Though the winter is not severe enough in Scotland to make such a change of coat inevitable where it does not already exist, it is yet quite severe enough to preserve the habit in animals which have once acquired it, as we see in the case of the varying hare, a creature which in colder ages spread over the whole of northern Europe, and which still holds its own among the chillier portions of the Scotch Highlands. Hence we may reasonably infer that if our grouse had ever possessed a winter coat it would have always retained it for an alternative dress, as the ptarmigan still does in the selfsame latitudes. Accordingly, analogy seems to point to the conclusion that the Scotch grouse is a truly native breed, slightly altered by the conditions of its insular habitat from a closely allied Continental species, whose representatives elsewhere have now all assumed the guise of Scandinavian willow-grouse. In other words, the two isolated groups into which the species has split up have altered each in its own way, but the Continental variety has moved faster away from the primitive type than its British congener."

But in thus recommending Mr. Allen's latest work, we do not wish to appear unduly tolerant of inaccuracy. All we should wish to say is that, assuming Mr. Allen or any other expositor of science to be an amateur not thoroughly versed in technical matters, and therefore liable to fall into technical errors, we do not feel on this account that he need be precluded from publishing his observations and his theories for whatever they may be worth. Sooner or later these are sure to be duly winnowed, and even though they may contain more chaff than Mr. Allen has been in the habit of presenting, they may also contain some seeds of germinative value.

GEORGE J. ROMANES

AGRICULTURE IN INDIA

Field and Garden Crops of the North-Western Provinces and Oudh. Part I. With illustrations. By J. F. Duthie, B.A., Superintendent of the Saharanpur Botanical Gardens, and J. B. Fuller, Assistant Director of Agriculture and Commerce, North-West Provinces and Oudh. (Printed at the Thomason Civil Engineering College Press, 1882.)

THIS *brochure* is the first of a short series in which it is proposed to describe the cultivated products of the North-West Provinces of India. With the exception of an introduction of considerable length, treating generally of the physical, social, and agricultural peculiarities of the North-Western Provinces, the volume is chiefly devoted to a description of farm crops. Many of these, such as wheat, barley, oats, maize, hemp, tobacco, millet, and poppy, are as familiar to European cultivators as to Asiatics. Others, such as opium, rice, sugar-cane, and cotton, betoken the tropical nature of at least a portion of the season. The botanical descriptions of the various crops are contributed by Mr. Duthie in the usual language of the text-books, affording little room for original remark of any kind. By far the greater portion of the work has been compiled from the reports of Settlement Officers and other Government records, or contributed by Mr. Fuller. The agricultural information is of a highly interesting character, and the illustrations are particularly excellent. The work is, however, in a manner disfigured and rendered obscure by the peculiar views of the authors as to the first rule of arithmetic. Sixty-seven millions, &c., are expressed as 6,79,06,496, and six millions, &c., as 64,96,567. Ten millions, &c., are written in figures as 1,09,57,837. This principle of notation renders the statistical portion of the work difficult to follow, and it is not easy to see why it has been adopted.

The text is not free from remarks betokening a want of knowledge as to the progress of research on certain points. When, for example, treating of the enemies which affect the wheat crop, the author (presumably Mr. Fuller) writes as follows :—" But by far the most extraordinary disease to which wheat is liable is *sehwan,* in which the young wheat-grains are found to be filled with minute worms . . . The most extraordinary fact connected with this disease is, however, that the worms can retain their vitality for a long time," &c. A footnote is then added as follows :—" Since the above was written, the worms have been identified as belonging to the order *Nematoidea*, and are apparently of the genus *Tylenchus*" ! This is really too gross and wilful ignorance. The well-known and often-described "pepper brand" or "ear-cockle" attributable to the *Vibrio tritici*, now known as the *Tylenchus tritici*, is paraded as a "most extraordinary" disease, the precise nature of which has been ascertained " since the above was written." If such is the fact, the figures 1882 should be withdrawn from the title-page, and 1828 be substituted in their place. Neither do the authors appear to be at home in treating of the varieties of the cultivated plants. The varieties of rice, we are told, are more numerous and more strongly marked than those of any other crop. Forty-seven distinct varieties are announced, in support of this statement, as existing in Bareilly, although the writer proceeds somewhat naïvely to add, " Probably in the Provinces their number considerably exceeds 100." Now, as 300 varieties of wheat have been propagated by one naturalist, the forty-seven varieties of rice do not strike us as bearing out the statement as to the extraordinary variability of the plant.

Another point we cannot forbear to notice is the evident carelessness on the part of the authors as to whether their work should be understood by Englishmen in England. What is a " lakh," a " maund," or a " seer " ? In vain we look for an English equivalent, and yet it is " maunds " *per acre* which are constantly spoken of, and which we long to translate into bushels or some intelligible unit of measure or weight. Viewing the volume as a whole, we cannot but pronounce it interesting and readable. The introduction is especially rich in information regarding the climate, irrigation, and cultivation of the North-West Provinces, a vast district comprising, in the quaint method of enumerating employed by the authors, 6,79,06,496 acres.

An alluvial soil and a climate by which the year is divided into two complete seasons certainly are conditions highly favourable to vegetation and to agriculture. In the colder season, wheat, barley, and oats are brought to perfection, while in the kharif, or hot season, rice, cotton, sugar-cane, and maize thrive. Not only do these highly-favoured provinces enjoy a temperate and a tropical climate, but each half of the year is again divided into two definite sub-seasons fitted for producing crops peculiar to it. We cannot but wonder whether the strange climatal vagaries to which the western world has latterly been exposed have disturbed the pleasant division of the year into kharif and rati in the North-West Provinces of India ; but on this point our authors are silent.

JOHN WRIGHTSON

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.*]

Auroræ of October 2 and November 17, 1882

THE article of Mr. Rand Capron in the *Philosophical Magazine* on the aurora of November 17, 1882, has proved to me that my observation of that phenomenon has not been without value, but it appears that Mr. Capron has been obliged to consult a not quite accurate abstract or translation of my description which I had inserted in the *Utrecht Journal ;* it was from lack of time that I did not immediately send translations of it to foreign periodicals.

Perhaps you will still be so kind as to admit into NATURE a translation of both my articles on the auroræ of October 2 and of November 17 ; they were written immediately after observing the phenomenon. J. A. C. OUDEMANS

Utrecht, June 9

Translation of the Article in the "Utrecht Journal" of October 3, 1882

Yesterday evening, between seven and eight o'clock, there appeared here a brilliant aurora. Before seven there was visible a white arc running from west to east. This arc grew clearer and clearer, and rose slowly, till at 7h. 5m. (mean time) there emanated brilliant beams from its whole circumference.

At 7h. 10m. there rose also a bright column from the east-north-east, which phenomenon was repeated now and then also from the west.

In the southern part of the sky a magnificent sight was the large white spots, looking like brightly illuminated white clouds, but proving by their variable brilliancy to be no clouds, but to be connected with the auroral light. At 7h. 15m. such a large white spot was just before Aquila, *i.e.* north of the equator, but the spots showed a movement to the south, so that at 7h. 30m. the zone formed by them was some degrees south of the equator.

At 7h. 42m. there arose a large beam through the quadrangle of Ursa Major to β Ursa Minoris ; this beam moved to the west, and was dissolved a few minutes afterwards.

At 7h. 50m. there appeared again a cloudy patch in Aquila.

At 7h. 54m. a brilliant shooting star descended almost vertically from the space between Lyra and the Dragon through Hercules ; this observation was, however, not made with accuracy.

At 8h. the last cloudy patches in the south vanished ; in the north also I saw no more upward radiating beams.

Long afterwards the auroral light remained visible in the north. After 8h. 30m. I did not longer look for the phenomenon ; it seemed to me to have come to an end.

Utrecht, October 3, 1882 J. A. C. O.

Translation of the Article in the " Utrecht Journal" of November 18, 1882

Yesterday we had again a brilliant aurora, differing entirely in its details from that of October 2.

In the east as well as in the west there appeared at 6h. mean time a red gleam like that of a distant fire. Both these extended red patches were united through the north by an arc much resembling that which appeared in the aurora of October 2. The splendid vertical beams remarked on that occasion were now fewer in number and not so intense ; they were of the same reddish hue as the above-mentioned patches visible in the east and in the west.

At 6h. 23m. there appeared suddenly in the east a bright featherlike [1] appearance, which in the beginning showed some resemblance to a comet ; the end of it was exactly above Aldebaran. In no more than two minutes this feather had lengthened over an arc that passed above Saturn, through the quadrangle of Pegasus, and south of the Aquila stars, and as the front or western end proceeded, the eastern end followed. With the aid of a star-map we see that the arc, covered successively by this featherlike appearance, was elevated 20° above the

[1] By this word I did not mean that the borders or edges were not fairly defined.

celestial equator, and that its intersections with that equator had R.A. 110° and 290°. The horizon was intersected by this arc about 18° N. of E. and 18° S. of W., *i.e.* in two points situated nearly 90° from the magnetic meridian (Mr. R. Capron cites 20° erroneously; a repeated calculation gives me 18° 14′ N. of E).

When the arc was visible over more than 90° (which lasted no longer than a few seconds), its middle part, having a breadth of about 3°, was separated by a dark rift, 10° long and ½° broad, sharp at both ends.

At 6h. 25m. the whole arc had vanished.

At 6h. 27m. a bundle of red rays appeared between Ursa Major and Ursa Minor; it extended from Polaris to γ Ursæ Minoris, *i.e.* over a width of almost 20 degrees; this bundle moved steadily to the west, just as had been the case with several vertical beams of the former aurora.

At 6h. 30m. clouds began to appear in different parts of the sky: first in Auriga, in the E.N.E.; a moment afterwards another in Aries. In the beginning it was not evident if they were clouds or auroral phenomena, but they proved soon to be clouds floating off southwards by the north wind.

The aurora had now lost much of its splendour; I noted still a few beams, viz.:—

At 6h. 32·5m. a beam about 10° east of Polaris; at 6h. 33m. the red beam, discovered at 6h. 27m., had so far shifted to the west that it went through the head of the Dragon; at 6h. 37m. there was still a faint beam extending from α Coronæ (visible in the twilight) to Vega, which stood higher and more to the south.

At 6h. 38m. there was a white band between α Aurigæ and α Persei; I was not sure if it was auroral or a cloud.

At 6h. 40m. there appeared two new very broad beams in the north-west.

Now the east becomes more and more covered; from the north to the west there extends itself a whitish glow to a height of 40 degrees; in the north-east this glow is much feebler and lower; therefore I estimate it as not higher than from 20 to 30 degrees. It flows off very indistinctly. The polar light seemed now to have passed its greatest intensity; the observations were no longer continued.

A part of the night a white auroral light remained still visible over the northern sky; at 9h. the sky was entirely overcast.

At midnight it was clear again, and the whole northern sky was always covered by an auroral light; I am told that it was still there at 5h. in the morning.

It is said to have been then in the north-west, of a purple colour, in the north-east more pale yellow. J. A. C. O.

Utrecht, November 18, 1882

Effects of Lightning

PERHAPS your readers will be interested in the following remarkable incident of the action of lightning which has just occurred at the village of Great Lumley, near Chester-le-Street, in Durham.

A severe thunderstorm passed over the valley of the Wear on Saturday, June 9. Great Lumley is situated on the top of an elevated plateau on the east side of this valley, and its houses are conspicuously exposed to the weather. At about 11 a.m., during the progress of the storm, an old stone house with steep pantiled roof, known as the "Old Hall," was struck by a thunderbolt. The house is only of moderate height, having three low stories; but it is on some of the highest ground in the village, and is also one of the loftiest houses therein. It is on the south side of the principal street forming the village, and it has two gable ends, which are, however, partially concealed at their lower portions by lower houses joining on. There is a yard in rear of the "Old Hall," separating it by a few yards from some smaller houses mostly inhabited by pitmen. The coal lies about seventeen fathoms below the surface, and there are several pits in the neighbourhood.

The principal damage done to the house is in the internal woodwork; but a hole has also been made in the tiled roof, the upper courses of a brick chimney-stack built over the centre of a brick partition wall which divides the building into two separate dwelling-houses have been thrown down, and some broken bricks and tiles were hurled as far as sixty feet distant to the southward. The building is about 220 years old, and is externally in a rather dilapidated condition. The masonry is rough sandstone rubble, the surface of which has in places been much disintegrated by age and weather. The building is Lord Durham's property, and is let in tenements. At the time of the accident the whole of its eastern dwelling-house was unfurnished and uninhabited. This was where the principal injuries were effected. The western compartment is occupied; and the inmates were knocked down by the concussion, various pieces of furniture being also damaged by the same cause; but nothing serious occurred. The building, being so old, has also experienced considerable damage externally from the tremendous concussion which appears to have accompanied the explosion of the thunderbolt. Loose tiles and stones have been dislodged; an old wooden frame in a window-opening in the loft at the east gable has been thrown to the ground below, and a considerable patch of surface masonry immediately above the window-opening has been shaken down. Falling bricks and stones have also made some holes in adjoining roofs; and the signs of injury shown by all these causes led the people in the adjacent houses to believe that these damages constituted the extent of the harm done by the explosion. I inspected the scene just three days after the event. The eastern and unused portion of the "Old Hall" had not then been examined internally, and the doors were still locked.

On visiting the interior I found that great injury had been done to a wooden rafter of the roof, close to the hole already mentioned; to a wooden upright post resting on the second floor and supporting this rafter; and to a wooden girder and joist sustaining the foot of the post. The plaster on the walls adjacent to the post and girder was also torn off; but below the first floor no certain trace of the explosion could be found. The damaged rafter is on the south side of the roof, and the nearest one on the east of the chimney. Its scantling is 6 inches broad by 3 inches deep; and at about one-third of its length from the eaves it is supported by a longitudinal purlin (on a level with the floor of the loft), and also (just inside the purlin) by the upright post already mentioned. From the level of the upper side of the purlin, for a length of about 6 feet upwards, the rafter is completely shivered, and two large pieces are torn out of it. One, the lower piece, is 3 feet 6 inches long, 3 inches wide, and about 1½ inch deep. This has been cut very neatly out of the west side of the under face of the rafter, leaving the new under face almost smooth; and the lower end of the scar thus formed is scooped out in a *dovetailed* form flush with the horizontal top of the adjacent purlin. No broken pieces corresponding to this scar could be found anywhere about the small loft; but some very small splinters of wood were discovered on the floor to the north-east of the rent rafter and in the direction of the window-opening already mentioned. This latter was quite open to the outer air when the accident happened, and immediately after it occurred numerous small splinters of wood were found in the yard to the eastward of the opening. These had evidently been blown out of it with the old window frame. Some were found against a low wall horizontally distant 63 feet from the opening. These splinters were not visible when I arrived, as they had at once been secured for firewood by the spectators; but I brought away one of the fragments found on the loft floor. Its fibres are quite dissevered from each other, as if the wood had been completely *permeated* along their direction by the force of the explosion. The other scar in the rafter is cut out of the under face on the east side, partly alongside the first scar, but extending higher up and ending just under the hole in the roof tiles already mentioned. This second scar is 3 feet long by 4 inches by about 2 inches, and two pieces of wood were found lying on the loft floor about 8 feet distant to the north-east, which exactly fitted this scar. The hole through the roof is made at a point where a small iron nail fixed a lath (for the tiles) to the rafter.

The upright post underneath the rafter has a scantling of 8 inches by 3 inches; it is split and torn right up from its foot at the second floor (the next floor below the loft) to its junction with the rafter, to which it was fixed by several 2½-inch iron nails. The exact joint between the principal splits in the post and rafter seemed to be at the position of one of these nails, which was almost laid bare. I brought this nail away. Its upper two-thirds is quite rusty, whilst its lowest third (nearest the point) is clean and, in minute places, nearly bright. A heavy piece measuring 7 feet 6 inches by 6 inches by about 3 inches was torn clean off the north-west angle of this upright, and was found lying on the second floor about 3 feet off to the northward. The upright forms an angle post on the east side of a sort of dormer or porch projecting out of the south side of the roof, and formerly giving access from the outside to the second floor by a step-ladder. The latter, however, had disappeared shortly before the accident occurred, having (as I understood) fallen down from age. The upright is split vertically in two places, one (where the piece was rent off) following exactly the line of the small iron nails which fixed the laths (for the wall plaster) to the upright, and the other about 2 inches to the east of this line. At this east split the outer portion of the upright is forced outwards about 4 inches from the centre portion, and all but separated from it. Along the line of the first split the lath nails are forced out of the upright, and the lath ends pushed outwards, and some broken off. A great patch of the plaster that covered them (the centre of it being about 4 feet above the floor) is torn off and thrown violently against the north wall of the building on the opposite side of the room 21 feet distant. The wall is dotted (high and low) with white powdery marks, and the floor at the foot of it is covered with broken and powdered plaster, as also is (more or less) the space of intervening floor. The splits in the upright unite upwards, and pass through the loft floor at a comparatively small orifice, and the piece rent out tapers considerably from the bottom upwards. The rent surface of this piece is minutely *fretted* in a curious manner. In the bottom of the rent off piece (which comprised the greater part of the sectional area of the post at this end) were three or four $2\frac{1}{2}$-inch iron nails, probably used for fixing the post to the floor. These appeared to be driven and bent into the wood; there was no sign of fusing on them, and the surface of the floor immediately underneath the bottom of the post was not in the slightest degree damaged, so far as could be detected. On each side of the slight brickwork forming the east wall of the dormer or porch, a small patch of plaster (about 6 inches square or so) was broken off close to the floor, and about 3 feet southward of the post, but no other marks attributable to the explosion (and these small patches might have been due only to the concussion) could be discovered at the second floor.

