THURSDAY, APRIL 6, 1882

THE ORIGIN OF THE SIGNS OF THE ZODIAC

The Unicorn: a Mythological Investigation. By Robt. Brown, Jun. (London: Longmans, Green, and Co., 1881.)

Astral Origin of the Emblems and Hebrew Alphabet. By J. H. Broome. (London: Edw. Stanford, 1881.)

IT is perhaps unjust to Mr. Brown's very attractive and suggestive book to couple it with the wild and ignorant lucubrations of the Rev. J. H. Broome. Mr. Brown has collected his facts from the latest and best authorities, and displays a wonderful amount of wide reading. His main object is to show that the unicorn of heraldry is the last faded representative of the horned moon of early mythology who struggles in vain with the solar lion, and among other curious points which he seems to have made clear is that the *Triquetra* of Sicily, the three legs of the Isle of Man, is the lunar ass of the Bundehesh with the triple legs. His book supplies another illustration of the close connection that exists between mythical astronomy and mythical zoology. As for Mr. Broome it is sufficient to say that he supposes the square Hebrew characters to constitute an independent alphabet of early origin, and the zodiac of Denderah to be "the oldest planisphere in the world, apparently referring to a time when the winter solstice, 4000 B.C., was quitting Pisces to enter Aquarius." Before he again commits himself to print, a study of some elementary work on the history of the alphabet, as well as some acquaintance with Hebrew and Arabic, would be advisable.

The subject, however, which he has attempted to handle is really an interesting one. The origin of the signs of the zodiac is a question which we have but recently obtained materials for answering. Even the origin and meaning of the symbols by which they are represented are unknown to most of those who are in the habit of using them. Some of these symbols, certainly, are plain enough: it is not difficult, for instance, to discover the horns of the bull in the symbol of Taurus, or the arrow in that of Sagittarius. But the meaning of others, such as the symbols of Virgo, of Scorpio, or of Capricornus, is not so self evident. These symbols, however, are of comparatively modern invention, and first came into use along with the symbols still employed by astronomers to denote the planets. In an interesting article upon the latter in *La Nature* last January, it is pointed out that they cannot be traced further back than the tenth century, and owe their origin to the connection the alchemists believed to exist between the planets and the metals. The precise forms of the symbols were not fixed immediately, and Letronne (*Revue archéologique*, iii. p. 261, 1846) maintains that at first the initial letters of the names of the planets were employed, of which the Greek Z, still representing Zeus or Jupiter, is the sole survival. The symbols of Mercury, of Venus, of Mars, and of Saturn are respectively pictures of the caduceus, the mirror, the spear and shield, and the sickle which characterised the deities after whom the planets were named. The cross which surmounts the globe of the earth points to Christian influence, and is probably not older than the sixteenth century, while the trident of Neptune has been substituted for the L. and V. of the name of Le Verrier only within the last half-century, and the symbol of Uranus is little more than the initial H of the name of Herschel.

But modern though the symbols of the planets and zodiacal signs may be, it is quite otherwise with the signs themselves, and the majority of the names by which we still call them. Recent research has shown that the general voice of classical antiquity was right in regarding the Chaldeans as the first to map out the path of the sun during the year into separate regions, or constellations. Copies made by Assyrian scribes of older Babylonian works on astronomy have been found in the library of Nineveh, and are now in the British Museum. From these we may form some idea of the astronomical notions which prevailed among the Babylonians 4000 years ago, as well as trace almost to their beginning the so-called Signs of the Zodiac.

The primitive population of Babylonia, now known by the name of Accadians, did not belong to the Semitic race, but spoke an agglutinative language like the Finns or Turks of to-day. It was they who first made Chaldea famous for its study of astronomy, and it is to them that the Signs of the Zodiac are due. Each sign represented a month of thirty days, and the signs and months were accordingly called by common names. As far back as our records carry us the year began with Aries, but we have indications that the names of the zodiacal signs were originally given in that remote epoch when the vernal equinox still coincided with the entrance of the sun into Taurus. At all events the Accadian name of the second month and second sign is that of "the directing Bull," a name which could have a signification only when the Bull directed the course of the year.

Why the opening of the year was thus placed under the protection of the Bull we are now able to explain. The ecliptic, or "path of the sun" as it is sometimes expressly called, was also termed "the furrow of heaven," and the planet Jupiter was commonly known as "the planet of the furrow of heaven," or "the bull of the sun." The sun-god, Merodach, when regarded as passing through the zodiacal signs, was addressed as Gudibir, "the bull of light," which must, therefore, have been another way of naming the ecliptic. Since the Accadian term for planet literally signified "old sheep," while Arcturus, the Bootes of the Greeks, was called "the shepherd of the heavenly flock," it is evident that the agricultural population of early Babylonia looked upon the sky as a vast field, filled with flocks and herds, where the sun, like a toiling bull, "directed" the plough through the bright furrow of heaven. The belief that the celestial bodies were animals was not confined to the Accadians; we find it prevailing among uncultivated tribes all over the world. The only way in which primitive man was able to explain the motions of the stars and planets was by supposing them to be endowed with the same life as the animals by whom he was surrounded.

The origin of the name of Aries is less clear. In Accadian the sign is called "he who dwells on the altar of uprightness," and is explained to mean the god Bel. Possibly we have here an allusion to the Assyro-Phœnician legend of the sacrifice by Bel of his only son, the Sun-god, for whom a later and more humane age substituted the ram. In the tariffs of Carthage and Marseilles a ram takes the place of the human victim of the earlier cult.

The usual Accadian name of the third month was that "of bricks," on account of the suitableness of May for house-building; but I have also found it called "the double one," in reference probably to the twin stars which were supposed to preside over it. Gemini is of course the modern descendant of this title. Cancer I cannot account for, and the name was perhaps of Greek origin, like Libra, which, as we learn from Achilles Tatius, was originally denominated the Claw of the Scorpion. Leo is at present equally obscure, but Virgo goes back to the Accadian sign of "the errand of Istar," a name due to the belief that it was in August that the goddess Astarte descended into Hades in search of her betrothed, the Sun-god Tammuz or Adonis, who had been slain by the boar's tusk. The month and sign which follow were dedicated to "the illustrious mound," the building of the tower of Babel being believed to correspond with the autumnal equinox. "The scorpion" was the chief star of the next month, the usual name of which, "the month which faces the beginning (of the year)," seems to prove unmistakably that the year began with Taurus when the Accadians first named the months and signs. I cannot explain Sagittarius, but the goat was the Accadian name of the constellation Capricornus, and "the rainy season" was the title given to the month which was watched over by Aquarius. Finally, "the month of sowing" was that in which the Sun-god in his journey through heaven was called "the fish of Hea," the god of the sea.

It is evident from this that several of the names had a mythological parentage, and were due to the fact that certain myths were localised, as it were, in particular months. But other names equally clearly originated in the peculiarities of the season when the sun was in a special sign of the zodiac. This is certainly the case with Aquarius, and it is probable that fish were particularly abundant under Pisces when the lowlands of Babylonia had been inundated by the rains. Other names, again, were derived from the chief stars which lay near the path of the sun; and the stars, as we have seen, were imagined to be endowed with life and so compared with the animals of this nether earth. Among the names of the stars preserved to us in the Assyrian tablets, a large proportion are those of beasts and birds. It was these which gave the signs of the zodiac their zoological appearance, and caused the whole circle of signs to be designated by the Greeks the ζωδιακὸς, or "circle of animals."

A. H. SAYCE

THE GEOLOGY OF SUTHERLAND

Geological and Mineralogical Map of Sutherland. By M. Foster Heddle, M.D., F.R.S.E., &c., President of the Mineralogical Society of Great Britain and Ireland.

ANYTHING relating to the Geology of Sutherland has a great interest for British geologists. It was there that the battle of the "North-West Succession" was fought out by Murchison, whose conclusions have been acquiesced in by most geologists. Notwithstanding the evident simplicity of the structure of the country, there have always been some who have demurred from his interpretation, and who, discovering a few inaccuracies in his work, have endeavoured to invalidate its general results. The last phase of this dissent has just appeared in the form of a geological and mineralogical map by Prof. Heddle, and accompanying papers on the Geognosy of Sutherland, published in the *Mineralogical Magazine*. The map clearly shows a lower gneiss separated by the wreck of a wide-spread unconformable formation of sandstones and conglomerates from a higher group of quartzites, limestones, and schists. Thus far it corroborates Sir Roderick. The author however tries to prove from the evidence afforded by chemical analysis that the Durness limestone with its lower Silurian fossils has no relation to any other rocks in the country, and consequently that there is no evidence of any other part of the Highland rocks belonging to the Silurian system. For this information we require to have recourse to the "papers," as the map only indicates that the Erribol and Assynt limestones, which Murchison and most geologists have identified with those of Durness, are dolomitic. They are therefore expressed by different colours. The physical and palæontological evidence, however, appears to be entirely against this notion.

It is probably quite true, as Murchison himself pointed out, that at Durness the junctions of the limestone with surrounding rocks, whether upper or lower, are chiefly lines of fault. But it is no less certain, from the same testimony, that this limestone, with its admittedly Lower Silurian fossils, is seen to lie conformably upon and to form part of a lower quartzite, and itself to contain bands of quartzite. No later rock is seen to lie upon the limestone at Durness; but most geologists who have visited the locality appear to have no hesitation in identifying this limestone with the band which runs on the top of the lower quartzite from Erribol through Assynt far into Ross-shire. Dr. Heddle maintains that the identification must be wrong because chemical analysis shows the composition of the limestone to be different. Chemical analysis, though a useful help, is not always a safe basis for stratigraphical work. In the face of distinct palæontological facts, it must at once be set aside. Some of the same fossils which occur in the Durness Limestone are found also in strata associated with the Erribol and Assynt Limestones. The *Serpulites Maccullochii*, so characteristic a fossil of the zone immediately below the Assynt Limestone, occurs also in the limestone of Durness. Orthoceratites have been detected in the limestone of Assynt.[1] The cause of the difference in composition between the rocks at Durness and in Assynt may very properly be made the subject of chemical investigation, but all the analyses in the world cannot overturn the evidence of recognisable fossils.

The Assynt and Durness area is the only part of Dr. Heddle's map which has been worked out in detail, and which gives a fair idea of the geological structure of the ground. On a map of such a scale as half an inch to a mile, one would naturally have expected marked petrographical bands, and the general disposition of the rocks, to have been clearly distinguished. But in these respects the author has not availed himself of the opportunity

[1] "Siluria," 4th edit. p. 166 (*footnote*).

offered by the map, nor of his advantage in possessing so extensive a knowledge of mineralogy. He might as well have used a map one-fourth the size, which would have given all the detail he has published, in sufficient minuteness for the illustration of his papers. It is extraordinary, for instance, that not the slightest indication of structure is given, over the whole of the area of the older gneiss. No one can tell from the map, that the strike of this rock is nearly at right angles to that of all the other rocks. It is equally remarkable, that where indications of structure have been inserted, they are, in some cases at least, obviously imaginary. Lines of fault are recklessly drawn along the bottom of lakes, where they could not possibly have been observed, and where, as they coincide with the strike of almost vertical beds, they would be extremely difficult to prove, even if the rocks were visible all the way. It is hard to understand why they should have been inserted, unless to support some theory of lake-formation.

Besides the more detailed mapping of the Durness and Assynt areas, the map makes a few additions to our knowledge, such as a greater extension of the Cambrian or Torridon sandstone, and the existence of a solitary outlier of Old Red Sandstone in the centre of Sutherlandshire.

The writer of the present notice has not had an opportunity of visiting the ground, but he is under the belief that the west of Sutherlandshire exhibits on a great scale the phenomena of glaciation. One would naturally look for indications of the moraines and other traces of old glaciers on so large a map, but these superficial markings are likewise conspicuous here by their absence. Only one moraine is marked by Dr. Heddle. Is this the only one in the county?

The index of colours is a model of confusion. The old gneiss is placed at the top, then in succession come the rest of the rocks up to the Old Red Sandstone, followed in reverse order by the Upper Oolite and lower members of the Jurassic system, Trias, the Durness limestone, Syenite, Granite, Porphyry, and Eruptive rocks. A more serious defect still is the want of acknowledgment of the sources of information from which the map has been largely compiled. The maps and papers of Macculloch, Murchison, Nicol, Geikie, and Judd, have all been made use of, and this should have been conspicuously stated on the map itself.

OUR BOOK SHELF

A Year in Fiji; or, An Inquiry into the Botanical, Agricultural, and Economical Resources of the Colony. By John Horne, F.L.S., Mauritius. (London: for Her Majesty's Stationery Office, 1881.)

THIS report gives an extremely interesting sketch of the food products of the Fijis. Mr. Horne's tour, which occupied a year, was made in 1877, and he was specially commissioned to report on the sugar culture in these islands.

Beginning with an account of his tour through the different islands of the group, we have then a chapter on the chief peculiarities of their flora. The flora he considers still very imperfectly known, and he was enabled to add some 300 species to Dr. Seeman's list. Here we find ourselves obliged to protest in the strongest possible way against the extremely objectionable manner in which the scientific names are printed in this report: the initial letters of all the generic terms are printed in lower case, and not, as is the universal custom, with a capital letter; and thus not only the usefulness, but the appearance of the book, is interfered with. We acquit the author of blame in this matter, for he may never have seen the proofs; but the reader for press, with the list of Fiji plants which appears on page 256 before him is without excuse.

Fruit is plentiful in Fiji, and might with advantage be exported, especially bananas, pine-apples and oranges. Attention is called to the necessity of re-foresting. Of the agricultural products, mention is made of copra, sugar, cotton, maize, tobacco, and coffee. Of copra, the dried kernel of cocoa-nuts, there was exported in 1878 122,194*l.* worth, but little oil was made, the copra paying better. The sugar crop is steadily on the increase: for 1880 it was estimated to produce 60,000*l.*, and when fully developed, Mr. Horne estimates a possible yearly make of about 200,000 tons. Coffee-trees thrive well, and the coffee export in time will be second only to sugar. Cotton is being displaced by the sugar-cane. The trees yielding caoutchouc in Fiji are Apocynaceous, belonging to the genera Tabernæmontana and Alstonia. The Fijians collect the juice which exudes from the broken leaves and branches in their mouths. Several mouthfuls are then rolled into a ball, and the juice congeals so quickly that it requires very little working with the fingers before it is dry and ready for the market. Samples sent to England were priced as high as 2*s.* 6*d.* a pound. Sandal-wood is becoming scarcer and dearer each year in Fiji; in 1878 it was worth 10*l.* a ton.

In an appendix we find a series of propositions for a forest ordinance for Fiji, which, carried into effect, would no doubt be of great service to this British colony.

LETTERS TO THE EDITOR

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

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

On a Perpetual Form of Secondary Cell

I HAVE succeeded, after many fruitless attempts, in discovering an indestructible material which can be substituted for lead, as the negative or oxygen-bearing plate of the Faure accumulators, without sacrificing any of the extraordinary good qualities which that excellent form of secondary couple possesses, excepting only its cheapness of construction.

The only substance which I have yet found to be such an effective substitute for the lead-plate, is platinum-foil, which has been coked at a high heat with lampblack for some days in a pottery kiln, until its smooth surface becomes thereby roughened with a dull drossy coat. To whatever assimilation of metalloids from the pure lampblack, or from the kiln-furnace gases, this surface-alteration of the clean platinum is due, it seems probable that the electrolytic oxygen in the charging process removes the contamination, leaving the platinum-surface in the fine state of nearly molecular sub-division necessary for forming conducting-contact with the ozone-, or oxygen-imbued dioxide. For the result is a current of very nearly the same copious quantity, or density of flow, and of nearly the same tension and storage capacity as that commonly yielded by the usual mode of construction, and of charging and discharging a Faure accumulator with lead plates.