On entering the room below (on the first floor), which has no ceiling, it was found that the wooden girder ($9\frac{1}{2} \times 4\frac{1}{2}$), on which the post rested, had a splinter 16 inches long and about 1 inch square (on an average) torn horizontally off the east side of it, 3 or 4 feet to the southward of the position of the bottom of the post, and about 6 feet from the south wall. The girder extends across the room, and rests on the north and south walls. Below the splinter, on the same girder, there was a horizontal crack, extending through the breadth of the girder, and proceeding about 8 feet along it northward, but stopping short of the position of the post above. It seemed, however, *possible* that there might be yet another horizontal split in this girder *close* to the under side of the floor above, and extending right up to the position of the post. Along the west side of the girder is a short joist (7 inches by 3 inches) passing through the south wall, extending about 4 feet into the room, and fixed to the girder by three large iron trenails; and just below it there was some more slight woodwork bedded in the wall, and apparently rotten. This joist was forced out from the other about 1 inch, and had a horizontal split passing exactly along the line of the heads of the three trenails, and completely separating it into two layers. A small piece of the rotten wood underneath (about 6 inches by 2 inches by $\frac{1}{2}$ inch) was broken off, and thrown about 4 feet into the room on the floor to the north. An irregular patch of damp plaster about 4 feet by 18 inches, which had formerly concealed this rotten woodwork, was torn off, and most of it was (as in the room above) thrown hard against the opposite north wall, to which portions were still adhering. These portions are chiefly high up the wall, and near the floor above. Some larger pieces were also spread over the intervening space. The wall where this plaster was torn off was almost saturated with moisture, and the plaster round the rent piece was quite wet and discoloured.

There are no certain traces of the thunderbolt visible on the outside of the south wall, where, however, it most assuredly must have been present. The ground at the foot showed no signs of rending. There was a small lean-to outhouse nearly below, the roof of which was damaged; but I was led to understand that this had been done before; and as the place was locked, and my time was limited, I did not go inside it. At the angle made by one of the side walls of this outhouse with the main building, and not far from a point vertically below the position of the end of the girder, was a wet piece of ground habitually used for emptying slops at; and this seemed by no means an unlikely place for the thunderbolt to have originated. Here and there on the face of the dilapidated masonry some rather new looking abrasions were to be seen; but not even just abreast of the end of the girder could I detect for certain any traces of the explosion; and no metal of any kind was visible. In this connection it may be mentioned that there were no eaves-gutters, rain-water pipes, or metals of any sort on the outside of the house or on the roof.

Perhaps the most noteworthy feature of this accident was the *complete absence of any sign of burning or charring* at the rents in the girder, joist, post, and rafter. The nails struck also showed no symptoms of fusing; and, for all the *traces* that were left by the stroke, it might have been quite unaccompanied by heat. The work of the explosion seems to have taken altogether the form of mechanical violence. The wood of the post, rafter, and girder is sound, dry, old fir, and this would seem peculiarly liable to be set on fire.

The almost perpendicular bend that the course of the stroke seems to have taken from the girder to the post is also very curious. That the direction and force of the stroke was *upward* appears to me a conclusion quite irresistible. I have but little doubt in my own mind, from the traces left by the thunderbolt, that it sprang from the ground outside the building, at or near the wet south wall; passed up its outer face, entered the building through the wall at the rotten wood, and passed through or close to the joist and girder; then, attracted by the nails in the bottom of the post, it took a sudden turn upward (for there were no other marks of its course in the first floor room than those described), cleft right through the heart of the post, altered its course obliquely to gouge out the lower part of the rafter as far as the small nail, broke through the tiles, knocked off the chimney-top, and thence rushed to join the complementary force that had already started from the thundercloud to meet it. A. PARNELL

13, Windsor Terrace, Newcastle-on-Tyne, June 14

The Soaring of Birds

IN NATURE, vol. xxvii. p. 535, Lord Rayleigh gives what he suggests as a possible explanation of the soaring of "pelicans and other large birds in Assam" mentioned by Mr. S. E. Peal. My own observations correspond so exactly with the theory advanced that I venture to give them for whatever they may be worth.

I have never indeed observed the flight of pelicans, but the Indian kite, the turkey buzzard, and perhaps all vultures, have the same habit of soaring in great circles. The *sandhill crane*, as it is commonly called in the United States, a large migratory crane, possesses this characteristic in a most remarkable degree. These birds will go soaring about for hours at an immense height, never seeming to move a pinion except once in a great while to steady themselves a little. They always move in irregular circles at such times, and there is always a drifting with the wind; but at such a great distance above one it would be impossible by mere ordinary observation to detect the obliquity of the circles if it existed.

A short time since, however, I had a fine opportunity of witnessing the soaring of some kites; the advantageous circumstances being that they were not far away, and that I saw them commence when they were so low that there was little chance of being mistaken in what I saw. I was sitting before an open window one day about eleven o'clock. There was a gentle breeze blowing from the south-east at the time. Presently my attention was attracted by several kites over the village to the north-west. The motions of two in particular I followed for some time. After moving their wings to attain an elevation above the houses and trees they began soaring, and continued upward in this manner to a height of perhaps two thousand feet, apparently making no exertion with their wings except to steady themselves a little occasionally. The method of accomplishing this was evidently to circle away to leeward in a great curve which inclined downward a little, thus acquiring considerable momentum; then turning toward the wind and adjusting the surfaces of the wings to the proper angle, they would shoot upward to a point considerably higher than the one from which the circle began. By the time the momentum was exhausted the bird was circling around again for another sweep to leeward.

There was considerable drifting with the wind, so that in attaining an elevation of some two or three thousand feet the birds had moved away nearly a quarter of a mile. Their consequent upward motion was in an irregular spiral, the highest parts of the curves being on the windward side.

Ongole, India, May 21 W. R. MANLEY

Geology of Cephalonia

IN answer to the inquiry of your correspondent in the last number of NATURE (p. 173) I beg to inform him that the shells of the Pliocene formation in the Morea have been long since investigated, as is shown by the great and well-known work of Hörnes. And Dr. Fischer has published a list of the fossil shells from the same formation at Rhodes. These subapennine beds extend over the whole of the south of Europe. For many of those species which are still living I have given the localities of the Morea and Rhodes as fossil in the *Proceedings of the Zoological Society*. J. GWYN JEFFREYS

June 25

On the Chemical Characters of the Venom of Serpents

DR. WEIR MITCHELL calls my attention to an error in the brief notice which I wrote in NATURE recently (vol. xxviii. p. 114), on the researches into the chemical characters of snake poison conducted by him and Dr. Reichart. It is that instead of "They are unable to confirm the statement of Gautier of Paris that an alkaloid resembling a ptomaine exists in cobra poison; *or that of Prof. Wolcott Gibbs, that the poison of Crotalus yields an alkaloid*," it should be, "Prof. Wolcott Gibbs was unable to find an alkaloid." J. FAYRER

53, Wimpole Street, W., June 26

Earthquake in South-West England

I HAVE just felt and heard the shock of an earthquake. The trembling of the earth was very great and the accompanying noise very loud, comparing it with one or two other slight shocks which I have before experienced in this district. I found the time to be 1.38 p.m. The time it lasted was several seconds. It was longer and louder than an ordinary clap of thunder when the lightning is not far off. A man reports that the slates of the cow-house were made to rattle.

As I now write (2.7 p.m.) a second shock has been felt, a little less severe. The weather is very calm, sky cloudy. This place is close to Dartmoor, on the westward side, about 500 feet above the sea-level. W. F. COLLIER

Woodtown, Horrabridge, S. Devon, June 25

I BEG to inform you of the occurrence of two slight earthquake shocks here to-day, one shortly before 2 p.m., the other near half an hour later. The direction of progress seemed to be from north-west to south-east—that is along the line of the deep and narrow valley. The tremor was sufficient to cause jangling of glass and earthenware, and of the slates covering the house. The usual rumbling noise accompanied the shocks.

SAMUEL DREW

Penalla Terrace, Boscastle, Cornwall, June 25

ON WHALES, PAST AND PRESENT, AND THEIR PROBABLE ORIGIN[1]

FEW natural groups present so many remarkable, very obvious, and easily appreciated illustrations of several of the most important general laws which appear to have determined the structure of animal bodies, as those selected for my lecture this evening. We shall find the effects of the two opposing forces—that of heredity or conformation to ancestral characters, and that of adaptation to changed environment, whether brought about by the method of natural selection or otherwise—distinctly written in almost every part of their structure. Scarcely anywhere in the animal kingdom do we see so many cases of the persistence of rudimentary and apparently useless organs, those marvellous and suggestive phenomena which at one time seemed hopeless enigmas, causing despair to those who tried to unravel their meaning, looked upon as mere will-of-the-wisps, but now eagerly welcomed as beacons of true light, casting illuminating beams upon the dark and otherwise impenetrable paths through which the organism has travelled on its way to reach the goal of its present condition of existence.

[1] Lecture delivered at the Royal Institution on the evening of Friday, May 25, 1883, by Prof. Flower, LL.D., F.R.S., P.Z.S., &c.

It is chiefly to these rudimentary organs of the Cetacea and to what we may learn from them that I propose to call your attention. In each case the question may well be asked, granted that they are, as they appear to be, useless, or nearly so, to their present possessors, insignificant, imperfect, in fact *rudimentary*, as compared with the corresponding or homologous parts of other animals, are they survivals, remnants of a past condition, become useless owing to change of circumstances and environment, and undergoing the process of gradual degeneration, preparatory to their final removal from an organism to which they are only, in however small a degree, an incumbrance, or are they incipient structures, beginnings of what may in future become functional and important parts of the economy? These questions will call for an attempt at least at solution in each case as we proceed.

Before entering upon details, it will be necessary to give some general idea of the position, limits, and principal modifications of the group of animals from which the special illustrations will be drawn. The term "whale" is commonly but vaguely applied to all the larger and middle-sized Cetacea, and though such smaller species as the dolphins and porpoises are not usually spoken of as whales, they may to all intents and purposes of zoological science be included in the term, and will come within the range of the present subject. Taken all together the *Cetacea* constitute a perfectly distinct and natural order of mammals, characterised by their purely aquatic mode of life and external fishlike form. The body is fusiform, passing anteriorly into the head without any distinct constriction or neck, and posteriorly tapering off gradually towards the extremity of the tail, which is provided with a pair of lateral pointed expansions of skin supported by dense fibrous tissue, called "flukes," forming together a horizontally-placed, triangular propelling organ. The forelimbs are reduced to the condition of flattened ovoid paddles, incased in a continuous integument, showing no external sign of division into arm, forearm, and hand, or of separate digits, and without any trace of nails. There are no vestiges of hind-limbs visible externally. The general surface of the body is smooth and glistening, and devoid of hair. In nearly all species a compressed median dorsal fin is present. The nostrils open separately or by a single crescentic valvular aperture, not at the extremity of the snout, but near the vertex.

Animals of the order *Cetacea* abound in all known seas, and some species are inhabitants of the larger rivers of South America and Asia. Their organisation necessitates their life being passed entirely in the water, as on the land they are absolutely helpless; but they have to rise very frequently to the surface for the purpose of respiration. They are all predaceous, subsisting on living animal food of some kind. One genus alone (*Orca*) eats other warm-blooded animals, as seals and even members of its own order, both large and small. Some feed on fish, others on small floating crustacea, pteropods, and medusæ, while the staple food of many is constituted of the various species of Cephalopods, chiefly *Loligo* and other *Teuthidæ*, which must abound in some seas in vast numbers, as they form almost the entire support of some of the largest members of the order. With some exceptions the Cetacea generally are timid, inoffensive animals, active in their movements, sociable and gregarious in their habits.

Among the existing members of the order there are two very distinct types—the Toothed Whales, or *Odontoceti*, and the Baleen Whales, or *Mystacoceti*, which present throughout their organisation most markedly distinct structural characters, and have in the existing state of nature no transitional forms. The extinct *Zeuglodon*, so far as its characters are known, does not fall into either of these groups as now constituted, but is in some respects intermediate, and in others more resembles the generalised mammalian type.

The important and interesting problem of the origin of the Cetacea and their relations to other forms of life is at present involved in the greatest obscurity. They present no more signs of affinity with any of the lower classes of vertebrated animals than do many of the members of their own class. Indeed in all that essentially distinguishes a mammal from one of the oviparous vertebrates, whether in the osseous, nervous, vascular, or reproductive systems, they are as truly mammalian as any, even the highest, members of the class. Any supposed signs of inferiority are, as we shall see, simply modifications in adaptation to their peculiar mode of life. Similar modifications are met with in another quite distinct group of mammalia, the *Sirenia*, and also, though in a less complete degree, in the aquatic Carnivora or seals. But these do not indicate any community of origin between these groups and the Cetacea. In fact, in the present state of our knowledge, the Cetacea are absolutely isolated, and little satisfactory reason has ever been given for deriving them from any one of the existing divisions of the class more than from any other. The question has indeed often been mooted whether they have been derived from land mammals at all, or whether they may not be the survivors of a primitive aquatic form which was the ancestor not only of the whales, but of all the other members of the class. The materials for—I will not say solving—but for throwing some light upon this problem, must be sought for in two regions—in the structure of the existing members of the order, and in its past history, as revealed by the discovery of fossil remains. In the present state of science it is chiefly on the former that we have to rely, and this therefore will first occupy our attention.

One of the most obvious external characteristics by which the mammalia are distinguished from other classes of vertebrates is the more or less complete clothing of the surface by the peculiar modification of epidermic tissue called hair. The Cetacea alone appear to be exceptions to this generalisation. Their smooth, glistening exterior is, in the greater number of species, at all events in adult life, absolutely bare, though the want of a hairy covering is compensated for functionally by peculiar modifications of the structure of the skin itself, the epidermis being greatly thickened, and a remarkable layer of dense fat closely incorporated with the tissue of the derm or true skin; modifications admirably adapted for retaining the warmth of the body, without any roughness of surface which might occasion friction and so interfere with perfect facility of gliding through the water. Close examination, however, shows that the mammalian character of hairiness is not entirely wanting in the Cetacea, although it is reduced to a most rudimentary and apparently functionless condition. Scattered, small, and generally delicate hairs have been detected in many species, both of the toothed and of the whalebone whales, but never in any situation but on the face, either in a row along the upper lip, around the blowholes or on the chin, apparently representing the large, stiff "vibrissæ" or "whiskers" found in corresponding situations in many land mammals. In some cases these seem to persist throughout the life of the animal; more often they are only found in the young or even the fœtal state. In some species they have not been detected at any age.

Eschricht and Reinhardt counted in a new-born Greenland Right Whale (*Balæna mysticetus*) sixty-six hairs near the extremity of the upper jaw, and about fifty on each side of the lower lip, as well as a few around the blowholes, where they have also been seen in *Megaptera longimana* and *Balænoptera rostrata.* In a large Rorqual (*Balænoptera musculus*), quite adult and sixty-seven feet in length, stranded in Pevensey Bay in 1865, there were twenty-five white, straight, stiff hairs about half an inch in length, scattered somewhat irregularly on each side of the vertical ridge in which the chin terminated, extending over a space of nine inches in height and two and a half inches in breadth. The existence of these rudimentary hairs must have some significance beyond any possible utility they may be to the animal. Perhaps some better explanation may ultimately be found for them, but it must be admitted that they are extremely suggestive that we have here a case of heredity or conformation to a type of ancestor with a full hairy clothing, just on the point of yielding to complete adaptation to the conditions in which whales now dwell.

In the organs of the senses the Cetacea exhibit some remarkable adaptive modifications of structures essentially formed on the Mammalian type, and not on that characteristic of the truly aquatic Vertebrates, the fishes, which, if function were the only factor in the production of structure, they might be supposed to resemble.

The modifications of the organs of sight do not so much affect the eyeball as the accessory apparatus. To an animal whose surface is always bathed with fluid, the complex arrangement which mammals generally possess for keeping the surface of the transparent cornea moist and protected, the movable lids, the nictitating membrane, the lacrymal gland, and the arrangements for collecting and removing the superfluous tears when they have served their function cannot be needed, and hence we find these parts in a most rudimentary condition or altogether absent. In the same way the organ of hearing in its essential structure is entirely mammalian, having not only the sacculi and semicircular canals common to all but the lowest vertebrates, but the cochlea, and tympanic cavity with its ossicles and membrane, all, however, buried deep in the solid substance of the head; while the parts specially belonging to terrestrial mammals, those which collect the vibrations of the sound travelling through air, the pinna and the tube which conveys it to the sentient structures within are entirely or practically wanting. Of the pinna or external ear there is no trace. The meatus auditorius is certainly there, reduced to a minute aperture in the skin like a hole made by the prick of a pin, and leading to a tube so fine and long that it cannot be a passage for either air or water, and therefore can have no appreciable function in connection with the organ of hearing, and must be classed with the other numerous rudimentary structures that whales exhibit.

The organ of smell, when it exists, offers still more remarkable evidence of the origin of the Cetacea. In fishes this organ is specially adapted for the perception of odorous substances permeating the water; the terminations of the olfactory nerves are spread over a cavity near the front part of the nose, to which the fluid in which the animals swim has free access, although it is quite unconnected with the respiratory passages. Mammals, on the other hand, smell substances with which the atmosphere they breathe is impregnated; their olfactory nerve is distributed over the more or less complex foldings of the lining of a cavity placed in the head, in immediate relation to the passages through which air is continually driven to and fro on its way to the lungs in respiration, and therefore in a most favourable position for receiving impressions from substances floating in that air. The whalebone whales have an organ of smell exactly on the mammalian type, but in a rudimentray condition. The perception of odorous substances diffused in the air, upon which many land mammals depend so much for obtaining their food, or for protection from danger, can be of little importance to them. In the more completely modified Odontocetes the olfactory apparatus, as well as that part of the brain specially related to the function of smell is entirely wanting, but in both groups there is not the slightest trace of the specially aquatic olfactory organ of fishes. Its complete absence and the vestiges of the aërial organ of land mammals found in the Mystacocetes are the clearest possible indications of the origin of the Cetacea from air-breathing and air-smelling terrestrial mammalia. With their adaptation to an aquatic mode of existence, organs fitted only for smelling in air became useless, and so have dwindled or completely disappeared. Time and circumstances have not permitted the acquisition of anything analogous to the special aquatic smelling apparatus of fishes, the result being that whales are practically deprived of whatever advantage this sense may be to other animals.