The processes of maturing or "forming" the coked platinum-plate, and of charging and discharging it, exactly resembles the usual processes with a lead one. At the same time, if leakage by local action is not entirely prevented, it must at least be reduced to a minimum on a plate of platinum, and such a plate is not liable, like a lead one, to suffer gradual destruction by occasional accidental wants of watchful attention against overcharging it.

I have not tried the effect of electro-depositing platinum upon it as a means of roughening the surface of platinum foil; but experiments with clean platinum in sulphuric acid, and with clean platinum in strong solution of caustic potash, and again with iron-wire gauze, and even with iron-wire gauze spread with fine iron-filings, in the latter liquid, as supports for the layer of dioxide, sufficiently evinced that mechanical roughness alone is quite unproductive of the close intimacy of contact between the peroxide and the metal plate required to establish the necessary kind of rheomotive continuity between them. But on the other hand, if iron in caustic potash could by any means be brought superficially (perhaps by kilning it in oxide of manganese) to as intimate conjunction during the charging process with lead peroxide, as platinum-foil is brought by a preparatory coking of its surface, it would be an equally effective and equally indestructible substitute for a lead plate with platinum, and as far as I have observed it, as retentive an accumulator of the charge communicated to it as platinum itself is either in dilute acid or in caustic potash.

But on an iron conductor in a solution of caustic alkali, dioxide of lead itself must be originally spread out; since this liquid seems incapable (at least without protracted action), although it soon forms the spongy-lead layer opposite to it, of converting the minium into a dioxide layer. The electrolysis of water by iron electrodes in a solution of caustic soda and of caustic potash, also, is singularly rapid, attended perhaps by a minimum counter-force of polarisation, and by little production of ozone, so that the proportion of oxygen absorbed to the oxygen wasted and given off in charging,[1] unless a weak current only is applied, is less than with dilute sulphuric acid, and the liquid has an inconvenient tendency to froth up. But in regard to storage and retention of a charge communicated to it, and in its manner of furnishing the return or secondary current, this arrangement appears to be just as efficacious as one with a clean platinum conductor.

A cell made with minium laid on two clean platinum-leaves of a pair of ordinary pint Grove-cells, weighed when placed with acid in its glass jar (not much larger than a glove's thumb- or finger-stall), just seven ounces. Yet when well charged it rang a call-bell continuously for eight hours. When afterwards re-charged, and washed, and left to dry unavoidably for a fortnight, on simply immersing it then in a solution of caustic potash, it rang a bell with a few intervals of intermittence of the current, for twenty hours before it was exhausted. It still continues with similar intermittences of a few day's rest to furnish residual bell-ringing currents of two or three hours' duration each, sufficiently proving the extreme hardiness and retentiveness of its construction. A rather bulkier cell formed with two coated sheets of iron-wire gauze in caustic potash comported itself in an exactly similar manner, having just now, five days after being charged, and without yet ceasing its clatter, rung a bell continuously for thirty-six hours.[2]

But between these small messenger-currents and the substantial stream that can be drawn from a properly-formed Planté or Faure cell with lead-plates of the same size, there is as much difference as between a caged song-bird and a slipped falcon; and it has afforded me extreme pleasure to be able to reproduce successfully the normal action of the lead accumulators with an indestructible metal plate as the negative conductor, by the fortunate possession and trial of a piece of platinum-foil roughened in the way described above, which was accidentally preserved from some former experiments on mossy incrustations produced on platinum surfaces by contact with carbon or with heated vapours in a carbonising kiln.

Although already convinced of its correctness by these experiments, I owed to the pages (pp. 382-83) of Prof. Silvanus Thompson's excellent book of "Elementary Lessons in Electricity and Magnetism" which treat of secondary batteries, my first acquaintance with the general acceptance as an established fact of the view that gaseous polarisation of the plates by oxygen and hydrogen is in these extreme, as much as in ordinary weaker cases, the source of the secondary or return current in a secondary cell—that, for example, in Planté's cells the lead-plates acquire their high tension by "becoming with use coated with a semi-porous film of brown dioxide of lead, presenting a large amount of surface and holding the gases well"; and that by Faure's method of preparation, the improvement is effected that "cells thus prepared sooner acquire the effective spongy brown surface of dioxide of lead."

It is, in fact, a well-known result, and one which I can thoroughly confirm from the tests and observations to which I have submitted it, that whatever electromotive force the simple contact of dioxide of lead by itself may be sufficiently energetic to produce,[1] it is to a natural aptitude which it possesses besides for occluding ozone or nascent electrolytic oxygen in its pores, and probably also by undergoing at the same time chemical superoxydation, to which its remarkably high tension and effective electromotive deportment in secondary cells must really be ascribed. It is thus that a platinum cathode, by occluding electrolytic hydrogen in its substance, becomes electropositive, and that palladium similarly charged to repletion with hydrogen by electrolysis, even becomes at last spontaneously inflammable.

In Dr. Gore's treatise in the "Circle of the Sciences" on "Electro-Deposition," it is mentioned (pp. 55, 56) that in rapid negative depositions of antimony, the freshly-deposited metal is explosive to such a degree, with evolution of heat and of a cloud of white vapour at points where it is rubbed, that thickly plated articles are sometimes liable to sudden fractures and destruction by this accident, if incautiously handled, even for some hours after they are washed and dried. Either the storage of nascent hydrogen in the antimony, it is supposed, or of an unstable molecular form of antimony itself, is here effected also by the galvanic current; and ozone is a form of oxygen which is only producible by similar means of exciting and provoking molecular accumulation or storage of energy.

The absorbed oxygen's state in the peroxide film would seem to be, as that of occluded hydrogen has appeared to be in metals, one of easy dissociation from, joined and consorted to physical admixture with, some precarious chemical oxide or compound depending, as it seems reasonable to suppose, for its existence in some degree upon the quantity of its free materials present in the substance with it. But the freedom with which the gases are able to diffuse themselves everywhere through the film or metal, is no doubt a sufficient and suitably adequate condition to maintain the precarious compound's chemical integrity, so as to make it a retentive source of energy, as long as the uncombined gas-portions with which it is surrounded in the film or metal, are not withdrawn from it by a galvanic discharge arising from completion either of the secondary circuit or else of some unavoidable channels of destructive local actions.

The contact theory of current excitation requires such close linkage together of circuit elements, for the establishment of a current through them, that if the highly negative peroxide-film should be severed by liquid, or by any substance equally inert to a liquid in the voltaic chain, from its metal plate conductor, its effective electromotive force would immediately disappear from the circuit. This is the ground on which I surmised the need, above, of such a perfect contact between the peroxide film and its metal carrier that only a molecular union produced between them in the charging process could well be expected to prevent the intrusion of the liquid of the cell, to the current's detriment, between the actively electromotive gas-absorbing layer and its adjoining inoperative metal-plate conductor, or battery-connection.

It is, again, to the hints contained in a paragraph on a later page (p. 391) of Prof. Silvanus Thompson's book, describing the phenomena and the modes of producing Nobili's rings, that I owe the suggestion of trying the experiment of iron-gauze electrodes in solution of caustic alkalies, which produced a very satisfactory form of secondary cell, showing at least a possibility of perhaps effecting in it some future practical improvements.

A. S. HERSCHEL

College of Physical Science, Newcastle-on-Tyne, March 20

[1] See Drs. Gladstone and Tribe's experiments and remarks on the relative absorptions and losses of the electrolysed gases in charging a lead-cell; "The Chemistry of the Planté and Faure Accumulators," Part II.; NATURE, xxv. p. 462.

[2] This cell's current lasted forty hours; but a week later a residual current of two more hours' duration was extracted from it.

[1] This was shown by F. Munck, in *Poggendorff's Annalen* (*circa*, 1835), to surpass negatively that of all the other metallic oxides, not excepting the black oxide of manganese, by means of the usual contact experiments with a gold-leaf electroscope and condenser.

Aristotle on the Heart

ALLOW me space to say, in reference to Dr. Richardson's letter in NATURE, vol. xxv. p. 505, that my note on Aristotle's account of the heart, though so lately published, was written many years ago, and therefore in complete independence of Prof. Huxley's article on the same subject. This fact, of course, in no way lessens Prof. Huxley's complete rights of priority; but I am anxious to state it, in order to clear myself of any suspicion of having borrowed from that distinguished writer without acknowledgment. W. OGLE

April 2

Rime Cloud observed in a Balloon

IN his letter, inserted in NATURE, vol. xxv. p. 507, Dr. Hermann Kopp says that "when Kratzenstein (1744) advocated the opinion anticipated by Halley (1686), that water-vapour may be condensed in a vesicular state, he availed himself of the *observation that in clouds and mists and condensed steam over boiling water, a rainbow is not to be observed in reflected light.*" I have good grounds to suppose these negative observations were made only because the intensity of reflected light was not sufficient, as a white rainbow is produced under these circumstances. In support of these assumptions, I may be allowed to quote an observation published by M. Faye in vol. xxviii. of the *Comptes rendus*, 1849, p. 244, where the celebrated astronomer says :—

"J'ai observé cette nuit un phénomène que je signale aux personnes qui l'occupent d'optique méteorologique. En sortant d'une salle de travail qui donne sur le parc de l'observatoire, j'ai remarqué que la lumière d'un bec de gaz en arrière produisait en face de moi par la porte entrouverte un arc-en-ciel blanc semblable à un halo lunaire . . . Cet arc-en-ciel blanc doit être aisement réproduit par les temps de brouillards ; ou pourrait le faire naître a la lumière électrique . . . et l'étudier plus complétement que je ne l'ai fait."

It is to be regretted that the suggestion of the illustrious astronomer has not been taken into account by the physicists in an age when the electric light is so frequently in their hands. I believe that this kind of experimentation will elucidate the controversy, and afford some new ideas on the constitution of clouds under several circumstances, as artificial clouds may be produced by using jets of steam or condensing steam over a boiler. I believe a white rainbow, which is really the corona of the aëronauts, would appear under these circumstances, and the phenomenon would take another aspect when electric light falls on solid snow. The electric lighthouses now building will afford to the keepers many opportunities of making this observation. I take advantage of this opportunity to ask M. Hermann Kopp if he will obligingly suggest some observations to be made in a balloon for examining whether the minute particles of water are liquid or solid. By doing so, he will confer a great benefit on aëronauts next winter. W. DE FONVIELLE

The Kunnungs

HAVING just returned from an exploring expedition east of Asam, where I met a number of "Kunnungs," I may report that they appear distinct, both in language and physique, to the Naga groups south of Asam, and, in language, have affinities with Singphos. Those I saw, were with one exception, much more prepossessing in appearance than the other hill-savages, and in colour very pale, *i.e.* 33 and 45 of Broca's scale. I have got a limited vocabulary. They are great iron and steel workers, and extend from the Mli-kha to what they call the boundary of China, living on pile platform dwellings, raiding like all the hill-men about, having "morongs," or separate houses for the unmarried ; like others, also, their "morals" (as we should say) begin with marriage.

I am now preparing some notes of my trip, and send this as I am writing, as it may interest some to know whom these people seem like. S. E. PEAL

Subsagar, Asam

Burrowing Larvæ

IN his letter *ante* p. 265, Dr. Hagen states that he had "been informed by M. Lesquereux that a large number of magnolia leaves, from the Tertiary of Alaska, show serpentine trails not larger than a thread, running all over the leaves, apparently under the epithelium," and Dr. Hagen evidently believes them to be the mines or burrows of some Tineid larvæ. Precisely such mines are now made in this country, in the leaves of magnolias, by a larva of the genus *Phyllocnistis*, Zell. The moth has not been bred from the larvæ, but the mine and larvæ are indistinguishable from those made by *Phyllocnistis liriodendronella*, Clem., in leaves of *Liriodendron tulipifera*, and doubtless it is the same species in both of these allied trees. "What is a species?" however, is a doubtful question in *Phyllocnistis*, at least in our American species. No species of this or any other genus is known to burrow in the leaves of any of the other genera of plants named in Dr. Hagen's letter besides Magnolia, Liquidambar, and Sassifras. Another *Phyllocnistis* mines the leaves of Liquidambar, and has been described by me under the name of *P. liquidambar-isella*, but it is probably identical with *P. vitifoliella*, Cham. The mine is similar to, but distinct from, that of *P. liriodendronella*. The larva which mines Sassafras leaves is that of *Gracilaria sassafracella*, Cham., but it leaves the mine at a very early stage of larval life, when the mine is too small to be recognised in a fossil leaf, unless it has been unusually well preserved. In this connection I will add that I distinctly remember having *somewhere* seen a figure, by Lesquereux I think, of a fossil leaf of a species of *Acer*, on which there were several blotches, one of which bore a strong resemblance to the mine of *Lithocolletis aceriella*, now made in leaves of *Acer saccharinum* ; but as I saw only the figure, and not the fossil, I cannot be certain that it was a mine of that larva.

Covington, Ky., U.S.A., March 10 V. T. CHAMBERS

Vignettes from Nature

WILL Dr. W. B. Carpenter kindly tell us where in "South America" are the "coprolite diggings" from which he had "just seen a collection of sharks' teeth"? I am aware that at Bull River, South Carolina, North America, are vast deposits of "coprolites" (almost identical in character with those of our Suffolk Cray), which are largely imported into England from the United States. Of these Bull River sharks' teeth, &c., I have had many specimens. W. BUDDEN

Ipswich, March 23

Red Flints in the Chalk

AT one part of Caterham Valley, Surrey, there is an example of an abundance of red flints similar to that mentioned by W. Fream (NATURE, vol. xxv. p. 437). The colour is, doubtless, due to the presence of oxide of iron, but I have not tested it. I find that the red flints invariably contain the remains of sponges, the network of spiculæ of which, being coated with the oxide of iron, show up in crimson or orange on a ground of black flint, and are very beautiful objects under a lens. Thus it appears to me that the redness observable in these flints is mostly due to the inclosure of sponges which contain either oxide of iron or iron which afterwards became oxidised. The yellow oxide of iron is disseminated throughout the *chalk* itself, some strata being very much stained by it. JOHN BADCOCK, Jun.

270, Victoria Park Road, E.

ON THE DISPERSAL OF FRESHWATER BIVALVES

THE wide distribution of the same species, and of closely-allied species of freshwater shells must have surprised every one who has attended to this subject. A naturalist, when he collects for the first time freshwater animals in a distant region, is astonished at their general similarity to those of his native European home, in comparison with the surrounding terrestrial animals and plants. Hence I was led to publish in NATURE (vol. xviii. p. 120) a letter to me from Mr. A. H. Gray, of Danversport, Massachusetts, in which he gives a drawing of a living shell of *Unio complanatus*, attached to the tip of the middle toe of a duck (*Querquedula discors*) shot on the wing. The toe had been pinched so hard by the shell that it was indented and abraded. If the bird had not been killed, it would have alighted on some pool, and the Unio would no doubt sooner or later have relaxed its hold and dropped off. It is not likely that such cases should often be observed, for a bird when shot would generally fall on the ground so heavily that an attached shell would be shaken off and overlooked.