It is characteristic of the greater number of mammalia to have their jaws furnished with teeth having a definite structure and mode of development. In all the most typical forms these teeth are limited in number, not exceeding eleven on each side of each jaw, or forty-four in all, and are differentiated in shape in different parts of the series, being more simple in front, broader and more complex behind. Such a dentition is described as "heterodont." In most cases also there are two distinct sets of teeth during the lifetime of the animal, constituting a condition technically called "diphyodont."

All the Cetacea present some traces of teeth, which in structure and mode of development resemble those of mammals, and not those of the lower vertebrated classes, but they are always found in a more or less imperfect state. In the first place, at all events in existing species, they are never truly heterodont, all the teeth of the series resembling each other more or less or belonging to the condition called "homodont," and not obeying the usual numerical rule, often falling short of, but in many cases greatly exceeding it. The most typical Odontocetes, or toothed whales, have a large number of similar, simple, conical, recurved, pointed teeth, alike on both sides and in the upper and under jaws, admirably adapted for catching slippery, living prey, such as fish, which are swallowed whole without mastication. In one genus (*Pontoporia*) there may be as many as sixty of such teeth on each side of each jaw, making 240 in all. The more usual number is from twenty to thirty. These teeth are never changed, being "monophyodont" and they are, moreover, less firmly implanted in the jaws than in land mammals, having never more than one root, which is set in an alveolar socket which is generally wide and loosely fitting, though perfectly sufficient for the simple purpose which the teeth have to serve.

Most singular modifications of this condition of dentition are met with in different genera of toothed whales, chiefly the result of suppression, sometimes of suppression of the greater number, combined with excessive development of a single pair. In one large group, the Ziphioids, although minute rudimentary teeth are occasionally found in young individuals, and sometimes throughout life, in both jaws, in the adults the upper teeth are usually entirely absent, and those of the lower jaw reduced to two, which may be very large and projecting like tusks from the mouth, as in *Mesoplodon*, or minute and entirely concealed beneath the gums, as in *Hyperoodon*,—an animal which is for all practical purposes toothless, yet in which a pair of perfectly formed though buried teeth remain throughout life, wonderful examples of the persistence of rudimentary and to all appearance absolutely useless organs. Among the *Delphinidæ* similar cases are met with. In the genus *Grampus* the teeth are entirely absent in the upper, and few and early deciduous in the lower jaw. But the Narwhal exceeds all other Cetaceans, perhaps all other vertebrated animals, in the specialisation of its dentition. Besides some irregular rudimentary teeth found in the young state, the entire dentition is reduced to a single pair, which lie horizontally in the upper jaw, and both of which in the female remain permanently concealed within the bone, so that this sex is practically toothless, while in the male the right tooth usually remains similarly concealed and abortive, and the left is immensely developed, attaining a length equal to more than half that of the entire animal, projecting horizontally from the head in the form of a cylindrical or slightly tapering pointed tusk, with the surface marked by spiral grooves or ridges.

The meaning and utility of some of these strange modifications it is impossible, in the imperfect state of our knowledge of the habits of the Cetacea, to explain, but the fact that in almost every case a more full number of rudimentary teeth is present in early stages of existence, which either disappear, or remain as concealed and functionless organs, points to the present condition in the aberrant and specialised forms as being one derived from the more generalised type, in which the teeth were numerous and equal.

The Mystacocetes, or Whalebone Whales, are distinguished by entire absence of teeth, at all events after birth. But it is a remarkable fact, first demonstrated by Geoffrey St. Hilaire, and since amply confirmed by Cuvier, Eschricht, Julin, and others, that in the fœtal state they have numerous minute calcified teeth lying in the dental groove of both upper and lower jaws. These attain their fullest development about the middle of fœtal life, after which period they are absorbed, no trace of them remaining at the time of birth. Their structure and mode of development has been shown to be exactly that characteristic of ordinary mammalian teeth, and it has also been observed that those at the posterior part of the series are larger, and have a bilobed form of crown, while those in front are simple and conical, a fact of considerable interest in connection with speculations as to the history of the group.

It is not until after the disappearance of these teeth that the baleen, or whalebone, makes its appearance. This remarkable structure, though, as will be presently shown, only a modification of a part existing in all mammals, is, in its specially developed condition as baleen, peculiar to one group of whales. It is therefore perfectly in accord with what might have been expected, that it is comparatively late in making its appearance. Characters that are common to a large number of species appear early, those that are special to a few, at a late period; alike both in the history of the race and of the individual.

Baleen consists of a series of flattened, horny plates, several hundred in number, on each side of the palate, separated by a bare interval along the middle line. They are placed transversely to the long axis of the palate, with very short spaces between them. Each plate or blade is somewhat triangular in form, with the base attached to the palate, and the apex hanging downwards. The outer edge of the blade is hard and smooth, but the inner edge and apex fray out into long, bristly fibres, so that the roof of the whale's mouth looks as if covered with hair, as described by Aristotle. The blades are longer near the middle of the series, and gradually diminish near the front and back of the mouth. The horny plates grow from a dense fibrous and highly vascular matrix, which covers the palatal surface of the maxillæ, and which sends out lamellar processes, one of which penetrates the base of each blade. Moreover, the free edge of these processes is covered with very long vascular thread-like papillæ, one of which forms the central axis of each of the hair-like epidermic fibres of which the blade is mainly composed. A transverse section of fresh whalebone shows that it is made up of numbers of these soft vascular papillæ, circular in outline, each surrounded by concentrically arranged epidermic cells, the whole bound together by other epidermic cells, which constitute the smooth cortical (so-called "enamel") surface of the blade, and which, disintegrating at the free edge, allows the individual fibres to become loose and to assume the hair-like appearance spoken of before. These fibres differ from hairs in not being formed in depressed follicles in the enderon, but rather resemble those of which the horn of the rhinoceros is composed. The blades are supported and bound together for a certain distance from their base, by a mass of less hardened epithelium, secreted by the surface of the palatal membrane or matrix of the whalebone in the intervals of the lamellar processes. This is the "intermediate substance" of Hunter, the "gum" of the whalers.

The function of the whalebone is to strain the water from the small marine mollusks, crustaceans, or fish upon which the whales subsist. In feeding they fill the immense mouth with water containing shoals of these small creatures, and then, on their closing the jaws and raising the tongue, so as to diminish the cavity of the mouth, the water streams out through the narrow intervals between the hairy fringe of the whalebone blades, and escapes through the lips, leaving the living prey to be swallowed. Almost all the other structures to which I am specially directing your attention, are, as I have mentioned, in a more or less rudimentary state in the Cetacea; the baleen, on the other hand, is an example of an exactly contrary condition, but an equally instructive one, as illustrating the mode in which nature works in producing the infinite variety we see in animal structures. Although appearing at first sight an entirely distinct and special formation, it evidently consists of nothing more than the highly modified papillæ of the lining membrane of the mouth, with an excessive and cornified epithelial development.

The bony palate of all mammals is covered with a closely-adhering layer of fibrovascular tissue, the surface of which is protected by a coating of non-vascular epithelium, the former exactly corresponding to the derm or true skin, and the latter to the epiderm of the external surface of the body. Sometimes this membrane is perfectly smooth, but it is more often raised into ridges, which run in a direction transverse to the axis of the head, and are curved with the concavity backwards; the ridges moreover do not extend across the middle line, being interrupted by a median depression or *raphé*. Indications of these ridges are clearly seen in the human palate, but they attain their greatest development in the Ungulata. In oxen, and especially in the giraffe, they form distinct laminæ, and their free edges develope a row of papillæ, giving them a pectinated appearance. Their epithelium is thick, hard, and white, though not horny. Although the interval between the structure of the ridges in the giraffe's palate and the most rudimentary form of baleen at present known is great, there is no difficulty in seeing that the latter is essentially a modification of the former, just as the hoof of the horse, with its basis of highly developed vascular laminæ and papillæ, and the resultant complex arrangement of the epidermic cells, is a modification of the simple nail or claw of other mammals, or as the horn of the rhinoceros is only a modification of the ordinary derm and epiderm covering the animal's body differentiated by a local exuberance of growth.

(*To be continued.*)

THE PERAK TIN-MINES[1]

THIS interesting memoir, which forms part of the *Archives des Missions scientifiques et littéraires*, série iii. vol. ix., gives the result of a seven months' exploration of the Malay State of Perak, made by the author, who was sent by the French Government upon a mission of scientific inquiry into the Malay Archipelago in 1881. Perak, although an insignificant unit among even the smallest States of the world, its extreme dimensions being only 95×50 miles, or an area of less than 5000 square miles, has long been known as a tin-producing country, being mentioned in the narratives of Tavernier, and the Dutch and Portuguese navigators of the seventeenth century; but it is only since the large influx of Chinese miners, consequent upon the suppression of the Taeping rebellion, that it has become of first-rate importance. The success attained by the first-comers led to a rapid increase of the Chinese population, who arrived in such numbers as to be soon beyond the control of the feeble Malay Government, and the mining being carried on without any regulations as to boundaries, the miners became divided into two parties, who made war upon each other with varying success, the Sultan looking on impartially during the contest, but siding with the winners. The defeated party in 1872 having taken to piracy at sea, was suppressed by English gunboats, and a resident was appointed for the purpose of keeping order; but the Malays having revolted in 1875, when the resident was murdered, the country has since been placed under a British protectorate, with a native rajah, under the title of Regent. This has been attended with the happiest results, the country having made great progress during the last six years, under the vigorous and enlightened management of the resident, Hugh Low, Esq., C.M.G., and now bids fair, according to the author, to become the most considerable producer of tin in the world.

The mines worked up to the present are entirely alluvial or stream works, the watercourses being filled with sand and gravel deposits to a depth of 20 or 30 feet, resting upon a floor of pure china clay, apparently derived from the decomposition of the granitic rocks forming the numerous parallel ridges which traverse the country from north to south. The geological description is necessarily imperfect owing to the dense tropical vegetation which covers the entire county; but the author has been able to establish the presence of numerous quartz veins traversing the granites which are coarsely porphyritic in the centre and largely charged with tourmaline at the edges of the masses, in fact reproducing the phenomena observed in the north-western tin districts of Cornwall. No mines have as yet been opened in any of these veins, but the author speaks of blocks of tin ore weighing more than 1 cwt. as having been found in the immediate vicinity of the hills, which are evidently not far removed from their original position. The bulk of the production is, however, derived from smaller rounded crystalline masses and grains contained in the lower part of the alluvial gravel, the workable thickness ranging from 7 to 10 feet, and the proportion of clean ore or "black tin" from about 1 to 4½ per cent. by weight. This is remarkable for its purity, being almost entirely free from wolfram, arsenic, and other foreign substances, which are so troublesome to the Cornish tin-miner. The methods of working, mechanical preparations, and smelting of the ore are of the simplest possible kind, the work, with the exception of a few centrifugal steam-pumps, and of Chinese chain-pumps driven by water-wheels, being entirely carried out by manual labour, with furnaces and other appliances of the most primitive types. This simplicity adds considerably to the interest of the author's detailed and carefully illustrated description, which enables the reader to realise in imagination the conditions prevailing in our western districts in the days when the Phœnicians traded with the Cornish miners for tin at St. Michael's Mount. Under the new British rule, the country has made rapid progress, the output of tin having risen from 2059 tons in 1876 to 5994 tons in 1881, the whole of which is exported through Penang. As at the latter date the cost of production, including revenue charges of about 17*l*., was estimated at about 61*l*. per ton, while the local selling price was 88*l*., showing a profit of 45 per cent., the popularity of the business is sufficiently explained. It is not probable, however, that such large profits will continue to be realised after the more productive deposits have been exhausted. It does not appear from the narrative that European labour of any kind is employed, the workpeople belonging to three races, namely, Malay aborigines, Klings or coolies from Madras and the Malabar coast, and Chinese, the latter supplying the whole of the miners, smelters

[1] "Les Mines d'Étain de Perak." Par J. Errington de la Croix. 8vo. Paris, 1882.)

and other artisans directly employed in producing the metal. The author has a very high opinion of the Chinese miners, who are described as sober, regular in work, and accustomed to cooperative enterprises, against which, however, must be set the defects of being addicted to excess in opium and gambling, besides being very quarrelsome and exceedingly superstitious. The latter failing is, however, of interest as reproducing the old European legends of guardian genii of the mine, the "Kobads" of Germany and "Knockers" of Cornwall, who require to be propitiated by sacrifices and kept in good humour by orderly behaviour on the part of the miners. Infractions of the last rules are punished by the withdrawal of the guardian gnome, who takes all the unwrought ore in the mine away with him.

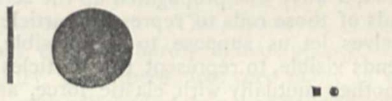
The execution of the work, both as regards illustration and typography, are exceedingly good, and reflect great credit upon the French National Printing Office.

H. B.

THE SIZE OF ATOMS[1]

FOUR lines of argument founded on observation have led to the conclusion that atoms or molecules are not inconceivably, not immeasurably small. I use the words "inconceivably" and "immeasurably" advisedly. That which is measurable is not inconceivable, and therefore the two words put together constitute a tautology. We leave inconceivableness in fact to metaphysicians. Nothing that we can measure is inconceivably large or inconceivably small in physical science. It may be difficult to understand the numbers expressing the magnitude, but whether it be very large or very small there is nothing inconceivable in the nature of the thing because of its greatness or smallness, or in our views and appreciation and numerical expression of the magnitude. The general result of the four lines of reasoning to which I have referred, founded respectively on the undulatory theory of light, on the phenomena of contact electricity, on capillary attraction, and on the kinetic theory of gases, agrees in showing that the atoms or molecules of ordinary matter must be something like the 1/10,000,000, or from the 1/10,000,000 to the 1/100,000,000 of a centimetre in diameter. I speak somewhat vaguely, and I do so, not inadvertently, when I speak of atoms and molecules. I must ask the chemists to forgive me if I even abuse the words and apply a misnomer occasionally. The chemists do not know what is to be the atom; for instance, whether hydrogen gas is to consist of two pieces of matter in union constituting one molecule, and these molecules flying about; or whether single molecules each indivisible, or at all events undivided in chemical action, constitute the structure. I shall not go into any such questions at all, but merely take the broad view that matter, although we may conceive it to be infinitely divisible, is not infinitely divisible without decomposition. Just as a building of brick may be divided into parts, into a part containing 1000 bricks, and another part containing 2500 bricks, and those parts viewed largely may be said to be similar or homogeneous; but if you divide the matter of a brick building into spaces of nine inches thick, and then think of subdividing it farther, you find you have come to something which is atomic, that is, indivisible without destroying the elements of the structure. The question of the molecular structure of a building does not necessarily involve the question, Can a brick be divided into parts, and can those parts be divided into much smaller parts? and so on. It used to be a favourite subject for metaphysical argument amongst the schoolmen whether matter is infinitely divisible, or whether *space* is infinitely divisible, which some maintained, whilst others maintained only that *matter* is not infinitely divisible, and demonstrated that there is nothing inconceivable in the infinite subdivision of space. Why, even time was divided into moments (time-atoms!), and the idea of continuity of time was involved in a halo of argument, and metaphysical—I will not say absurdity—but metaphysical word-fencing, which was no doubt very amusing for want of a more instructive subject of study. There is in sober earnest this very important thing to be attended to, however, that in chronometry as in geometry, we have absolute continuity, and it is simply an inconceivable absurdity to suppose a limit to smallness whether of time or of space. But on the other hand, whether we can divide a piece of glass into pieces smaller than the 1/100,000 of a centimetre in diameter, and so on without breaking it up, and making it cease to have the properties of glass, just as a brick has not the property of a brick wall, is a very practical question, and a question which we are quite disposed to enter upon.

I wish in the beginning to beg you not to run away from the subject by thinking of the exceeding smallness of atoms. Atoms are not so exceedingly small after all. The four lines of argument I have referred to make it perfectly certain that the molecules which constitute the air we breathe are not very much smaller, if smaller at all, than 1/10,000,000 of a centimetre in diameter. I was told by a friend just five minutes ago that if I give you results in centimetres you will not understand me. I do not admit this calumny on the Royal Institution of Great Britain; no doubt many of you as Englishmen are more familiar with the unhappy British inch; but you all surely understand the centimetre, at all events it was taught till a few years ago in the primary national schools. Look at that diagram (Fig. 1), as I want you all to understand an



One centimetre. One millimetre.

FIG. 1.

inch, a centimetre, a millimetre, the 1/10 of a millimetre, and the 1/100 of a millimetre, the 1/1,000 of a millimetre, and the 1/1,000,000 of a millimetre. The diagram on the wall represents the metre; below that the yard; next the decimetre, and a circle of a decimetre diameter, the centimetre and a circle of a centimetre, and the millimetre, which is 1/10 of a centimetre, or in round numbers 1/40 of an inch. We will adhere however to one simple system, for it is only because we are in England that the yard and inch are put before you at all, among the metres and centimetres. You see on the diagram then the metre, the centimetre, the millimetre, with circles of the same diameter. Somebody tells me the millimetre is not there; I cannot see it, but it certainly is there, and a circle whose diameter is a millimetre, both accurately painted in black. I say there is a millimetre and you cannot see it. And now imagine *there* is 1/10 of a millimetre, and *there* 1/100 of a millimetre and 1/1000 of a millimetre, and *there* is a round atom of oxygen 1/1,000,000 of a millimetre in diameter. You see them all.

Now we must have a practical means of measuring, and optics supply us with it for thousandths of a millimetre. One of our temporary standards of measurement shall be the wave-length of light; but the wave-length is a very indefinite measurement, because there are wave-lengths for different colours of light, visible and invisible, in the ratio of 1 to 16. We have, as it were—borrowing an analogy from sound—four octaves of light that we know of. How far the range in reality extends above and below the range hitherto measured, we cannot even guess in the present state of science. The table before you (Table I.) gives you an idea of magnitudes of length,

[1] A lecture delivered by Sir William Thomson at the Royal Institution, on Friday, February 2. Revised by the Author.

TABLE I.—*Data for Visible Light.*

Line of Spectrum.	Wave-length in Centimetres.	Wave Frequency, or number of periods per second.
A	$7·604 \times 10^{-5}$	$395·0 \times 10^{12}$
B	6·867 ,,	437·3 ,,
C	6·562 ,,	457·7 ,,
D_1	5·895 ,,	509·7 ,,
D_2	5·889 ,,	
E	5·269 ,,	570·0 ,,
b	5·183 ,,	
F	4·861 ,,	617·9 ,,
G	4·307 ,,	697·3 ,,
H_1	3·968 ,,	756·9 ,,
H_2	3·933 ,,	763·6 ,,

and again of small intervals of time. In the column on the left you have the wave-length of light in fractions of a centimetre; the unit in which these numbers to the left is measured is the 1/100,000 (or 10^{-5}) of a centimetre. We have then, of visible light, wave-lengths from $7\frac{1}{2}$ to 4 nearly, or 3·9. You may say then roundly, that for the wave-lengths of visible light, which alone is what is represented on that table, we have wave-lengths of from 4 to 8 on our scale of 1/100,000 of a centimetre. The 8 is invisible radiation a little below the red end of the spectrum. The lowest, marked by Fraunhofer with the letter *A*, has for wave-length $7\frac{1}{2}$/100,000 of a centimetre. On the model before you I will now show you what is meant by a "wave-length;" it is not length along the crest, such as we sometimes see well marked in a breaking wave of the sea, on a long straight beach; it is distance from crest to crest of the waves. [This was illustrated by a large number of horizontal rods of wood connected together and suspended bifilarly by two threads in the centre hanging from the ceiling;[1] on moving the lowermost rod, a wave was propagated up the series.] Imagine the ends of those rods to represent particles. The rods themselves let us suppose to be invisible, and merely their ends visible, to represent the particles acting upon one another mutually with elastic force, as if of india-rubber bands, or steel spiral springs, or jelly, or elastic material of some kind. They do act on one another in this model through the central mounting. Here again is another model illustrating waves (Fig. 2).[2] The white circles on the wooden rods represent pieces of matter—I will not say molecules at present, though we shall deal with them as molecules afterwards. Light consists of vibrations transverse to the line of propagation, just as in the models before you.

[1] The details of this bifilar suspension need not be minutely described, as the new form, with a single steel pianoforte wire to give the required mutual forces, described below and represented in Fig. 2, is better and more easily made.

[2] This apparatus, which is represented in the woodcut, Fig. 2, is of the following dimensions and description. The series of equal and similar bars (B) of which the ends represent molecules of the medium, and the pendulum bar (P), which performs the part of exciter of vibrations, or of kinetic store of vibrational energy, are pieces of wood each 50 centimetres long, 3 centimetres broad, and 1·5 centimetres thick. The suspending wire is steel pianoforte wire No. 22 B.W.G. (·07 of a cm. diameter), and the bars are secured to it in the following manner. Three brass pins of about ·4 of a centimetre diameter are fitted loosely in each bar in the position as indicated; *i.e.* forming the corners of an isosceles triangular figure, with its base parallel to the line of the suspending wire, and about 1 mm. to one side of it. The suspending wire, which is laid in grooves cut in the pins, is passed under the upper pin, outside the pin at the apex of the triangle, over the upper side of the lower pin, and thence down to the next bar. The upper end of this wire is secured by being taken through a hole in the supporting beam and several turns of it put round a pin placed on one side of the hole, as indicated in the diagram. To each end of the pendulum bar is made fast a steel spiral spring as shown; the upper ends of these springs being secured to short cords which pass up through holes in the supporting beam, and are fastened by two or three turns taken round the pins. These steel springs serve as potential stores of vibrational energy alternating in each vibration with the kinetic store constituted by the pendulum bar. The ends of the vibrating bars (B) are loaded with masses of lead attached to them. The much larger masses of lead seen on the pendulum bar, which are adjustable to different positions on the bar, are, in the diagram, shown at the smallest distance apart. The lowermost bar carries two vanes of tin projecting downwards, which dip into viscous liquid (treacle diluted with water) contained bn the vessel (*c*). A heavy weight resting on the bottom of this vessel, and connected to the lower end of the suspending wire by a stretched indiarubber band, serves to keep the lower end of the apparatus in position. The period of vibration of the pendulum bar is adjustable to any desired magnitude by shifting in or out the attached weights, or by tightening or relaxing the cords which pull the upper ends of the spiral springs.

Now in that beautiful experiment well known as Newton's rings we have at once a measure of length in

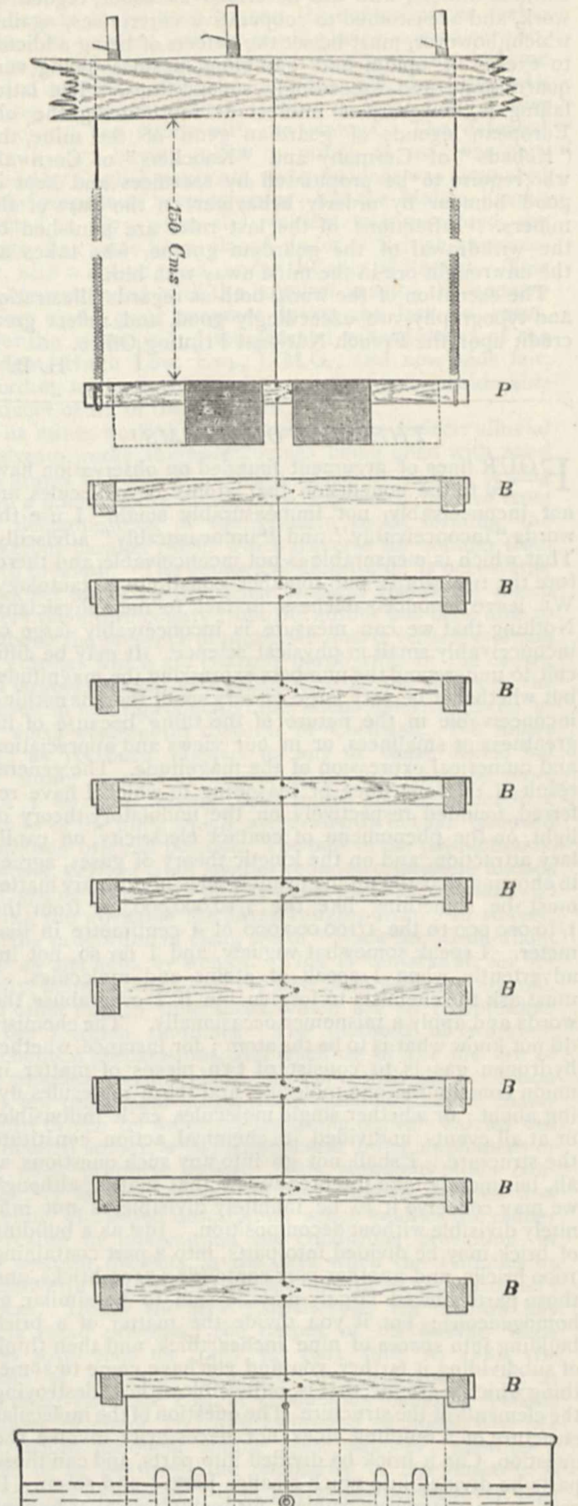


FIG. 2.

the distance between two pieces of glass to give any particular tint of colour. The wave-length you see, in the distance from crest to crest of the waves travelling up the long model when I commence giving a simple harmonic oscillation to the lowest bar. I have here a convex lens of very long focus, and a piece of plate glass with its back blackened. When I press the piece of glass against the glass blackened behind, I see coloured rings; the phenomenon will be shown to you on the screen by means of the electric light reflected from the space of air between the two pieces of glass. This phenomenon was first observed by Sir Isaac Newton, and was first explained by the undulatory theory of light. [Newton's rings are now shown on the screen before you by reflected electric light.] If I press the glasses together, you see a dark spot in the centre; the rings appear round it, and there is a dark centre with irregularities. Pressure is required to produce that spot. Why? The answer generally given is, because glass repels glass at a distance of two or three wave-lengths of light; say at a distance of 1/5,000 of a centimetre. I do not believe that for a moment. The seeming repulsion comes from shreds or particles of dust between them. The black spot in the centre is a place where the distance between them is less than a quarter of a wave-length. Now the wave-length for yellow light is about 1/17,000 of a centimetre. The quarter of 1/17,000 is about 1/70,000. The place where you see the middle of that black circle corresponds to air at a distance of less than 1/70,000 of a centimetre. Passing from this black spot to the first ring of maximum light, add half a wave-length to the distance, and we can tell what the distance between the two pieces of glass is at this place; add another half wave-length, and we come to the next maximum of light again; but the colour prevents us speaking very definitely because we have a number of different wave-lengths concerned. I will simplify that by reducing it all to one colour, red, by interposing a red glass. You have now one colour, but much less light altogether, because this glass only lets through homogeneous red light, or not much besides. Now look at what you see on the screen, and you have unmistakable evidence of fulcrums of dust between the glass surfaces. When I put on the screw, I whiten the central black spot by causing the elastic glass to pivot, as it were, round the innumerable little fulcrums constituted by the molecules of dust; and the pieces of glass are pressed not against one another, but against these fulcrums. There are innumerable—say thousands—of little particles of dust jammed between the glass, some of them of perhaps 1/3,000 of a centimetre in diameter, say 5 or 6 wave-lengths. If you lay one piece of glass on another, you think you are pressing glass on glass, but it is nothing of the kind; it is glass on dust. This is a very beautiful phenomenon, and my first object in showing this experiment was simply because it gives us a linear measure bringing us down at once to 1/100,000 of a centimetre.

Now I am just going to enter a very little into detail regarding the reasons that those four lines of argument give us for assigning a limit to the smallness of the molecules of matter. I shall take contact electricity first, and very briefly. If I take these two pieces of zinc and copper and touch them together at the two corners, they become electrified, and attract one another with a perfectly definite force, of which the magnitude is ascertained from absolute measurements in connection with the well-established doctrine of contact electricity. I do not feel it, because the force is very small. You may do the thing in a measured way; you may place a little metallic knob or projection on one of them of 1/100,000 of a centimetre, and lean the other against it. Let there be three such little metal feet put on the copper; let me touch the zinc plate with one of them, and turn it gradually down till it comes to touch the other two. In this position, with an air-space of 1/100,000 of a centimetre between them, there will be positive and negative electricity on the zinc and copper surfaces respectively, of such quantities as to cause a mutual attraction amounting to 2 grammes weight per square centimetre. The amount of work done by the electric attraction upon the plates while they are being allowed to approach one another with metallic connection between them at the corner first touched, till they come to the distance of 1/100,000 of a centimetre, is 2/100,000 of a centimetre-gramme, supposing the area of each plate to be one square centimetre.

(*To be continued.*)

DEATH OF THE PRESIDENT OF THE ROYAL SOCIETY

IT is with the profoundest regret that we announce the death of Mr. Spottiswoode, the President of the Royal Society, at 11.15 yesterday morning. The bulletin issued on Tuesday to the effect that although there was no hemorrhage, still that there was no improvement in Mr. Spottiswoode's condition, boded ill because those who knew him best feared that a reserve of strength, which might perhaps have made way against the further progress of the fever through its later stages, was wanting.

As the sad news reaches us just as we are going to press, and as indeed we so recently entered at some considerable length into the lifework of him who is now no more, there is no necessity for us on the present occasion to do more than make the above announcement. This, however, must be said: that there is hardly a man of science in this country, and there are very many in other countries, who will not feel that they have lost a true friend, and one of whose friendship any man might have been proud. There is little doubt too that if he had been more sparing of himself in the various duties which were incumbent upon him as President of the Royal Society, if he had not so freely given all his thoughts and all his exertions to any scientific question which was going on, there might have been more time for relaxation, and there might have been strength to have tided over the illness which has now laid him low.

NOTES

WE regret to have to announce the death of General Sir Edward Sabine, K.C.B., which occurred on the 26th inst. at Richmond, where he had been residing for the last twelve months. He was in his ninety-fifth year, having been born October 14, 1788.

AT the meeting of the Paris Academy of Sciences on Monday last week the following message concerning the eclipse observations from M. Janssen, dated San Francisco, was read:—"*Janssen:* discovery of the Fraunhofer spectrum and the dark lines of the solar spectrum in the corona, showing cosmical matter around the sun. Large photographs of the corona and the circumsolar regions to a distance of 15°, in search for intra-Mercurial planets. *Palisa* and *Trouvelot:* Exploration of the circumsolar regions; no intra-Mercurial planets found. *Trouvelot:* Sketch of the corona. *Tacchini:* Polarisation of the corona and streamers; spectrum of the streamers, showing analogy with the spectrum of comets; continuous spectrum corona; spectrum of protuberances; plates and drawings of protuberances."

THE American Association for the Advancement of Science will hold its thirty second annual meeting at Minneapolis, Minn., August 15 and following days. The president-elect is Prof. C. A. Young of Princeton, and the following is the list of the sectional vice-presidents of the meeting:—Section A (Mathematics and Astronomy), W. A. Rogers of Cambridge; B (Physics), H. A. Rowland of Baltimore; C (Chemistry), E. W. Morley of Cleveland; D (Mechanical Science), De Volsen Wood of Hoboken; E (Geology and Geography), C. H. Hitchcock of Hanover; F (Biology), W. J. Beal of Lansing; G (Histology and Microscopy), J. D. Cox of Cincinnati; H (Anthropology), O. T. Mason of Washington; I (Economic Science and Statistics), F. B. Hough of Lowville. The permanent secretary is F. W. Putnam of Cambridge; the general secretary (of the meeting), J. R. Eastman of Washington.

THE annual meeting of the American Academy of Arts and Sciences was held in Boston, Tuesday, May 29. The following officers, we learn from *Science*, were elected for the ensuing year:—President, Prof. Joseph Lovering; vice-president, Dr. Oliver Wendell Holmes; corresponding secretary, Prof. Josiah P. Cooke; recording secretary, Prof. John Trowbridge; treasurer, H. P. Kidder; librarian, S. H. Scudder. M. Adolph Wurtz of Paris was elected a foreign honorary member. The list of members of the Academy now includes 192 resident Fellows, 92 associate Fellows, and 72 foreign honorary members. The Academy voted unanimously to confer the Rumford gold medal upon Prof. Henry A. Rowland of Baltimore for his researches in light and heat.

A NEW mode of measuring light was proposed at the last meeting of the Royal Society by Mr. Preece, F.R.S. The standard of reference is a small surface illuminated to a given intensity, and the mode of comparison is the light given by a small glow lamp whose state of incandescence is raised or lowered by increasing or diminishing an electric current. The amount of illumination is measured by the amount of current flowing, so that the number of amperes gives the degree of illumination. The standard surface is that illuminated by a British "candle" at 12·7 inches, and this is the same as that produced by the French "bec" at 1 metre distance. In this way sunlight, moonlight, twilight, fog, and the amount of illumination in any part of a room or building, or that distributed over a street or area at any time of day or night can be measured without any reference to the source of light or its distance from the point lighted. We have in fact a standard of illumination very easily and simply measured.

PROF. BUREAU has been appointed Director of the Jardin des Plantes in place of the late M. Decaisne.

ON Saturday, June 16, a joint meeting of the Essex Field Club and the Geologists' Association was held at Grays for the purpose of visiting the "Deneholes" in Hangman's Wood. From fifty to sixty members and visitors, including many members of the Anthropological Institute, were present, and nearly all had an opportunity of descending one or both of the two holes which were exhibited for the occasion. The meeting was under the conductorship of Mr. T. V. Holmes, F.G.S., who has written a paper giving an account of last year's preliminary exploration, which will shortly appear in the *Transactions of the Essex Field Club*. Photographs of the interior of one of the holes were successfully taken by Mr. A. J. Spiller by means of magnesium burning in oxygen. The party assembled for tea at the "King's Arms" Hotel, when the president of the Club, Prof. G. S. Boulger, and Mr. Holmes announced that it was the intention of the Club to undertake the systematic investigation of these interesting prehistoric remains, both at Grays and elsewhere along the Essex shore of the Thames. A large fund will be required for this work, and a committee has been formed for the purpose of organising the explorations, which will be carried on under the personal superintendence of Mr. T. V. Holmes and Mr. F. C. J. Spurrell. After some remarks by Dr. Hicks, the president of the Geologists' Association, the meeting broke up. A public appeal for assistance will shortly be made, and in the meantime subscriptions will be gladly received by the treasurer of the Essex Field Club, Mr. Andrew Johnston, J.P., The Firs, Woodford, or by the Hon. Secretary, Mr. William Cole, Laurel Cottage, Buckhurst Hill, to be paid to the account of the "Denehole Exploration Fund."

IT will be seen from our Correspondence Columns that an earthquake was felt in the south-west of England on Monday. The shock seems to have spread very widely over Devonshire and East Cornwall. At Holsworthy, Devonshire, a very perceptible shock was felt at seventeen minutes to two o'clock that afternoon. Floors shook, and doors and windows rattled as from a passing train. No damage is reported. A severe shock was felt at Hartland and Clovelly at 1.30 p.m., and a second shock at Clovelly at 1.40. Houses shook considerably, and the bottles on counters in shops were knocked against each other. A similar statement is sent from Bude. The inhabitants of Princetown and the vicinity of Dartmoor, about two o'clock were startled by two smart shocks, followed by a subterranean rumbling like the passing of a very heavy waggon, or the echo of distant thunder. The first trembling was of sufficient intensity to be perceptibly felt by those who happened to be occupying a chair, and the like effect was produced on small movable objects, but it resulted in no mischief. The disturbances apparently travelled from north east to west. At Launceston at twenty minutes to two a shock was felt, accompanied by a rumbling noise, which lasted at intervals during about thirty minutes. The houses shook, and china and earthenware rattled on the shelves. About an hour afterwards another shock was felt, but not so severe. Similar information comes from Lostwithiel, Liskeard, Lydford, Tavistock, Okehampton, and Bideford.