I am now able to add, through the kindness of Mr. W. D. Crick, of Northampton, another and different case. On February 18 of the present year, he caught a female *Dytiscus marginalis*, with a shell of *Cyclas cornea* clinging to the tarsus of its middle leg. The shell was ·45 of an inch from end to end, ·3 in depth, and weighed (as Mr. Crick informs me) ·39 grams, or 6 grains. The valves clipped only the extremity of the tarsus for a length of ·1 of an inch. Nevertheless, the shell did not drop off, on the beetle when caught shaking its leg violently. The specimen was brought home in a handkerchief, and placed after about three hours in water; and the shell remained attached from February 18 to 23, when it dropped off, being still alive, and so remained for about a fortnight while in my possession. Shortly after the shell had detached itself, the beetle dived to the bottom of the vessel in which it had been placed, and having inserted its antennæ between the valves, was again caught for a few minutes. The species of Dytiscus often fly at night, and no doubt they generally alight on any pool of water which they may see; and I have several times heard of their having dashed down on glass cucumber frames, no doubt mistaking the glittering surface for water. I do not suppose that the above weight of 6 grains would prevent so powerful an insect as a Dytiscus from taking flight. Anyhow this beetle could transport smaller individuals; and a single one would stock any isolated pond, as the species is an hermaphrodite form. Mr. Crick tells me that a shell of the same kind, and of about the same size, which he kept in water "extruded two young ones, which seemed very active and able to take care of themselves." How far a Dytiscus could fly is not known; but during the voyage of the *Beagle* a closely-allied form, namely, a Colymbetes, flew on board when the nearest point of land was forty-five miles distant; and it is an improbable chance that it had flown from the nearest point.

Mr. Crick visited the same pond a fortnight afterwards, and found on the bank a frog which appeared to have been lately killed; and to the outer toe of one of its hind legs a living shell of the same species was attached. The shell was rather smaller than in the previous case. The leg was cut off and kept in water for two days, during which time the shell remained attached. The leg was then left in the air, but soon became shrivelled; and now the shell being still alive detached itself.

Mr. F. Norgate, of Sparham, near Norwich, in a letter dated March 8, 1881, informs me that the larger water-beetles and newts in his aquarium "frequently have one foot caught by a small freshwater bivalve (*Cyclas cornea ?*), and this makes them swim about in a very restless state, day and night, for several days, until the foot or toe is completely severed." He adds that newts migrate at night from pond to pond, and can cross over obstacles which would be thought to be considerable. Lastly, my son Francis, while fishing in the sea off the shores of North Wales, noticed that mussels were several times brought up by the point of the hook; and though he did not particularly attend to the subject, he and his companion thought that the shells had not been mechanically torn from the bottom, but that they had seized the point of the hook. A friend also of Mr. Crick's tells him that while fishing in rapid streams he has often thus caught small Unios. From the several cases now given, there can, I think, be no doubt that living bivalve shells must often be carried from pond to pond, and by the aid of birds occasionally even to great distances. I have also suggested in the "Origin of Species" means by which freshwater univalve shells might be far transported. We may therefore demur to the belief doubtfully expressed by Mr. Gwyn Jeffreys in his "British Conchology," namely, that the diffusion of freshwater shells "had a different and very remote origin, and that it took place before the present distribution of land and water."

CHARLES DARWIN

THE FISHERY EXHIBITION AT EDINBURGH

IT has now been placed beyond doubt that this exhibition will prove successful, so far as a great show of interesting exhibits is concerned. Such exhibitions, of course, partake in some degree of the nature of a commercial adventure—the projectors being dependent on the gate money to pay the expenses incurred, which are naturally heavy—although the prize list has been largely contributed to by private individuals and public bodies. Such an exhibition being a novelty will no doubt attract, from day to day, a considerable body of spectators, although it is deprived of many attractive features by reason of the place of exhibition not being fixed on the immediate sea-coast. It would have proved interesting, could the spectators have been shown the beam trawl at work, or have had displayed before them a suite of herring nets, or other items of the machinery of fish capture. Such apparatus will be largely displayed in the place of exhibition, but their effects cannot so well be judged as when they are seen in action. Upwards of seventy prizes are offered for "exhibits" and "essays"; the latter, indeed, seem to be a chief feature of the exhibition, and if they can be utilised for behoof of the public and the fisher people, some good may result. But, although a large number of prizes were given for essays at the Norwich Fishery Exhibition of last year, the public have not been made any the wiser in consequence. A very handsome surplus resulted from the Norwich exhibition—nearly a thousand pounds it is said. Why, then, has not a portion of that sum been devoted to the dissemination of the knowledge contained in the prize essays? As regards the "exhibits," they can always be seen and understood by those who please to look at them, and if there are half a dozen of the same sort, they can be compared one with the other, and the decisions of the judges can be criticised, so that persons in search of new boats or other fishing gear, can give their orders for the same in the direction they think most suitable. But with respect to the essays the knowledge contained in these productions—judging from what took place at Norwich—will remain buried in the brains of the committee! Of what possible use is it to bestow a prize on the writer of an essay, "On the Fish Supplies of Great Cities, with special reference to the best Methods of Catching and Packing," if the knowledge thus obtained is never to become public? The prize list of the Edinburgh Exhibition is rich in material for the essayist, many subjects of interest in the fishery world being selected for illustration, such as the salmon disease, oyster culture, the migrations and spawning of sea fish, the utilisation of fish offal, the best methods of preserving fish alive for markets, the pollution of rivers, the natural history of the herring, and twenty other subjects. In view of the still larger international fishery exhibition, which will take place in London next year, it is time this question of "what ought to be done with the prize essays," should be ventilated and settled. Up till this moment it remains a blot on the Norwich exhibition that none of the prize essays sent there have been made public. So far as we know, only one of the essays has become accessible; that is the essay, on the salmon disease, by Sir James Gibson Maitland, which, however, was printed at the baronet's own expense. The exhibition at Edinburgh will be very much on the lines of those which took place some years ago at the Hague and Arcachon, except that the most attractive feature of the latter exhibition will be wanting in the well-arranged aquarium. Neither in Edinburgh nor in London can we hope to compete with the great fishery show of Berlin, which was undoubtedly very complete, the American national exhibits being of much interest. At home we have no fishery collection of a national kind, if we except Buckland's Museum of Economic Fish Culture; and, so far, we are at a disadvantage with the United States, which possesses a very complete collection of fishery apparatus of all kinds. It is to be hoped, in the circumstances, that America will do for this country what it did for Germany, give us an opportunity of seeing and judging for ourselves how far they are ahead of us in fishery economy. We shall doubtless be able, when the exhibition opens, to find some points of interest worthy of being alluded to in a future number of NATURE.

THE WINGS OF PTERODACTYLES[1]

THE first Pterosaurians discovered were recognised as flying animals, but were thought to be bats. As soon as their general structure became known, they were classed with the reptiles, although it was considered possible that their power of flight was due to feathers. Later their bones were mistaken for those of birds by various experienced anatomists, and others regarded them as sharing important characters with that group. Some anatomists, however, believed that the fore-limbs of Pterodactyles were used for swimming rather than for flight, and this view has found supporters within the present decade. A single fortunate discovery, made a few years since, has done much to settle the question as to the wings of Pterodactyles, as well as their mode of flight, and it is the aim of the present article to place on record some of the more important facts thus brought to ight.

The specimen to be described was found in 1873, near Eichstädt, Bavaria, in the same lithographic slates that have yielded *Archæopteryx*, *Compsognathus*, and so many other Jurassic fossils known to fame. This specimen, which represents a new species of the genus *Rhamphorhynchus*, is in a remarkable state of preservation. The bones of the skeleton are nearly all in position, and those of both wings show very perfect impressions of *volant membranes* still attached to them. Moreover, the extremity of the long tail supported a separate vertical membrane, which was evidently used as a rudder in flight. These peculiar features are well shown In Fig. 1, which represents the fossil one-fourth the natural size.