THE Fine Art Society (148, New Bond Street) have sent us an artist's proof of M. Leopold Flameng's very fine etching after Mr. John Collier's picture of the late Mr. Darwin. The original is admittedly faithful and characteristic, and of high rank as a work of art, and M. Flameng has been perfectly successful in reproducing the artist's intention. The result of both these labours is a portrait of the greatest man of science of this century, which all other men of science should be glad to possess. We believe the number printed is limited. M. Flameng will also undertake a similar etching of Mr. Collier's picture of Prof. Huxley in this year's Exhibition.

WE have received the Report of the Royal Victoria Coffee Hall, where, as may be known to many of our readers, much good work is being done at the present time in the way of providing cheap amusement every night, free from the temptation to drink and other evils common to ordinary music halls. Among other experiments being tried are short lectures of the simplest and most popular kind, generally on some scientific subject illustrated by the oxyhydrogen lantern. We are told that a really good lecturer who understands his audience as well as his subject meets with a most encouraging reception, but that very few men of science give their assistance in this good work. We regret this; but we believe it is largely due to the fact that very little is known of the work in question, and that if a general appeal were made to those men of science who occasionally give an account either of their own work or the work of others, many would be found willing to join in the effort which is now being made to interest the working classes in science in what was formerly the Royal Victoria Theatre.

OUR Paris Correspondent writes:—An interesting experiment took place on June 24, at the early hour of 3.45 in Paris, for the purpose of testing the capacity of accumulators of the French Storage Company to move tramcars. We travelled up to La Muette and back, a distance of 30 kilometres, in about three hours and twenty minutes, including stoppages and loss of time incurred by several incidents. The road has many steep inclines, which were ascended without difficulty. The mean velocity exceeded 10 kilometres per hour. The electricity was supplied by seventy accumulators, weighing 30 kilograms each, which were placed under the seats. At starting the potential was 140 volts, and having completed its task the current was as high as 126, so that at least 10 kilometres more could have been run if deemed necessary. This run is the longest on record made by electricity. M. Philippart was directing the operations.

THE Balloon Exhibition was closed at the Trocadéro on the 24th inst. It was visited by two officers of the British army, sent by the Government to report. Among the notable objects we may mention the original valve used by Gay-Lussac in his ascent, a new valve used by French aëronauts, the car and net of Lhoste as rescued from the North Sea, a panoramic apparatus for photographing a bird's-eye view of scenery as seen from a balloon at an altitude of 200 metres, several photographs taken from the cars of captive or free balloons in Paris, Boston, and Rouen, a refrigerator by Mignon and Bouard for instantly condensing vapour from clouds, bichromate elements constructed by Trouvé for Tissandier's intended aërial experiments.

THE following are the details of the method by which the fairy-like illuminations at Moscow at the coronation were produced:—The Tower of Ivan the Great and its side galleries were lit up by 3,500 small Edison lamps, fed by eighteen portable engines, which moved a number of dynamo-electric machines of every existing system. The portable engines and machines were kept at the other bank of the Moskwa. The sheds communicated with the tower by seventy aërial electric wires. On the ramparts of the Kremlin towards the river eight large and ten smaller electric suns threw their light over the river. The rest of the illuminations consisted of 200,000 lamps and 30,000 coloured glass globes, 50,000 lanterns of Venetian glass, 600,000 tapers, and 10,800 lb. of fireworks.

THE National Museum at Washington is one of the best examples in the United States of the practical application of electricity. In so large a building it was found advisable to take advantage of the best means of communication, first being its system of telephones and call-bells, by which those in any room can communicate with every room in the building. Twenty-six telephones are connected by a local telephone exchange, which in turn is connected with the main telephone office of the city. The result is that but three messengers are needed in this vast establishment. The photographic laboratory is independent of the sun, owing to the electric light there used. If one of the 850 windows or 230 doors is opened, a bell rings, and an electric annunciator shows to an attendant at the main office which window or door it is. This system is soon to be applied to every case of specimens. The watchmen at night, also, are kept to their posts by hourly releasing an electric current at certain stations, which pierces a dial and records their visit. The sixteen clock dials are likewise run by electric currents.

A MONUMENT to the memory of the celebrated naturalist, Lorenz Oken, will be unveiled at Offenburg on August 1 next. It will be in the shape of a fountain crowned with a marble bust of Oken.

MESSRS. GRIFFITH AND FARRAN have issued a new and cheaper edition of Mrs. Lankester's "Talks about Plants; or Early Lessons in Botany," first published in 1878.

PRINCE LUDWIG FERDINAND of Bavaria, an indefatigable worker in the domain of comparative anatomy, is about to publish a monograph on the tongue. Riedel (Munich) will be the publisher.

A MAGNIFICENT meteor was observed at Giesshübl, near Mödling (Vienna), on June 3, at 9.44 p.m. It seemed to consist of two fireballs, an emerald green one followed by a red one. They both moved apparently at a not very great altitude in the direction south-east to north west. The phenomenon lasted for three seconds. It is remarkable that the meteor seen at the same place on the evening of March 13, moved in almost exactly the same direction. Also at Gau-Algesheim (near Mainz) a fine meteor was seen in the northern sky on the evening of June 3; it left a most vivid trail behind, which shone for some time along the whole extent of its path.

A WRITER in the *North China Herald* gives some curious information respecting the foot-measure in China. At present it varies largely in different parts of the country and according to different trades; thus the foot of the carpenter's rule at Ningpo is less than ten, while that of the junk-builders at Shanghai is nearly sixteen, inches. But a medium value of twelve inches is not uncommon. The standard foot of the Imperial Board of Works at Peking is twelve and a half inches. A copper foot-measure, dated A.D. 81, is still preserved, and is nine and a half inches in length. The width is one inch. The small copper coins, commonly called *cash*, were made of such a size, sometimes, as just to cover an inch on the foot-rule. In the course of two centuries it was found that the foot had increased half an inch, and a difference in the dimensions of musical instruments resulted. Want of harmony was the consequence, and accordingly in A.D. 274 a new measure, exactly nine inches in length, was made the standard. Among the means employed for comparing the old and new foot are mentioned the gnomon of official sundials, and the length of certain jade tubes used according to old regulations as standards. One of these latter was so adjusted that an inch in breadth was equal to the breadth of ten millet seeds. A hundred millet seeds, or ten inches, was the foot. The Chinese foot is really based on the human hand, as is the European foot upon the foot. It strikes the Chinese as very incongruous when they hear that we measure cloth, woodwork, masonry, &c., which they regard as especially matters for the hand, by the foot. Of the jade tubes above mentioned there were twelve, and these formed the basis for the measurement of liquids and solids four thousand years ago. They are mentioned in the oldest Chinese documents with the astrolabe, the cycle of sixty years, and several of the oldest constellations. It is likely that they will be found to be an importation from Babylon, and in that case the Chinese foot is based on a Babylonian measure of a span, and should be nine inches in length.

MR. CHAS. G. LELAND, the writer of No. 4 (1882) of the "Circulars of Information" of the United States Bureau of Education, on the subject of Industrial Art in Schools, after premising that ornamental art is innate in man, and indeed is developed in a race before it attains proficiency in the useful, and remarking that the brains of the Parisians of the thirteenth century, when Gothic art adorned every object, were much smaller than they are now, draws the conclusion that children are more open to art education than to technical training. He finds the sexes equal in ability; urges outline drawing and monochrome as the foundation of further work; recommends the use of various mechanical helps, as of compasses and stencilling as actual incentives to freehand drawing; urges the practice of freehand from the shoulder, even in the variety of drawing called writing; and gives a wonderful list of artistic effects which pupils who have had only short instruction in these arts are competent to produce. Education of this sort is valuable as simply affording healthy occupation of body and mind to some classes; it opens the eyes of the mind, which will tend to make work popular instead of idleness. He teaches that nothing made by machinery can be artistic; physical comforts may be supplied by it, but works of taste and refinement must be hand-made, and among the poorer classes should be the produce of home art, like the carved oak of Ann Hathaway's cottage. Mr. Leland was one of the first to point out that the decay of the apprentice system must soon necessitate industrial education, and he has prepared a series of cheap art-work manuals on decorative design, ceramic or porcelain painting, tapestry or dye-painting, outline and filled-in embroidery, decorative oil-painting, wood-carving, *repoussé* or sheet-brass work, leather work, papier mâché, modelling in clay, with underglaze faïence decoration, and stencilling.—No. 5 of the "Circulars" is on the subject of Maternal Schools in France, which answer to our Infant Schools. The value of them as laying the foundations of education is urged by the Commissioners. Excellent suggestions for object lessons, whose subjects are supplied by the season of the year, and also for the arrangement of school buildings are given. The result of such schools should be a slight training of the senses by object-lessons; the beginnings of habits and dispositions favourable to future education; a taste for gymnastics, for singing, and for drawing; an eagerness to listen, observe, question, and answer; the power of attention; a generally quickened intelligence, and a mind open to receive good moral influences. In other words, education is a "bringing forth" of the powers of the mind, and not a making it a live cyclopædia. No. 6 is a full copy, with a few useful notes for comparison, of the English Report of the Royal Commission on Technical Education in France, presented by Mr. Samuelson and his coadjutors in February, 1882.

WITH the May number the *Journal of Forestry* changed both its title and the colour and design of its cover, and it now appears under the simple name of *Forestry*. It is an acknowledged fact that changes of this character are generally inadvisable in a journal of long-established reputation, but under the editorship of Mr. Francis George Heath we have no doubt that *Forestry* will at least maintain the reputation and circulation it had attained under its old management, if it does not increase them, which indeed it is most likely to do. The May number opens with an editorial note entitled "A May Note," in which the glories of spring and summer in woodland glades and forest are set forth. Then Mr. R. D. Blackmore gives us "A Cuckoo Song." Amongst other readable articles may be mentioned "Lord Somerville; a forgotten President of Agriculture," by Mr. R. A. Kinglake; Mr. Boulger's "Beauties of British Trees," and Mr. Guillemard's "Forest Ramble in New South Wales." In the June number the same amount of interest and variety is maintained. Mr. Guillemard gives "A Forest Ramble in Norway." The article on "Epping Forest and its Future Management" will however, we have no doubt, be read by most readers, as any one having the slightest inclination towards any branch of natural history cannot fail to be interested in maintaining the Forest in all its native beauty, and if *Forestry* is able by its advocacy, backed up by the opinions of those who are now taking a lead in the matter, to stem the tide of improvements so-called in Epping Forest, it will have fulfilled a work for which thousands will be thankful.

THE additions to the Zoological Society's Gardens during the past week include a Crab-eating Raccoon (*Procyon cancrivorus* ♂) from Brazil, presented by Mr. Theo. Walsh; a Ring-tailed Coati (*Nasua rufa* ♂) from Brazil, presented by Mr. R. G. Hamilton; two Common Hedgehogs (*Erinaceus europæus*), British, presented by Mr. S. Mummery; four Restless Cavies (*Cavia caprera*) from Brazil, presented by Mr. E. H. Draper; a Ring-necked Parrakeet (*Palæornis torquatus*) from India, presented by Mr. W. Quail; two Common Kingfishers (*Alcedo ispida*), British, presented by Mr. T. E. Gunn; three Common Vipers (*Vipera berus*), British, presented by Mr. C. Taylor; two Common Snakes (*Tropidonotus natrix*), European, presented by Lord Arthur Russell, F.Z.S.; a Puma (*Felis concolor* ♀) from South America, a Goffin's Cockatoo (*Cacatua goffini*) from Queensland, deposited; two West African Love Birds (*Agapornis pullaria*) from West Africa, an Indian Python (*Python molurus*) from India, purchased; two Vulpine Phalangers (*Phalangista vulpina*), eight Gold Pheasants (*Thaumalea picta*), six Prairie Grouse (*Tetrao cupido*), a Herring Gull (*Larus argentatus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

THE NEXT TOTAL SOLAR ECLIPSE.—In NATURE, vol. xiv. p. 450, we gave some results of an approximate calculation of the total eclipse of the sun on September 8–9, 1885, wherein the central line traverses New Zealand, but does not encounter land in any other part of its course. The correction required to the moon's place there employed is sufficiently important to render a new calculation of interest, and we shall accordingly present here some of the circumstances of the eclipse, resulting from the substitution of the lunar places in the *Nautical Almanac*, which are founded upon Hansen's Tables, with Prof. Newcomb's corrections. The elements of the eclipse as given in the ephemeris are employed, excepting that in place of Hansen's semidiameter of the moon, we infer the semidiameter from the ratio, 0·2725 of the horizontal parallax.

At a point in longitude 11h. 40m. 0s. E. of Greenwich, with 40° 49′·4 south latitude (nearly on the central line) the total eclipse begins, September 9, at 7h. 44m. 9s. local mean time, and continues 1m. 51s., and this will be about the longest duration of totality available for observation upon land in this eclipse. For any place near the above point, the Greenwich mean times of beginning and ending of totality may be obtained from the following formulæ:—

$$\text{Cos. } w = -116{\cdot}3108 - [2{\cdot}10869] \sin. l + [1{\cdot}64777] \cos. l \cos. (L - 161^\circ\ 16'{\cdot}5)$$
$$t = 8\text{h. } 58\text{m. } 21{\cdot}1\text{s.} \mp [1{\cdot}74578] \sin. w - [3{\cdot}37987] \sin. l$$
$$- [3{\cdot}85619] \cos. l \cos. (L - 145^\circ\ 49'{\cdot}6).$$

Here L is the longitude from Greenwich, reckoned *positive*, and l the geocentric latitude, which may be deduced from Mr. Stone's valuable table in the *Monthly Notices of the Royal Astronomical Society* for January last, a table it might have been worth while to publish separately. The quantities in square brackets are logarithms.

As one result of the introduction of the more accurate place of the moon, it is found that the central line approaches much nearer to Wellington; a direct calculation for that place shows that the total eclipse begins there at 7h. 44m. 23s. a.m., and ends at 7h. 45m. 46s. local mean time, thus continuing 1m. 23s., and the same figures are given by the above equations. At Nelson totality commences at 7h. 37m. 16s. a.m. local mean time, and continues 1m. 3s.

It may be noted that during the totality of this eclipse the planet Jupiter will be situated only 45′ from the sun's limb, on an angle of about 26° with the circle of declination at his centre.

THE ANNULAR SOLAR ECLIPSE OF OCTOBER 31, 1883.—In May last we had a case where the track of a total eclipse of the sun was almost wholly an ocean-track, and where it was consequently necessary to send expeditions to the Mid-Pacific, to obtain observations. The annular eclipse in October next is similarly circumstanced; excepting possibly one or two mere rocks in the Pacific, it will not be observable on land, elsewhere than on the island of Niphon, Japan. If we calculate from the *Nautical Almanac* elements for longitude 9h. 20m. 48s. E. and latitude 38° 11′ N., we find the annular phase commences at 7h. 28m. 2s. a.m., and ends at 7h. 35m. 23s., a duration of 7m. 21s., and the sun will be at an altitude of about 12°. At the capital, Tokio, the eclipse will not be annular; the greatest phase is at 7h. 28m. a.m., magnitude 0·88 (the sun's diameter being taken as unity).

THE GREAT COMET OF 1882.—In No. 2521 of the *Astronomische Nachrichten* is an elliptical orbit of this comet by Mr. John Tatlock, jun., of Williamstown, Mass., with a period of 1376 years, which, as Prof. Krueger remarks in a note, differs materially from the results of Kreutz, Frisby, and Fabritius. It may be added that the new calculation can have little weight, being founded upon normals for October 8, November 24, and January 29, so that at the date of the first normal the comet was already far past the perihelion, and in fact during the whole interval only described a heliocentric arc of about 5° 10′. Dr. Kreutz has shown the possibility of closely representing by the same orbit the anteperihelion observations and those made subsequently to perihelion passage, though there may be need of much more minute discussion before it can be safely assumed that there was absolutely no appreciable effect from the comet's passage through the solar coronal region.

GEOGRAPHICAL NOTES

Science announces that Lieut. Schwatka, accompanied by Assistant-Surgeon Wilson, C. A. Homan, U.S. Engineer Corps, and three private soldiers, left for Chilkat, Alaska, May 22, from Portland, Or., on the steamer *Victoria*. They are provisioned for a six months' cruise, will employ Indians for packers, &c., and intend to ascend the Chilkat River to its head, make the passage to the head waters of the Lewis River, and descend the same to its junction with the Yukon, and descend the Yukon River to its mouth. It is said to be their intention to survey the course of these rivers; and there is no doubt that a properly qualified and equipped party would find abundance of useful work ready to their hands. The whole route has been travelled before, but not by persons in search of and qualified to obtain geographical information, except in very small part. The explorations of the Krause brothers on the Chilkat and vicinity have been alluded to before. The Yukon has been superficially examined by McMurray, Ketchum, Zagoskin, Dall, Whymper, Raymond, Nelson, and others, and a few points have been astronomically determined; but nothing like an exact map has been attempted, nor do the data for it exist. Astronomical and magnetic observations anywhere along its banks, and especially any data for a map of the Lewis River and its feeders (which are only known from the reports of prospectors and natives), would be of the highest interest.

AT last news has again been received by Dr. Schweinfurth from the well-known African explorer, Dr. W. Junker. He was still in the Nyam Nyam country, and his last news was dated October 16, 1882, from the residence of a chief named Semio some days' journey south of the Mosio district of the present maps. Dr. Junker, who has travelled through vast districts hitherto unexplored, will now soon return home. The last time he had spent principally in various excursions, during which he repeatedly crossed the Uëlle River to the south, and also the third degree north latitude, leaving his provisions in the care of his companion, Herr Bohndorff. On September 27 he again joined the latter after an absence of eighteen months, but found him so poorly that he had to send him home with the collections made up to that time. Bohndorff started with thirty-two porters, who carried the natural history and ethnographical collections. Of special interest for geographers was an excursion of Dr. Junker's, which he made south of the former Munsa district of the Monbuttu. Some seven days' journey (about 60 kilometres) south of this place he reached a large river named the Nepoko, which the traveller identified with Stanley's Aruwimi, one of the main northern tributaries of the Congo in the middle course of the latter.

DR. POGGE has sent a report from the Mukenge station on the Lulua regarding his return journey from Nyangwe, showing that this was not quite as peaceable as the journey to Nyangwe, and that he had frequently to defend himself seriously against the enmity of the natives. From the Lualaba to the Lomani, Dr. Pogge travelled by the same route as he had previously come with Lieut. Wissmann

ONE of the most recent additions to the "Bibliothèque d'Aventures et de Voyages" published by Dreyfous of Paris is a volume containing the letters and journals of La Perouse during his famous voyage round the world in 1785–88, which ended in the disappearance of the circumnavigator among the islands of the South Pacific. The volume is annotated by M. George Mantoux, who also supplies a prefatory memoir of the great sailor.

"IM Reiche des Æolus" is the title of a little book by Adolf von Pereira, published by Hartleben of Vienna, and containing reminiscences of a tour the author undertook to the Lipari Isles. It is profusely illustrated and contains a map.

AUSTRIAN papers report that a mountain in the neighbourhood of Czernowitz, in the Bukovina, is manifesting singular symptoms of disturbance. The ground around its base, to the extent of over 1000 fathoms, has opened out in wide and deep chasms. Most of the houses of a village on the spot (Kuczumare) have fallen down.

THE Thuringian Geographical Society met at Jena on the 17th inst., when Prof. Hæckel read a paper on the flora of Ceylon, and Herr G. Kurze one on the outposts of European civilisation on the way from Zanzibar to Lake Tanganyika.

THE SPECTRUM OF THE AURORA

IN view of the increased frequency of auroras, an inquiry into the present position of our knowledge as to their spectra has seemed to me desirable.

The accompanying table gives in wave-lengths all the observations I could find of the position of the bright lines of the auroral spectrum. J. R. Capron's "Auroræ and their Spectra," goes more fully into the subject than any other work I know, and therefore many of the positions are taken from it, being found on the page or plate indicated in the column headed "Page, &c." The authorities for other observations are given in the notes, but in other cases again I cannot now state whence I obtained them.

They are arranged approximately in order of accuracy,[1] but this is manifestly a very difficult matter to decide: if, as is very likely, I have made mistakes in this respect, I hope I shall be excused. I have gone very carefully into the matter, judging of the accuracy of the observations partly by their internal evidence, and partly by the weights which are in some cases attached to them by the observers themselves. The observers' probable errors are given in the table after the positions of the lines. I consider J. R. Capron has attributed too much accuracy to most of the observations of the auroral spectrum that have hitherto been made; certainly he has to mine. Nearly all the observers have measured the principal line; and, as its position is very well known, the measurements of it are to a considerable extent a guide to the amount of dependence that may be placed on the rest. Of course it may happen to be measured correctly by accident, while the rest are incorrect; but, on the other hand, if it is incorrectly measured, it is not likely that the rest will be correct. It is, therefore, very desirable that observers should measure this line at the same time as they measure any of the others; not necessarily in order to ascertain its position, but as an indication of the correctness of the rest; although it does not always happen that all the lines are by any means equally accurate.

The most probable positions of the lines, given at the foot of the table, are derived from the most accurate of the observations of each. Below are indicated the observations which have been used in the calculation in each case, with the weight given to each; for I have not taken the simple average of those used, but have given higher weights to those that seemed the best. The "Probable Error," as given below the "Probable Average," is partly calculated and partly estimated; it seems rather large; perhaps it should not really be so large.

My second series of observations (No. 18 in the table) are not absolute measurements, but only comparisons with α and γ. I have therefore not used them in the calculation of the general averages. This series is most likely affected by constant errors much larger than the probable errors given in the table from calculation. It seems rather curious that the actual errors of my first series (No. 17) are nearly all so much greater than the probable errors; and possibly the same thing may occur in some other cases.

E. B. Kirk's observation (No. 28) (though a very rough one as regards position) is one of the most striking of all; and, being unique, confirmation of it is very desirable. It will be described under the different lines, &c., concerned.

Where I have attached to an observation a Greek letter with a note of interrogation, it means that it is uncertain whether the

[1] But the observations of each observer are placed together, however unequal in accuracy they may be.

line observed was that named at the head of the column. It is not always possible to identify the lines, and, in some cases, my identifications disagree with J. R. Capron's.

This table shows eleven distinct and well-separated lines or bands, the existence of all of which may, in my opinion, be considered proved, all but λ having been seen by two or more observers.

Seven have been seen by numerous observers; I have myself seen them repeatedly, though none of the other four with certainty; but these (θ, ι, κ, and λ) have all been seen by trustworthy observers, and therefore may be accepted, though of course further confirmation would be advantageous.

I shall now consider each line separately.

β is the only line yet seen in the red. It exists in all auroras that are tinged with red, though the spectroscope does not always show it. I have always seen this line most easily with a single prism; but often the slit has to be so wide that it appears merely as a red border to α. In those reddish auroras where I have not been able to detect it, its invisibility is probably due to moonlight or some such cause. There can be no doubt that this line is the cause of the red colour. It varies greatly in brilliancy with reference to α; I have seen it as bright as α, but never brighter.[1] It sometimes exists when no redness is perceptible in the aurora, it being overpowered by the other rays.

α is almost always the brightest line in the spectrum. The only exceptions I have seen were that once β was as bright, and once ϵ brighter (see below). α probably exists in all true auroras. In a few very faint ones I have not been able to see it, perhaps because it has been overpowered by the diffused light of the spectrum, which certainly varies in brightness relatively to the brightness of the lines. Very often when there is no decided aurora, a luminosity overspreads the sky, uniform in all directions, though fading gradually towards the zenith; I have several times seen the line α in its spectrum, but at other times it has been invisible, though the light has appeared equally bright.

α and β are slender lines; it is not clear whether this can be said of any of the other lines or bands.

θ. Wijkander's is the only reliable observation of this line, but Vogel has one not far from the same place, and as he states his position is unreliable, there is no reason to doubt its being the same line. There is more doubt whether Peirce observed the same.

ι was observed both by Wijkander and Parent, and probably by Peirce and Copeland.

ϵ consists of two lines, according to Vogel, which I have called ϵ^1 and ϵ^2; the latter, he says, became very bright whenever β appeared. He is the only observer who describes two lines here (though I have at least once suspected ϵ to be double), and therefore it is difficult to tell which of them other observers have seen, or whether they have seen both combined as one band. In the table I have assumed that the latter has usually been the case, or at least that a band has been seen in this place; possibly this band has been different from either. I have therefore placed the observations which seem to apply to the band, or to the combined lines, in a separate column from those that seem to refer to the individual lines; but the average of the former includes the observations of the latter. Barker and Procter describe a band here; also E. B. Kirk, who, in 1880, August 12, saw it as a band fading towards the violet; but in 1882, August 4, it faded away on both sides, though quite sharp at the edges, and with a pretty narrow slit it was broken up into lines—his impression is there were six or eight; and that the group was broader than the distance between ϵ^1 and ϵ^2. He used one of Browning's "Maclean star spectroscopes," with an ordinary convex lens instead of the cylindrical one.

I have carefully examined my observations of this band, to see whether it has appeared more refrangible when the red line has been visible or bright than when there has been little or no red; but the result of this examination is inconclusive. However, in 1869, April 16, and 1874, October 3, I noted that ϵ was relatively brighter in the red part of the aurora than elsewhere, so far confirming Dr. Vogel.

ϵ exists in nearly all auroras that are bright enough to show any line besides α; perhaps in all. It varies very much in brightness with respect to the other lines. I have sometimes found it the brightest next to α, and once the brightest of all, viz. in 1882, November 20, between 5.50 and 6.5 a.m. There was twilight at the time in addition to the aurora, but I do not see how this could produce the effect. Between 5.40 and 5.50 that morning I estimated α three times as bright as ϵ, which was the second brightest line; but I see no way of avoiding the conclusion that it was the brightest of all a few minutes later.

ζ may be seen in most bright auroras. It is sometimes brighter than ϵ.

η is much more seldom visible; but I have several times seen it brighter than either ϵ or ζ; rarely as bright as γ, or brighter than it; but never so conspicuous as it, as the latter is rendered more visible by its position at the edge of the brighter part of the continuous spectrum.

γ and δ belong, I believe, to all auroras, always being visible when the spectrum is moderately bright. But their brightness varies with respect to each other and to α; indeed I do not know any two auroral lines that always vary together.

γ is usually the brightest line next to α, with my mode of observation. Several observers describe it as a band; Vogel as a double band (if not triple). Capron, on the authority of A. S. Herschel, says it consists of "two lines, the first rather more frequently noted than the second" (the more refrangible). I cannot see that this assertion is borne out by the accompanying table, but if it is correct, the two lines must be about 4700 and 4654. I have several times seen γ as a band fading towards the violet. E. B. Kirk, in 1880, saw it as a band; but in 1882, August 4, resolved it into bright lines—a broader group than ϵ, less distinctly bounded, and with a less bright centre, and containing, he thinks, about twice as many lines.

κ appears to have been noted by two observers; one being Wijkander, who seems very accurate.

δ is invariably fainter than γ to me.

λ. Seen only by Lemström; but he says that in 1871, November 22, he "observed it with certainty three separate times."

The likelihood of the existence of lines in the violet or blue (such as λ or κ) in addition to those commonly seen, is manifest to me from the fact that I have twice seen purple in auroras. The first time was at Sunderland, 1869, May 13, at 10.55 p.m., when for a minute or two there was a large patch of coloured light—deep crimson, exquisite pink, and most lovely pinkish purple, gradually passing into one another. The crimson was the same colour frequently observed; the pink was very different, and far more beautiful. The crimson lasted after the other colours faded. The second time was in Skye, 1872, August 3, about 10.30 p.m., when for two or three minutes there were large patches of a beautiful, but not deep, pinkish purple. I had no time to observe the spectrum in either case. It is manifestly improbable that these colours would be caused by any of the ordinary lines of the spectrum; probably one line in the violet or blue, in combination with the red line, could account for the various tints.

Colours are closely connected with the spectrum; but I cannot say I ever saw any in the aurora, except the purples and pink just referred to, that might not be readily accounted for by the ordinary lines of the spectrum with or without the red line; as the only other decided colours I have seen are red and the usual greenish colour, varying somewhat in intensity and perhaps tint. I have seen other less decided colours; but, considering the extent to which the colours of the aurora might be affected by mist, smoke, twilight, moonlight, &c., and one's judgment by the effect of contrast, I could not say that they certainly belonged to the aurora.

The continuous light of the spectrum always reaches from α to δ; being very faint from γ to δ, rather faint from α to ϵ, and sometimes brighter from ϵ to η or to ζ than beyond. Sometimes when ϵ is too faint to be detected, the abrupt brightening of the continuous spectrum at that point is plainly visible. Kirk, in 1882, on the occasion already mentioned, when the spectroscope was pointed between the streamers, saw the spaces from α to ϵ and from ϵ to γ apparently filled with shifting lines, very numerous and close. Not that the lines really shifted, but their flickering caused them to appear shifting, and possibly also to appear more numerous than they really were. When the spectroscope was pointed on the streamers these lines were obscured by the greater brightness of the rest of the spectrum. I have myself often suspected lines between ϵ and γ, besides ζ and η.

It has been suggested that some of the lines may vary somewhat in position; but there is no evidence yet that the apparent variations are due to anything but errors of observation.

A flickering of the lines has been observed in certain cases; in all probability this occurs with the whole spectrum when the

[1] In considering the relative brightness of the different bands, it must be borne in mind that it varies considerably with the width of the slit, the dispersion, &c.

POSITIONS OF LINES, IN WAVE-LENGTHS.

	Page, &c.	β	α	θ	ι	ε¹	ε	ε²	ζ	η	γ	κ	δ	λ
1. Wijkander, A.	p. 96			5359±3	5289±5	5239±4			4996±9	4871	4692±2	4366	4280±3	
2. Vogel, Dr. H. C., av.	p. 198		5571·3±·9											
3. ,, ,,	pp. 99, 105	6297±14	5569±2	5390		5233±4		5189±9	5004±3		4663±3 (4694 to 4629)			
4. Parent, Lieut.	p. 96				5280±1			? ε 5207±11		4873	4708±5		4286±16	
5. Zöllner, F.	pl. xii.	6279												
6. Lemström, K. S.[1]			5569			? ε 5250			4959		4686		4256	4112
7. German North Polar Expedition.			5569											
8. Copeland, R., 1880.		.	5571·6±2		ι? 5275		ε? 5120±22		ζ? 4930±21		4714±20		4320±20	
9. Ångström, A. J.	p. 198		5567											
10. ,, ,,							? ε² 5210				4720			
11. Von Oettingen.		6290±70	5548±30								4660±25		4240±12	
12. Barker, G. F.	pl. xii.	6300	5550 (this	series is	±20 to	± 6)	(5330 to 5200)		(5050 to 4990)	(4930 to 4850)	4705 (4740 to 4670)		4310	
13. ,, ,,	p. 97	6200	5620					? ε 5170	5020	? γ 4820				
14. Rowland, H. A. (Troy).		6283	5543										4250	
15. Respighi, L.			5573						5050					
16. Peirce.[2]			5570	θ ? 5450	5315			? ε 5205		4860	4640		4310	
17. Backhouse, T. W.		6010	5605±14				5225		5025±9	4920	4663±10		4302±6	
18. ,, ,,		6280±100					5227±6		5002±5	4874±5			4370±6	
19. Struve, O., 1868.			5545±20											
20. Herschel, A. S.			5555±25											
21. Maclear, Capt. J. P.	pl. xi.		5510								4685	4410	4280	
22. Procter, H. R.		6270	5590				(5200 to 5100) 5170				(4840 to 4650) 4760		4240	
23. Smyth, C. P., 1872	p. 98	6350	5580				? ε¹ 5300		5100	4900				
24. Ellery, R. J. (Melbourne).		6350	5600											
25. Church, A. H.		6180	5600								4870		4480	
26. Lindsay, Lord.	p. 102		5690				5330		5170		4850		4340	
27. Clarke, A., Jun.	p. 97		5690				5320				4850		4350	
28. Kirk, E. B.[3]			5800				5150				4850		4300	
29. T. F., Torquay.	p. 96	6400	5880								4870		4400	
30. Elger, T. G.	p 96	6550	5880						5280		4870			
Probable Average ...		6289	5569·7	5359	5285	5237	5226	5199	5001	4870	4688	4366	4278	4112
Probable Error		±6	±0·6	±15	±8	±8	±8	±8	±8	±8	±9	±12	±8	±20
Observations used for Average		3, *w* 1. 5, *w* 1. 12, *w* ·2. 14, *w* ·2	2, *w* 1. 6, *w* 1. 7, *w* ·5. 8, *w* ·5. 9, *w* ·5.	1	1, *w* 1. 4, *w* 1.	1, *w* 1. 3, *w* ·5	1, *w* 1. 3, *w* ·5. 4, *w* ·5. 6, *w* ·3. 10, *w* ·25. 12, *w* ·2. 16, *w* ·15. 17, *w* ·1.	3, *w* 1. 4, *w* 1. 16, *w* ·3.	3, *w* 2. 1, *w* 1.	1, *w* 1. 4, *w* ·6. 16, *w* ·2.	1, *w* 2. 3, *w* 1. 4, *w* 1. 6, *w* ·5. 11, *w* ·3. 12, *w* ·3. 10, *w* ·1. 17, *w* ·1.	1	1, *w* 2. 4, *w* 1. 6, *w* ·5. 11, *w* ·3. 12, *w* ·3. 14, *w* ·2. 16, *w* ·1. 17, *w* ·1.	6

[1] *Archives des Sciences Physiques et Naturelles*, 1874. [2] Reported by Winlock: *American Journal of Science*, vol. xlviii. [3] *Observatory*, 1880, p. 542; 1882, p. 272.

aurora flashes, though it does not seem to have been remarked. My own observations have all been made with a very wide slit, or, which comes practically to the same thing, with small dispersion. This has been owing to the usual feebleness of the greater part of the spectrum ; and many of the other observers have for the same reason also used a wide slit. It may be useful to explain the method by which most of my observations were made, as it seems successful for perceiving the lines and general character of the spectrum, though not for measuring the positions. I have simply used one or two, or in some cases three prisms, usually of Chance's dense flint glass, and for a slit, the space between window-shutters nearly shut, or between two planks placed against the window. I hold the prisms in my hand on a simple stand, not always fixed, but so that they may be easily moved with respect to each other and to the slit, so varying the amount of dispersion. The best results are usually obtained by holding them in the position of almost the greatest deviation possible. Varying the deviation alters the focus. If one plank or shutter is placed rather further forward than the other, the apparent width of the slit is varied at will by simply moving one's head to one side or the other. By these means it is easy to observe all the different features of the spectrum, which require different widths of the slit and degrees of dispersion. A vacuum-tube or other light for comparison may be placed behind the slit, though it is obvious that with small dispersion accurate comparisons cannot be made.

I have made some observations with a Browning's "Miniature Spectroscope," with the diaphragm off, but it gives less light than simple prisms. I have also tried a "half-prism spectroscope," by Hilger, but unsuccessfully ; but I find that by taking off the outer lens of the eyepiece and the diaphragm much more light is obtained ; I have not, however, had an opportunity of trying this plan yet on an aurora.

The number of nights of aurora on which I have seen each line, between 1871, November 1, and 1883, March 27, is as follows :—

β	α	ϵ	ζ	η	γ	δ
11	83	34	14	7	33	26

On thirteen nights I could not be sure of any line, but on six of these I suspected α, or else there was an abrupt fading away about where α should come. There were other auroras—mostly faint ones—whose spectra I did not observe.