The discovery of this unique specimen naturally attracted much attention at the time, and many efforts were made to secure it for European museums. The writer was then at work on the toothless Pterodactyles which he had recently found in the Cretaceous of Kansas, and believing the present specimen important for his investigations, sent a message by cable to a friend in Germany, and purchased it for the museum of Yale College, where it is now deposited.

The Wing Membranes.—A careful examination of this fossil shows that the patagium of the wings was a thin

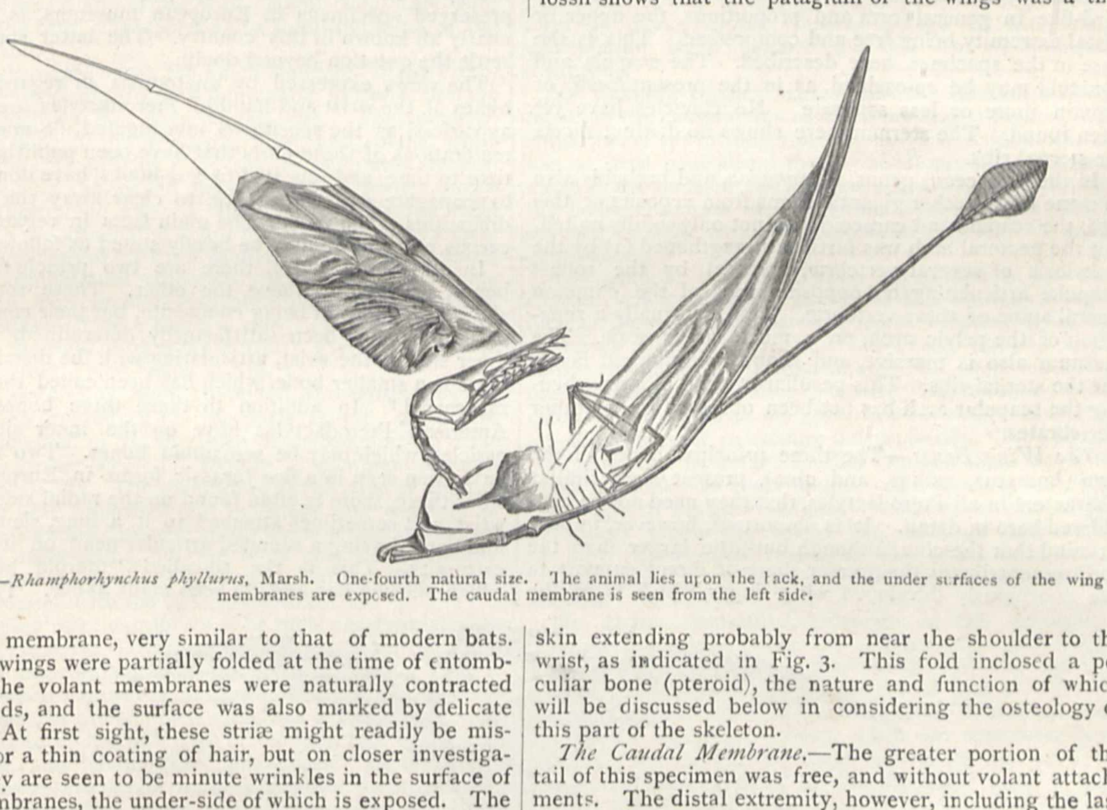


FIG. 1.—*Rhamphorhynchus phyllurus*, Marsh. One-fourth natural size. The animal lies upon the back, and the under surfaces of the wing membranes are exposed. The caudal membrane is seen from the left side.

smooth membrane, very similar to that of modern bats. As the wings were partially folded at the time of entombment, the volant membranes were naturally contracted into folds, and the surface was also marked by delicate striæ. At first sight, these striæ might readily be mistaken for a thin coating of hair, but on closer investigation they are seen to be minute wrinkles in the surface of the membranes, the under-side of which is exposed. The wing membranes appear to have been attached in front along the entire length of the arm, and out to the end of the elongated wing finger. From this point the outer margin curved inward and backward, to the hind foot.

The membrane evidently extended from the hind foot to near the base of the tail, but the exact outline of this portion cannot at present be determined. It was probably not far from the position assigned it in the restoration attempted in the cut given below, Fig. 3. The attachment of the inner margin of the membrane to the body was doubtless similar to that seen in bats and flying squirrels.

In front of the arm there was likewise a fold of the skin extending probably from near the shoulder to the wrist, as indicated in Fig. 3. This fold inclosed a peculiar bone (pteroid), the nature and function of which will be discussed below in considering the osteology of this part of the skeleton.

The Caudal Membrane.—The greater portion of the tail of this specimen was free, and without volant attachments. The distal extremity, however, including the last sixteen short vertebræ, supported a vertical membrane, which is shown in Fig. 1 and also in Fig. 2. This peculiar caudal appendage was of somewhat greater thickness than the patagial membrane of the wings. It was rhomboid in outline, and its upper and lower portions were slightly unequal in form and size. The upper part was kept in position by a series of spines, sent off one from near the middle of each vertebral centrum, and thus clearly representing neural spines. The lower half also was strengthened by similar spines, which descended from near the junction of the vertebræ, and hence were homologous with chevron bones. These spines were cartilaginous, and flexible, but sufficiently firm in texture to keep the membrane in an upright position.

The Scapular Arch.—The osteology of the scapular

[1] Communicated by the author. This article will also appear in the *American Journal of Science* for April.

arch and wings of Pterodactyles involves many interesting points, some of which have been discussed by anatomists from Cuvier to those of the present day, but with little agreement of opinion. The cause of this diversity of opinion is mainly due to the fact that the specimens examined have been either too small or too imperfect for accurate determination of their more obscure parts. Fortunately, the museum of Yale College has among its specimens of Cretaceous Pterodactyles (some 600 in all), quite a number with the scapular arch and wing-bones nearly perfect, and in position. These specimens were nearly all of gigantic size, having in life a spread of wings from fifteen to twenty feet. They were also destitute of teeth, and belong to the order *Pteranodontia*. Probably

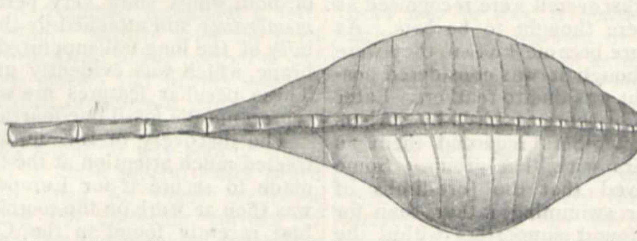


FIG. 2.—Caudal extremity of *Rhamphorhynchus phyllurus*, Marsh; natural size. Seen from the left side.

their great size induced special modifications of the scapular arch, which is here far more complicated than in any other members of the group.

In the Jurassic Pterodactyles, the scapula is usually bird-like in general form and proportions, the upper or distal extremity being free and compressed. This is the case in the specimen here described. The scapula and coracoid may be co-ossified, as in the present fossil, or remain more or less separate. No clavicles have yet been found. The sternum here shows no distinct facets for sternal ribs.

In the Cretaceous genus, *Pteranodon*, and probably also in some of the other gigantic forms from deposits of this age, the scapula and caracoid were not only solidly united, but the pectoral arch was further strengthened (1) by the ankylosis of several vertebræ, and (2) by the robust scapulæ articulating on opposite sides of the common neural spine of these vertebræ. This is virtually a repetition of the pelvic arch, on a much larger scale. The sternum also is massive, and shows well-marked facets for the sternal ribs. This peculiar method of strengthening the scapular arch has not been observed in any other vertebrates.