The lines visible in the spectrum often vary in the course of a few minutes, and indeed are not always the same in different parts of the sky at the same time. I have never been able to detect that any particular feature of the spectrum belongs to any particular type or feature of aurora, except that the line β belongs to red auroras.

Dr. Vogel thinks it probable that the auroral spectrum is a modified air-spectrum. The following are the most striking coincidences or approximations between my revised list of auroral lines and Vogel's lists of lines in the spectra of air and its constituents. They are sufficient to make the subject one worthy of consideration ; but perhaps this is as much as can as yet be said. There are other approximations to very faint air or gas lines, which he regards as of some importance ; but, as the lines in the latter spectra are so numerous, one would naturally expect such coincidences accidentally.

Aurora Spectrum Coincidences.

Aurora.		Air.		
ϵ^1 5237	...	Moist air	5231	dull.
ϵ 5226	...	N	5224	very bright.
ϵ^2 5199	...	O	5189	very bright.
	...	H	5187	very bright.
ζ 5001	...	N	5004	bright.
	...	Air	5008	very bright.
	...	Air	5002.	very bright.
η 4870	...	O	4870	moderately bright.
γ 4688	...	N	4704	very intense.
κ 4366	...	O	4372	moderately bright.
	...	N	4363	bright.
	...	N	4357	bright.
	...	H	4358	very bright.
δ 4278	...	N	4275	very bright.

A. S. Herschel has pointed out the proximity of β to the dark atmospheric band α at 6279.

Sunderland THOS. WILLIAM BACKHOUSE

SCIENCE AT KAZAN[1]

THE Kazan Society of Naturalists, which began its *Memoirs* in 1871 with the remarkable work of M. M. Bogdanoff on the birds and mammals of the black earth region of the basin of the Volga, has continued since to publish a series of most valuable explorations of the region of the lower Ural, Volga, and Siberia. We notice thus in the first eight volumes of its *Memoirs* the researches on earthquakes in Siberia, in Turkestan, and on the Ural, by M. Orloff; several valuable papers on the Geology of the Obschiy Syrt plateau, by M. Sintsoff; of the Government of Vyatka, by M. Krotoff; of the Government of Kazan, by Prof. Stuckenberg; and of the banks of the Kania, by M. Zaïtseff; a work on the birds of Caucasus, by M. Bogdanoff; a paper on the Teleostei of the mouth of the Volga, by M. Yakovleff; the history of the development of the *Acipenser sturio*, by M. Zalensky; and mycological researches, by M. Sorokin; several papers on the flora of the Government of Perm, by M. Kryloff; and two papers by M. Levakovsky on the substitution of certain species of plants for others in a given region; as well as several valuable researches into the anthropology of the Bashkirs, Voguls, and Votyaks, by MM. Malieff, Sorokin, and Ostrovsky.

The three last volumes of the *Memoirs*, which we have now before us, contain also many valuable papers. In the department of botany we notice the second part of M. Kryloff's flora of the Government of Perm. It contains a complete list of all Phanerogamæ discovered in this interesting province, which includes the Ural Mountains, completed by special researches into the subarctic and Alpine flora of this region. A map shows pretty well how such plants as the *Viburnus opulus*, the *Cystisus biflorus*, the *Tilia parviflora*, and the cereals are stopped in their extension by the Ural Mountains, reappearing again on their eastern slope; whilst others, like the *Quercus pedunculata*, or the *Acer platanoïdes*, are stopped in their extension towards the east by the western spurs of the Ural and the lowlands of Siberia, their north-eastern limit meeting nearly together with the south-western limit of extension of the *Pinus cembra*, the *Lonicera cœrulea*, the *Spiræa media*, and *Polygonum viviparum*. The whole list contains 948 Angiospermæ, and 8 Gymnospermæ. The Cryptogamæ are represented by 38 Lycopodiaceæ and 124 Lichens.—Dr. Martianoff publishes valuable materials for the flora of the Minusinsk region in Eastern Siberia, comprising a sketch of its climate (according to five years' meteorological observations by A. Krapotkin) and its physico-geographical characters. The flora of Minusinsk is much varied, as it embodies three separate botanical regions: the Alpine, the forest, and the steppe floras, intermingled with one another. Its general character is that of the Altai region, and out of 777 Phanerogams, no less than 714 are Altaic, whilst only 59 belong to the flora of Eastern Asia. The Alpine flora has but 104 representatives; the forest-flora is the most widely spread, and at the same time the richest; it is represented by 579 species. The steppe flora, which covers nearly one-quarter of the Minusinsk district, and appears sporadically even on the plateaux of the hilly tracts, numbers 315 species. We can only notice here the excellent botanical sketches of separate parts of this "Siberian Italy" which we find in M. Martianoff's work. His list of plants, which contains 760 species of vascular plants, is unusually rich also in lower plants, the number of determined Fungi and Myxomycetes comprising 644 species.—An interesting work which has cost much labour to its author, M. Kryloff, is a description of all drugs—mostly plants—used in the popular pharmacies of the Governments of Kazan and Perm. The list comprises about 200 plants, with a description of their use in popular medicine.

The zoological papers in this volume are but two:—On the innervation of the heart of the *Esox lucius* and *Acipenser ruthenus*, by MM. Kazem-beck and Doguel; and on the ear-labyrinth of the Plagiostomi (*Acipenser ruthenus*, *A. sturio*, and *A. schiffa*), by M. Sizoff. Both papers have appeared also in the *Archiv für microskopische Anatomie*.

Geology is represented by the following papers:—On the upper part of the mottled marls, by Prof. Stuckenberg; on the Permian in the Governments of Kazan and Samara, by A. Zaitseff; and on the geology of the Volga between Nijni-Novgorod and Kazan, by P. Krotoff. The Zechstein appears in the region situated between the Kama, the water-

[1] *Memoirs of the Society of Naturalists at the Kazan University*, vols. ix., x., and xi., 1880-1882.

shed of the Sok and Sheshma, and the Volga, as an island extending from north-east to south-west, and covered on its borders by mottled marls. The former is closely mingled with the latter, as it extends also in the shape of thinner intermediate deposits among the marls; but on the whole it substantially differs from them by its fauna, undoubtedly belonging to the Zechstein. As to the mottled marls, they contain the *Unio umbonatus*, Fisch., the *Estheria* sp. (*Posydonomia minuta*, Bronn.), the *Lingula orientalis*, Golowkinsky, scales of *Acrolepis macroderma*, Eichw., and Calamites. The Post-Pliocene deposits are spread everywhere, and we notice the find of Caspian shells of *Cardium*, together with *Dreissena*, at the sources of the Cheremshan river (left tributary of the Volga, namely, at Balandino, ten miles from the Cheremshanskaya fort). This important find proves thus that the Caspian formerly extended at least as far north as 54° 40′ north latitude. As to the Permian formation to the west of Kazan, M. Krotoff, who includes in this formation both the Zechstein and the mottled marls, calculates that it has a thickness of 810 to 860 feet. Showing further that the fauna of the mottled marls but slightly differs from that of the Zechstein (a complete list of its fossils being given by the author), and that the fossils that are characteristic of these marls (*Unio umbonatus*, Fisch., *Unio castor*, Eichw., *Estheria* sp., *Cythere* sp., remains of fishes, and Calamites) were found elsewhere, either in company with purely Zechstein forms or in deposits subordinate to the Zechstein deposits, he concludes—perhaps too soon—that there is no ground to consider them as Triassic.

Anthropology and archæology are represented by several interesting papers:—M. Krotoff publishes his researches into the age of the stone implements found in the basin of the Oka, and M. Ivanoff on the Perm region.—M. Malieff publishes the results of his most interesting measurements of the Old Bulgarian skulls dug out from the Babiy Bugor, at the Bulgarian village situated on the left bank of the Volga, close to Tetushi, and his paper is accompanied by sixteen photographs of four skulls. He measured the best preserved twenty-five skulls, all belonging to full-grown males. They are all much like one another, but could be subdivided into three groups: fourteen dolichocephalic, with indexes varying from 71·4 to 77·1; five mesatycephalic, their indexes varying from 77·8 to 79·8; and five subbrachicephalic, whose indexes vary from 81·1 to 82·1. The average size of the horizontal circumference of the twenty-five skulls is 515 millimetres, with a maximum of 555 millimetres and a minimum of 490; the average capacity is 1381 cubic centimetres. They completely differ from the skulls of other inhabitants of the same region: not only Kalmuks, or Bashkirs, but also from the Russian, Tartar, or Mordovian skulls. Without expressing a definitive opinion until a comparison of these skulls with those of Bulgarians from the Balkan peninsula is made, the author points out that they are very much like those of the Koorgan inhabitants of the Government of Moscow, who seem to be Old-Sclavonic, and certainly are not Finnish, as results from an inquiry made on 120 skulls by Prof. A. Bogdanoff. They are similar also to the skulls of the old inhabitants of Kieff and to those of the Scythes of Southern Russia. M. Malieff's companion in these researches, who gives in the same periodical a sketch of the Old Bulgarian burying-place at Babiy Bugor, adds that the skeletons they dug out had their heads towards the west, and were lying on the left side, looking towards the north (towards the Volga). Masses of pieces of earthenware were found together with the skeletons, and the pottery was of the roughest kind, made by hand, and burned very incompletely. He argues with much probability that this burying-place did not belong to a Mussulman people, but to idolaters, and supposes that its antiquity may be traced as far back as the Stone period. In any case, the customs of burying, as shown by this burying-place, seem to have been very much like those of the Sclavonians before their conversion. As to the burying-places at Chulpanovka and Ukrech, in the districts of Christopol and Laisher, explored by MM. Malieff and Vysotsky and described by the latter in his second "Anthropological Sketch of the Explorations of the Year 1880," and by M. Malieff in his just-mentioned paper, both explorers agree in considering them as belonging to Chuvashes. The craniological measurements which M. Malieff made on twenty skulls show that six of them belong to the mesatycephalic type, the average cephalic index of which is 74·5, and the others are either dolichocephalic, or belong to women and children, or afford a most pronounced asymmetry, and cannot thus give reliable figures.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE *alumni* and other friends of the University of St. Andrews have been roused to action by the threat (now withdrawn) of its possible dissolution, in consequence of insufficient endowment. An "Appeal" which has just been issued shows that 2700*l*. (in sums of from 100*l*. to 1000*l*.) has been already subscribed towards the better endowment of the Professorial Chairs; and a scheme has been set on foot amongst the younger graduates for the no less essential object of securing the augmentation of the open bursaries. Upwards of 200*l*. (in sums of from 1*l*. to 50*l*.) has been already promised towards this special fund, and an appeal from the Committee appointed for this purpose will shortly be circulated. There is good reason to believe that the withdrawal of the obnoxious clause has been partly occasioned by the practical shape which the defence of the oldest Scottish University has thus assumed.

SCIENTIFIC SERIALS

THE *American Journal of Science*, June, 1883.—On the nature of the induration in the St. Peter's and Potsdam sandstones and in certain Archæan quartzites, in Wisconsin, by R. D. Irving. The author extends the conclusions already arrived at by Sorby in several important respects.—On the existence of a deposit in North-Eastern Montana and North-Western Dakota, that is possibly equivalent with the Green River group, by Charles A. White. The paper embodies a detailed description of the new extinct genus and species of Percidæ occurring in the Dakota rocks, by Prof. E. D. Cope.—On the peculiar concretions occurring in meteoric irons, by J. Lawrence Smith. These concretions are found to contain sulphuret of iron, schreibersite (phosphuret of iron and nickel), graphite, daubréelite, chromite, lawrencite, aragonite.—On mineral vein formation now in progress at Steamboat Springs compared with the same at Sulphur Bank, by Joseph Le Conte.—Observations on the transit of Venus, December 6, 1882, at the Vanderbilt University Observatory, Nashville, Tennessee, by Olin H. Landreth.—On the fauna found at Lime Creek, Iowa, and its relation to other geological fauna, by S. Calvin. A complete catalogue is given of the Lime Creek fauna which are compared with those of the Niagara, Cinderhook, and other Devonian rocks.—Observations on stratified drift in Delaware, by F. D. Chester.—On the western discharge of the flooded Connecticut, or that through the Farmington Valley to New Haven Bay, by James D. Dana.—Results of some experiments made to determine the variations in length of certain bars at the temperature of melting ice, by R. S. Woodward, E. S. Wheeler, A. R. Flint, and W. Voigt. The experiments are chiefly made with zinc and steel bars, and the authors found that zinc is the least reliable metal for the components of a metallic thermometer and standard of length, while steel, copper, and brass do not vary appreciably at any ordinary temperature.—On Scovillite, a new phosphate of didymium, yttrium, and other rare earths, from Salisbury, Connecticut, by George J. Brush and Samuel L. Penfield.

Journal of the Royal Microscopical Society for April, 1883, contains:—On five new Floscules, with a note on Prof. Leidy's genera, Acyclus and Dictyophora, by Dr. C. T. Hudson (Plates 3 and 4).—The President's (Prof. P. M. Duncan) address.—The action of tannin on the cilia of Infusoria, with remarks on the use of a solution of sulphurous oxide in alcohol, by H. J. Waddington.—Summary of recent literature.—Proceedings of the Society.

Journal of the Russian Chemical and Physical Society, vol. xv. fasc. 4.—On solutions, by W. Alexeyeff; being an inquiry into the mutual solutions of liquids, as depending upon temperature. The experiments carried out on aniline, amyl and isobutyl alcohols, phenol, &c., lead to the following conclusions:—The hypothesis of Person as to the liquefaction of bodies before solution is not confirmed. The solubility depends upon the molecular cohesion, and increases as this last becomes feebler. Thus, at the same temperature, more of liquid than of solid salicylic acid is dissolved. The solutions are quite different from chemical compounds, and the liquid mixtures are different from solutions.—On the specific volumes of elements in liquid compounds; second paper, by M. Shalfeyeff. The conclusions of these valuable researches are:—The compounds of the fat series are derived from the uneven-atomic carbon; and those of the aromatic series from the even-atomic carbon. The specific volume of carbon is C = 21 in the C_nH_{2n} compounds of the former series, and C = 12 in the C_nH_{2n} compounds of the second series.—On Caucasus naphtha, by M. W. Markovnikoff and W. Ogloblin, being a thorough analysis of it.—On the identity $(\Sigma a_i x_i^2)\Sigma a_i = (\Sigma a_i x_i)^2 + \Sigma a_i a_k (x_i - x_k)^2$, and its meaning in physics, by N. Slouguinoff.—On the focal properties of diffraction-nets, by M. Merching.—On the specific properties of indiarubber, by N. Heselus. They cannot be explained by the presence of air vesicles.

To the *Bulletin of the Belgian Académie Royale des Sciences*, for 1883, part 2, M. C. Malaise sends a valuable paper on the constituent elements of the Silurian formations of Brabant. An approximate thickness of 12,000 or 14,000 feet is assigned to the various groups constituting the older schistose rocks of this province.—Ed. Dupont deals with the origin of the Belgian Carboniferous limestones; and papers are contributed by M. Terby on the aspect and positions of the great comet of 1882; by M. Chevron, on the inflammable nature of the gases liberated in the decomposition of beetroot; by Baron Kervyn de Lettenhove, on the Conference of Bayonne of 1565; by Alphonse Wauterson, on the origin and rise of the early Flemish school of painting previous to the Van Eycks.—Part 3 contains contributions by J. de Tilly, on Chasles' theorem of central axes; by Ed. Van Beneden, on some additions to the ichthyological fauna of the Belgian seaboard; by M. Genocchi, on the algebraic functions of Prymand Hermite; by Joan Bohl, on the reforms recently introduced into the commercial jurisprudence of Italy.

Rendiconti of the *Reale Istituto Lombardo di Scienze e Lettere*, April 12, 1883.—Some applications of symbolic variability to mechanical problems, by S. C. C. Formenti. This paper is concluded in the next number, April 26.—On springs, head streams, and underground currents in the Italian Alps, by Prof. T. Taramelli.—Experimental researches on the decomposition of adipose substances in water, in damp earth, damp rooms, and in water charged with 10 per cent. of ammonia, by C. A. Tamassia.—A study of microscopic organisms in sweet, salt, and mineral waters, by Prof. L. Maggi.—Remarks on the equivalence of magnetic and galvanic distributions, by Prof. E. Beltrami.—A preliminary inquiry into Zanardelli's proposed Italian penal code, by Prof. A. Buccellati.—On an unpublished letter of Francesco Maurolico, dated September 11, 1571, in connection with the battle of Lepanto, by L. De-Marchi.—On an example of realism in classic art, by Prof. J. Gentile.

April 26.—A comparative study of the aracnofauna of Abyssinia and Shoa, by Prof. Pietro Pavesi. The author determines thirty new species of spiders, for one of which (*Chiasmopes*) he establishes a new order.—On the determination of the coefficients of specific force for iron independently of Wöhler's numbers, by Prof. C. Clericetti.—Suggestions on a substitute for capital punishment in Zanardelli's new Italian penal code, by Cesare Oliva.—Remarks on banking and the cheque system introduced into the new Italian commercial code, by L. Gallavresi.

Atti of the Roman *Reale Accademia dei Lincei*, April 1.—On Finlay's comet (1882), by S. Respighi.—On the first observer of the optical illusion converting convex into concave and concave into convex surfaces, by S. Govi. The priority of discovery usually assigned either to Joblot (1718) or to Christopher Cock (1688) is here credited to Eustachio Divini (1663) on documentary evidence.—On the presence of native cinnabar and sulphide of silver in the Tolfa Hills, by S. Blaserna.

April 15.—Biographical notice of the late Bertrando Spaventa, by S. Ferri.—On the migrations of the ancient peoples of the Armenian Highlands and Asia Minor, studied in the light of the Egyptian monuments and hieroglyphical inscriptions, by S. Fiorelli.—A notice of the archæological discoveries made in various parts of Italy duriug the month of March, by S. Fiorelli.