The Wing Bones.—The three principal bones of the arm (humerus, radius, and ulna), present such similar characters in all Pterodactyles, that they need not be considered here in detail. It is important, however, to bear in mind that the ulna, although but little larger than the radius, contributes the greater share of direct support to the enormously developed wing finger, which is on the outer or ulnar side of the hand. As this position has been a question of discussion among anatomists, it may be well to state, that the writer bases his opinion upon this point on the results of an examination of the best preserved specimens in European museums, as well as nearly all known in this country. The latter specimens settle the question beyond doubt.

The views expressed by anatomists in regard to the bones of the wrist and hand of Pterodactyles are almost as various as the specimens investigated. Some of the restorations of these parts that have been published from time to time, and repeated in text-books, have done much to propagate errors, and little to clear away the serious difficulties in the case. The main facts in regard to the carpus now known may be briefly stated as follows:—

In all Pterodactyles, there are two principal carpal bones, placed one above the other. These sometimes show indications of being composite, but their constituent parts have not been satisfactorily determined. On the inner side of the wrist, articulating with the distal carpal, there is a smaller bone, which has been called the "lateral carpal." In addition to these three bones, some American Pterodactyles have on the inner side three ossicles, which may be sessamoid bones. Two of these have been seen in a few Jurassic forms in Europe. Besides these, there is often found on the radial side of the wrist, and sometimes attached to it, a long, slender styloid bone, having a rounded articular head on its carpal extremity. This is the so-called "pteroid bone," to which allusion has already been made above. This bone

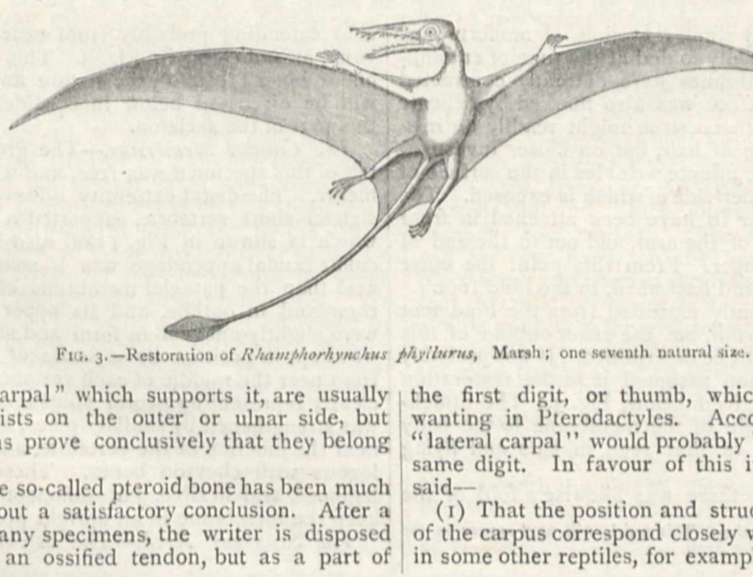


FIG. 3.—Restoration of *Rhamphorhynchus phyllurus*, Marsh; one seventh natural size.

and the "lateral carpal" which supports it, are usually placed by anatomists on the outer or ulnar side, but American specimens prove conclusively that they belong on the radial side.

The nature of the so-called pteroid bone has been much discussed, but without a satisfactory conclusion. After a careful study of many specimens, the writer is disposed to regard it, not as an ossified tendon, but as a part of the first digit, or thumb, which is often considered wanting in Pterodactyles. According to this view, the "lateral carpal" would probably be the metcarpal of the same digit. In favour of this interpretation it may be said—

(1) That the position and structure of this appendage of the carpus correspond closely with that of the first digit in some other reptiles, for example, *Iguanodon*.

(2) The "lateral carpal" unites both with the distal carpal and with the "pteroid" by very free, well-defined articulations.

(3) In American specimens, the "lateral carpal" stands nearly at right angles to the wrist, and the "pteroid" is much bent near its articular end.

(4) In no Pterodactyle known is there any remnant of a digit outside the wing finger, where the membrane might be expected to retain it.

(5) This view would make the wing finger of the fifth digit, the same to which the membrane is attached in the hind foot.

Perhaps the strongest objection against this interpretation is the number of phalanges in the respective digits of the hand. These, however are not constant in the known Pterodactyles, and they vary much in other reptiles which have the digits highly specialised. This subject will be more fully discussed by the writer elsewhere.

According to the above interpretation, there are five digits in the hand of Pterodactyles, although not the five often given in restorations. The first digit, the elements of which have been considered, undoubtedly supported a membrane in front of the arm. The second, third, and fourth are small, and armed with claws. The large wing finger is the fifth, corresponding to the little finger of the human hand.

The metacarpal bones are much elongated in the Pterodactyles with short tails, and quite short in those, like the present specimen, that have the tail long. The metacarpal of the wing finger is always large and robust, while those of the claw bearing digits are usually quite slender. In *Pteranodon*, the second metacarpal is a slender thread of bone throughout most of the length, while the third and fourth are attenuated splint bones, incomplete above.

The phalanges of the three middle digits are quite short, and the terminal ones supported sharp claws. The wing finger has four greatly elongated phalanges, the last being a styloid bone without a claw. This digit is well shown in the right wing represented in Fig. 1, and also in the restoration, given below in Fig. 3.

In the restoration here attempted, the writer has endeavoured to reproduce (1) the parts actually present or clearly indicated in the specimen described, and (2) those which the former seemed to require to complete the outward form in life. The membrane at the base of the tail may have been somewhat less in extent, and the fold of the skin above the fore-arm either more or less developed than here represented, but the facts now known render the outlines here given more than probable. The hands are represented with the palms forward.

The present species appears to be most nearly related to *Rhamphorhynchus Gemmingi*, von Meyer, from the same geological horizon, and near the same locality. That it is quite distinct, however, is shown, aside from the difference in size, by the complete ankylosis of the scapula and coracoid, and by the fifth digit of the hind foot being well developed, and having three phalanges. In the name *Rhamphorhynchus phyllurus*, here proposed for the species, the latter designation refers to the leaf-shaped caudal appendage, which appears to be one of its most characteristic features.

For the long delay in the description of this important European specimen, the writer can only plead *l'embarras des richesses* nearer home. O. C. MARSH

Yale College, New Haven, March 14

THE INSTITUTION OF NAVAL ARCHITECTS

THE annual meetings of the Institution were held this year on the 29th, 30th, and 31st of March. The programme included no less than nineteen papers, not one of which could in any sense be called a stop-gap. It seems a pity that this Institution should hold but one meeting in the year. The time available for reading papers on the three days amounts in all to but twenty hours, which leaves about one hour for the reading and discussion of each paper. It is no exaggeration to say that many of the subjects considered at the recent meetings required a whole day for their adequate discussion, and would have received this allowance of time at any other institution. The true interests of the naval architects are sure to suffer in the long run, if the present policy of cramming so many papers into the short space of time available at the meeting is adhered to. The first paper read, and the only one which dealt directly with ships of war, was by Mr. Samuda. It was an attempt to controvert the arguments made use of by Sir Wm. Armstrong in his recent address to the Institution of Civil Engineers. The address in question has been generally construed into a defence of unarmoured as against iron-clad ships. Sir William Armstrong states that for the cost of one iron-clad we could have three unarmoured ships, each carrying the armament of the iron-clad, and that in a match between the iron-clad and her three supposed antagonists they would probably get the better of it. Mr. Samuda, however, points out, that in fleet fighting, which he supposes will in the future, as in the past, be the principal form of naval combat, this advantage of the many unarmoured ships against the few iron-clads would disappear.

Mr. Samuda further argues that the recent improvements in the construction of the hulls and armour of war ships, due to the introduction of mild steel instead of iron, has at least neutralised the extraordinary improvements made in the guns in the last few years. He also warned his hearers against the disastrous consequences which may be brought about through false economy in naval construction.