Revue internationale des Sciences biologiques for March, 1883, contains:—On the origin of the vertebrates and the principle of the transformation of functions, by Dr. A. Dohrn.—On the excitability of plants, by Dr. Burdon Sanderson.—On dwarfs and giants, by D. L. Delbœuf.—Proceedings of the Academy of Sciences, Paris, of the Belgian Academy, and of the Academy of Amsterdam.

April, 1883, contains:—On the primordial flora, by Louis Crié.—On the origin and relation of sex, by M. Debierre.—On colour and mimicry in insects, by Dr. Hagen.—Proceedings of the Academy of Sciences, Paris, and the Academy of Sciences, Amsterdam.

SOCIETIES AND ACADEMIES

London

Royal Society, May 10.—"Note on the Motor Roots of the Brachial Plexus, and on the Dilator Nerve of the Iris." By David Ferrier, M.D., LL.D., F.R.S., Professor of Forensic Medicine in King's College.

In a communication to the Royal Society (published in the *Proc. Roy. Soc.*, vol. xxxii. 1881) on the "Functional Relations of the Motor Roots of the Brachial and Lumbo-Sacral Plexuses," my colleague Prof. Gerald Yeo and myself gave an account of the results of electrical stimulation of the several motor roots of the brachial and crural plexuses in the monkey. We there described the muscular actions of the upper extremity as resulting from stimulation of the first dorsal up to the fourth cervical nerve.

The careful dissections made at our request by Mr. W. Tyrell Brooks, Demonstrator in the Physiological Laboratory, King's College, and a repetition of the stimulation experiments which I have made, have revealed an error in the enumeration of the roots of the brachial plexus which, in common with Prof. Yeo, I wish to correct. What we took for the first dorsal nerve has proved in reality to be the second dorsal. Hence the results of the experiments must be read as applying to the spinal nerves from the second dorsal to the fifth cervical respectively, instead of from the first dorsal to the fourth cervical, as stated in our paper.

The anterior division of the second dorsal nerve in the monkey apparently invariably gives a well-developed communicating branch to the first dorsal, besides giving off the second intercostal nerve and a branch to the stellate or inferior cervical ganglion of the sympathetic.

The three branches, as seen in a dissection made for me by Mr. Brooks seem pretty equal in size, and all come off from the main trunk together.

The brachial plexis in man is not usually, in text-books of anatomy, considered as deriving any of its component roots below the first dorsal. In "Quain's Anatomy" (ninth edition, p. 619), however, a branch from the second to the first dorsal is given as a variety. On this subject Dr. D. J. Cunningham has published a note in the *Journal of Anatomy and Physiology*, vol. xi. part iii., p. 539, 1877. Dr. Allen Thomson having mentioned to him that he had on one or two occasions seen such a communicating branch in man, he investigated the point, with the result of finding a communicating branch from the second to the first dorsal in twenty-seven out of thirty-seven dissections. Of the ten cases where it was not found, five were so complicated by previous interference in the dissecting-room or by pleuritic adhesions and thickenings, that they may be considered as doubtful. But, even including these, it appears that the second dorsal sends a communicating branch to the first in 73 per cent. of the cases. Hence it should be considered as more than a mere variety. If a perfect homology exists betwen the roots of the plexus in man and the monkey, the second dorsal root would be the one presiding over the intrinsic muscles of the hand. Presumably in those cases where it is not found, its functions are represented in the first dorsal.

Dilator Nerve of the Iris.—Prof. Yeo and I mentioned in our paper (*sup. cit.*) that in one case in which we directed special attention to the pupil, stimulation of the anterior roots from the first dorsal to the fourth cervical—in reality from the second dorsal to the fifth cervical—caused no change in the pupil, though the movements of the limb occurred with regularity.

I have since investigated this point during the course of another research on which I have been for some time engaged. I have experimented on four monkeys. The animals were thoroughly narcotised with chloroform and kept so during the whole course of the experiments. The posterior roots of the nerves under investigation were cut, and the anterior stimulated within the vertebral canal with a weak induced current from the secondary coil (distant 20 to 15 cm.) of a Du Bois Reymond's magneto-electromotor and one Daniell. As in former experiments, a large flat electrode was placed on the sacrum as a neutral point, the exciting electrode being a hooked needle, by means of which the roots could be easily insulated and separately stimulated.

In the first experiment I failed to obtain dilatation of the pupil from stimulation of the spinal roots from the second dorsal up to the fourth cervical, though the functional activity of the roots was indicated by movements of the limb. In the second I exposed the dorsal roots from the eighth up to the third inclusive. Though different strengths of current were tried, no change in the pupil occurred, unless when the current was so strong as to cause diffuse stimulation. In such cases both pupils would occasionally become dilated, as under sensory stimulation in general. The functional activity of the roots under investigation was shown by contraction of the thoracic muscles on the side of stimulation.

In the third experiment, however, results were obtained of such definiteness and uniformity as to indicate almost without further confirmation the origin of the dilator nerve of the iris.

In this experiment the spinal nerves were exposed from the sixth cervical to the eighth dorsal inclusive. The posterior roots were cut on the left side, and the anterior roots stimulated, while the eyes were carefully observed by two assistants—my pupils, Mr. Norvill and Mr. East. Dilatation of the left pupil occurred almost invariably on stimulation of the second dorsal root, whereas no change whatever could be perceived on stimulation of any of the other exposed roots. This was verified over and over again, and the several roots repeatedly compared with each other. The distance of the secondary coil in this experiment ranged from 20 to 18 cm.

Stronger currents not carefully insulated caused dilatation of both pupils wherever the stimulation was applied, an expression only of general sensory stimulation.

After death a careful dissection was made for me by Mr. Brooks, and the effective root, which was marked, proved to be the second dorsal. An examination with a lens showed that the fibres of the posterior root of this nerve had been completely severed.

The results of the third experiment were entirely confirmed by the fourth.

In this I exposed the spinal nerves from the seventh cervical to the fourth dorsal and cut the posterior roots on the left side.

Here again with the utmost uniformity on each stimulation of the second dorsal, the left pupil, and this one only, became widely dilated; whereas stimulation of the other roots was entirely negative in respect to the pupil.

I ascertained in this experiment that a strength of current which would suffice to excite the muscles of the limb or trunk to action would frequently fail to cause any dilatation of the pupil when applied to the second dorsal. Somewhat stronger, but yet barely perceptible on the tongue, the current at once caused the pupil to dilate. Occasionally also if the second root had been stimulated repeatedly the iris failed to respond, probably from mere exhaustion of the nerve.

Circumstances such as these would, I think, account for the absence of the pupil-reaction in my first experiment, and also in the experiment related by Prof. Yeo and myself, where the second dorsal root was really under stimulation.

The general result of these experiments is to show that in the monkey, and presumably also in man, the dilator fibres of the iris contained in the cervical sympathetic are derived from the anterior root of the second dorsal nerve.

Mathematical Society, June 14.—Prof. Henrici, F.R.S., president, in the chair.—Prof. W. Woolsey Johnson, of Annapolis, was admitted into the Society.—Prof. Cayley, F.R.S., spoke on the subject of sever invariants, and Mr. Hammond's recent discovery.—Prof. Sylvester, F.R.S. (who was very cordially welcomed), and Mr. Hammond spoke on the same subject.—Mr. Tucker (Hon. Sec.) read parts of papers by Prof. H. Lamb, on the mutual potential of two lines in space; by Mr. H. M. Jeffery, F.R.S., on bicircular quartics with collinear foci; and made a few remarks on the subject of inverse coordinate curves.

Physical Society, June 9.—Prof. Clifton in the chair.—Dr. Obach described an improved construction of the movable coil of galvanometer for determining currents and E.M.F. in absolute measure. This is a more sensitive, accurate, and powerful instrument than the old form. It is intended for accurate measurements and testing other instruments. The needle of the new form does not dip; and its vibrations are rendered dead beat by an air chamber. The secants of the inclination of the coil are the multipliers of the tangents of the deflections. The coil consists of a single solid rod or band of copper for measuring powerful currents; and on the same ring is a fine coil of German silver wire for measuring E.M.F. No shunt is required, owing to the movability of the coil. Dr. Obach gave figures showing the accuracy of the apparatus, which is very great.—Professors Ayrton and Perry read a paper on the electric resistance of water, being the result of some experiments made by them some time ago. A comparison of the galvanometer and electrometer methods of measuring this resistance was made during the experiments, the results being in favour of the latter, especially with currents of less than 6 volts. When the electrodes or platinum plates in the water were end-on, the resistance was less than when face to face. Mr. Boys thought this curious result might be due to the resistance between the surface of the plates and the water being reduced. In answer to Dr. Coffin, Prof. Ayrton stated that the plates were heated between every two experiments in the blowpipe. Prof. G. Guthrie remarked that Kohlrausch had found ordinary distilled water to be much more conductive than pure distilled water, which was an insulator, and inquired if Prof. Ayrton chose pure water. The latter replied that as his experiments were to test the merits of the galvanometer and electrometer modes of testing, ordinary distilled water was used. Prof. Jones stated that he found it best to use alternating currents for measuring the liquid resistance of cells, and described a mercury commutator for rapidly reversing the testing current.—Prof. Ayrton then described a lecture apparatus for showing the laws of centrifugal force. A rapidly rotated arm carrying a movable weight springs from the centre of an aneroid chamber filled with mercury. This chamber is on the rotating axle, and as the centrifugal force of the arm pulls out the diaphragm, the mercury falls in the chamber and in a tube opening from it. Prof. Guthrie remarked that the apparatus would serve as a speed counter.—Prof. Perry then read a paper on the kinetic energy of rotating bodies, in which he pointed out the practical drawbacks to the "moment of inertia" calculations, and suggested the use of a new constant (termed for the nonce the "M"). This is the amount of kinetic energy possessed by a rotating body when making one revolution per minute. To find the energy for N revolutions per minute, multiply this by N^2. In the same way the "M" of a machine can be found and used.

PARIS

Academy of Sciences, June 11.—M. E. Blanchard, president, in the chair.—On some properties of a binary form of the eighth order, by F. Brioschi.—On the homogeneity of mathematical formulas, by A. Ledieu.—Four methods of separating gallium from iridium, by M. Lecoq de Boisbaudran.—Process to be adopted in observing the first radicules of the lymphatic system, and in determining whether these radicules communicate or not with the blood capillaries, by E. Sappey. The intimate union of the radicules with the bloodvessels, which had long been assumed on general grounds, is here demonstrated by actual observation.—Researches on rabies, by Paul Gibier. The points examined are (1) the manner of inoculation; (2) transmission of rabies through the mother; (3) the presence of foreign substances in the stomach of the dog in connection with the diagnosis of rabies; (4) attenuation of the virus: (5) the parasites of rabies. The author shows that the canine, like some other kinds of virus, may be attenuated by cold. That hydrophobia is due to a special parasite, although not yet scientifically demonstrated, is rendered highly probable.—Facts and results serving to determine some new properties of sulphate of iron, by M. Rohart.—On the properties of phosphoric glass (the so-called *verre de phosphate de chaux*), by M. Sidot.—M. de Quatrefages presented, on behalf of M. de Lacerda, a memoir on an organism found in the victims of yellow fever, and by him regarded as a fungus. In the accompanying plate are represented the various stages of development of this organism.—On the track of Encke's comet in the years 1871–1881, by M. Backlund.—On a mode of transformation of figures in space, by MM. J. S. and M. N. Vanecek.—On the theory of the binary form of the sixth order, by R. Perrin.—A study of continuous periodical fractions, by E. de Jonquières (continued).—On the reflection of light on the surface of disturbed fluids, by L. Lecornu.—On the variation of the capillary constant of insulating liquid surfaces, such as ether and sulphuret of carbon, in contact with water, under the action of an electromotive force, by M. Krouchkoll.—On the formation of the glycolate of bibasic soda, by M. de Forcrand.—On the hydrates of barytes, by E. J. Maumené. It is shown that barytes makes no exception to the general law of hydrates, with which the numerous results obtained by Fremy, Filhol, Deville, and others, are in harmony.—On the fermentation of bread-stuffs, by V. Marcano.—On the artificial production of barytine, cœlestine, and anhydrite, by A. Gorgeu.—On the origin and process of formation of bauxite and granular iron, by Stan. Meunier.—On respiration in rarefied air, by MM. Fraenkel and Geppert.

June 18.—M. Blanchard, president, in the chair.—A despatch from San Francisco was read announcing M. Janssen's discovery of the Fraunhofer spectrum and of the dark lines of the solar spectrum in the corona, implying the presence of cosmic matter round the sun. Five photographs were taken of the corona and circumsolar regions to a distance of 15° for intra-Mercurial planets.—A new method of determining the right ascensions and absolute declinations of the stars (continued), by M. Lœwy.—On a drawing of the great comet of 1882, executed at M. Bischoffsheim's observatory near Nice, by M. Faye.—On the movements observed in the monolithic pillars supporting the meridian of the Neuchâtel Observatory, by M. Faye. From these observations, which have been regularly recorded since the foundation of the Observatory in 1859, it appears that even the most solid parts of the earth's crust are subject to slight movements, slow, regular, and partly oscillatory; also that the variable intensity of the movements depends on the one hand on the meteorological conditions of the year, while it is connected on the other with the periodical perturbations produced in the solar photosphere.—On a system of optical telegraphy established by M. Adam between the Islands of Mauritius and Réunion, by M. Faie.—On a carbon meteorite which fell on June 30, 1880, near Nogoga, province of Entre-rios, Argentine States, by M. Daubrée.—Experimental and clinical researches on the method of producing anæsthesia in the organic affections of the encephalon, by M. Brown-Séquard.—Numerous experiments made on dogs, rabbits, &c., seem to show that the paralysis caused by an organic affection of one of the various parts of the brain depends scarcely ever, if at all, on the cause usually assigned to it, that is, the loss of function of the part destroyed.—On the determination of the fly-wheels of tool-engines, by M. X. Kretz.—On the sulphurets of phosphorus, by M. Isambert.—On a method of transformation of figures in space, by MM. J. S. and M. N. Vanecek.—On the theory of the binary form of the sixth order, by R. Perrin (continued).—On the continuous reduction of certain quadratic forms, by E. Picard.—On the magnifying power of optical instruments, by M. Monoyer.—Evaporation of sea water in the south of France, and more particularly in the Rhone delta, by M. Dieulafait. From various observations the author concludes that throughout the deltaic region, even to a distance of twelve miles inland, the mean annual evaporation of the sea water is at least 6 mm. every twenty-four hours.—On some properties of the sulphuret, selenide, and telluride of tin, by A. Ditte.—Determination of the carbonic acid of the air in the stations selected for observing the transit of Venus, by MM. A. Muntz and E. Aubin.—Volumetric quantitative analysis of sulphuret of carbon in sulphocarbonates, by E. Falières.—On the emetics of mucic acid, by D. Klein.—On the respiratory organs in the Chelonia, by L. Charbonnet Salle.—On the cellules of the follicule in the ovum, and on the nature of sexuality, by A. Sabatier. From his protracted studies of the processes of gemmation and parthenogenesis, the author concludes that in the reproductive elements there are two principles of opposed polarities, the centripetal (blastophore) and centrifugal (spermatoblast). When the two polarities are in a reciprocal state of equilibrium the cellule is in a state of *sexual neutrality*, and capable of parthenogenesis. But should the equilibrium become disturbed by the disappearance of either element through any biological change, one of the elements becomes predominant and the cellule acquires a determined sexuality, male by the elimination of the centrifugal, female by that of the centripetal element. There may thus be various degrees of sexuality, which become completely differentiated only through successive processes of elimination.—New method of discolouration of the pigment in the eye of Arthropods, by C. E. della Torre.—Observations on the movements of the ground in the Chiloë Archipelago, by Ph. Germain.

BERLIN

Physiological Society, June 1.—Prof. Kronecker reported that in a demonstration of the action of the cooling down of nerves upon their conductibility, he observed a lesser velocity of conduction of the stimulus instead of the greater velocity that he expected, and that he had found this observation confirmed by subsequent experiments. Hence the correctness of an earlier casual observation of Herr von Helmholtz, that the cooling down of a nerve diminished its conductibility, which had been denied by subsequent observers, has been vindicated; but Prof. Kronecker admits that the contrary may also be true, because frogs may present, under different conditions and at different seasons, utterly diverse phenomena. The influence of temperature on the excitability of sensory nerves, the complement of the above observation, was investigated in frogs whose spinal cord was cut through by measuring the length of time occupied by reflex movements when their legs were dipped into dilute sulphuric acid (·5 or 1 per thousand) at different temperatures. In the case of all frogs and at all active degrees of concentration of the acid, the time required for the reflex action was shortest, *i.e.* the immersed leg was quickest drawn out, when the acid was coldest—0° or +4° up to +6°—and the time required for the reflex action was on the contrary longer at the temperature of the air of the room, and longest at the highest temperature that was employed, 30° to 35°. The influence of cooling down, not the peripheral nerves, but the spinal cord itself, will be investigated in future experiments.—Prof. du Bois Reymond communicated a short notice from a letter of Prof. Babuchin's to him, which contains a fact interesting as showing the power of adaptation to their surroundings that electric fish possess. Prof. du Bois Reymond had previously called attention to the fact that the electric eels and malapterurus that live in badly-conducting fresh water show, in as far as they have accommodated themselves to this medium, a considerable development of their electric organ in length compared with the small size of its transverse diameter, whereas in the electric rays that live in sea water, which is a good conductor, the electric organ has a greater transverse development; consequently the electromotor powers of the electric organs of the electric eel and malapterurus on one side, and of the electric ray on the other, were to one another inversely as the conductibility of the surrounding media. The measurements of Humboldt and of Sachs of growing electric eels had shown that in their growth the electric organ increased proportionately more in length than in transverse diameter, which is a teleological adaptation to the badly-conducting fresh water. Now the above-mentioned note of Prof. Babuchin contained the communication that in growing electric rays the electric organ increased proportionately much more in breadth than in height; this is likewise in conformity with the adaptation to the sea water, which is a good conductor.

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