The opinion of the meeting as evoked in the discussion was certainly in favour of Mr. Samuda's arguments. Several distinguished naval officers, including Admirals Hornby and De Horsey, and Captain Noel, spoke emphatically of unarmoured war ships as being utterly useless for fighting purposes if opposed by iron-clads. They dwelt on the great value of even a moderate amount of armour, in keeping out projectiles which struck obliquely, and in actual combat but few shots would be likely to strike at right angles. Mr. Burnaby also lent the weight of his great authority to the same view of the question. Upon the whole Mr. Samuda may claim to have considerably modified the effect which was pretty generally produced by Sir William Armstrong's address.

Mr. Dunn, Assistant-Constructor at the Admiralty, read an interesting paper on Modern Merchant Ships. This communication dealt incidentally with the capacity of merchant ships for being converted into cruisers for the protection of other merchant vessels in time of war. This is an important subject, when we remember how miserably inadequate the royal navy is for this purpose. The actual money value of the merchant navy of this country falls little, if at all short, of two hundred millions sterling. If to this sum, we add the value of the freight carried, it will be easy to understand how vulnerable as a nation we are at sea. Mr. Dunn has for some time past been employed by the Admiralty in surveying those vessels, which are intended, should the occasion ever arise, to supplement the regular navy in defending the mercantile marine. The important qualities which a merchant steamer must possess in order to be capable of being converted into a man-of-war are speed, structural strength, considerable relative beam, and powerful steering gear. In all these points it is satisfactory to learn that much progress has been made during the last few years. Taking first the question of speed. Between the years 1875 and 1882, the number of steamers capable of steaming 13 knots and upwards continuously at sea has increased from twenty-five to sixty-five. In 1875 there were ten vessels capable of steaming over 14 knots, now there are thirty-five, while the highest speeds have been increased from 15 to 17 knots. At the same time the power of these vessels of keeping the seas has been greatly increased through the improvements which have been effected in the economy of the marine engine. There are many steamers which can carry coal enough to steam round the world at a 10 knot speed.

The structural strength of merchant vessels has undergone a remarkable improvement during the last few years, thanks to the increased attention which has been paid to their longitudinal strength, and also to the introduction of steel as a material of construction and of cellular as double bottoms. Doubts have been frequently expressed as to the capability of merchant steamers for carrying guns. A direct experiment was made on this point by the Admiralty in 1878, during the height of the Russian scare, by the purchase by the Admiralty of the *Hecla* from Messrs. Harland and Woolf of Belfast. She was armed with five 64-pounders and one 40-pounder, mounted on truck carriages, and has been in commission ever since, and most favourably reported on. As another example we may mention the case of an Irish cattle-boat which was purchased by the Chilians and armed with an 11-ton gun, and which was employed in the bombardment of the Peruvian ports.

Another most important point in considering the question of the structural strength of these steamers is the question of subdivision by water-tight bulkheads. There has been a strange apathy on this subject till very recently in the mercantile marine. Lloyd's rules insisted on the introduction of four bulkheads, viz. one at each end of the ship, and one at each end of the machinery space. The compartments into which a ship was thus subdivided were in general so large that if one of them filled the vessel went down. In many long passenger steamers where more numerous bulkheads were introduced, their useful effect was done away with by the doors through them not being water-tight; or occasionally by their heads being below the water-level. It is however some satisfaction to know that all the passenger vessels built during the last three or four years for the principal lines are properly subdivided.

It is a matter for regret that Mr. Dunn's official position prevented him from enlightening his audience as to the exact degree of useful help which we may look for from this auxiliary navy in case of actual need. We are also left without any information as the organisation, if any, which exists for rapidly equipping and manning these vessels whenever their services may be called for. Considering the scare which was produced in this country in 1878, by the attempt made by the Russians to convert a few American merchant steamers of very moderate speed into cruisers of the Alabama type, it seems only reasonable to hope that, by utilising the immense resources of our merchant marine, we may find the means of avoiding such panics in the future.

There were some interesting papers read on the subject of marine engines and boilers. Mr. Kirk, of the firm of Messrs. J. R. Napier and Sons, of Glasgow, read an interesting paper on the triple expansive or compound engines which he has recently fitted to the S.S. *Aberdeen;* and Mr. Parker, Chief Engineer Surveyor to *Lloyd's Register*, followed with a general paper on the subject of triple and double compound engines. Thoughtful students of the steam-engine have for some time recognised the fact that one of the principal sources of waste in engines which use steam expansively, is the variation in temperature of the cylinder, due to the difference between the temperature of the steam at the pressures at which it enters and leaves the cylinder. The greater the difference in these pressures, *i.e.*, the greater the range of expansion, the greater also is the difference between the initial and final temperatures of the steam. The consequence is, that the incoming steam finds the cylinder chilled; a portion of the steam as it enters is condensed, causing a loss of pressure and of useful work. As the steam expands and becomes colder than the surrounding walls of the cylinder, a portion of the condensed steam is re-evaporated towards the end of the stroke, and during the exhaust when it can do no useful work. Thus the cylinder at the commencement of the stroke acts as a condenser, and during the end of the stroke and the exhaust as a boiler. It was to obviate the waste due to the above causes that the compound engine was introduced. In this latter class the steam, instead of being expanded throughout in one cylinder, was allowed to expand partially in a high pressure, and subsequently in a low pressure cylinder. Thus the difference in temperature for each cylinder was halved, and the waste due to condensation proportionately diminished. By degrees, however, the pressures made use of in marine boilers were increased, and consequently the range of temperatures even in compound engines became as great as in the old simple expansive engine using lower pressures. To get over this difficulty Mr. Kirk made use of the triple expansive engine, which is really a compound engine again compounded, the steam being expanded successively in three cylinders. In this way the range of temperature is divided into three parts. In the case of the *Aberdeen* the boiler pressure was 125 lbs. per square inch, and the diameters of the cylinders were respectively 80 in., 45 in., and 70 in., by 4 ft. 6 in. in stroke. During a four hours' trial with Penrikyber Welsh coal, the consumption was found to be only 1·25 lbs. per indicated horse power per hour, from which very satisfactory result we should be led to expect a sea consumption of from 1·5 to 1·6 lbs.

Mr. Milton, of *Lloyd's Register*, read a paper on the influence of Lloyd's Rules on marine boiler construction. This paper was called forth by Mr. Marshall's statement at the Mechanical Engineers' meeting at Newcastle, that "the ordinary marine boiler, encumbered as it is by the regulations of the Board of Trade and of Lloyd's Committee, does not admit of much reduction in the weight of material or of water carred when working." Mr. Milton has endeavoured with considerable success to prove that the above remark, so far at least as it applies to Lloyd's, is far from expressing the truth. He explains very clearly the principles on which Lloyd's base their rules. The most important part of his paper is that in which he attempts to show that Fairbairn's rules, as to the strength of cylinders pressed from without, are very erroneous when applied to flues having the dimensions of those of marine boilers. Mr. Milton does not speak hopefully of the use of locomotive boilers for marine purposes. We trust, for the sake of the country, that his experience may not be confirmed by the Admiralty experiments with the *Polyphemus*, which vessel is, as is well known, entirely fitted with boilers of the locomotive type.

Mr. W. H. White, Chief Constructor at the Admiralty, read a most important paper on the Revision of the Tonnage Laws, which we intend to make the subject of a separate notice. It was followed by two communications from Mr. Martell, Chief Surveyor at Lloyd's, and Mr. W. Rundell, Secretary of the *Liverpool Underwriter Register*, on the subject of Load Line, a topic which for many years past has been the subject of much heated argument. Mr. Martell discusses freely the latest proposals of the Board of Trade, and considers in detail the practical considerations which should determine the load line for vessels of various clasess. He is of opinion that the day has passed for the acceptance by shipowners and builders of any scheme for loading which does not take cognisance of the *form* and other elements of a vessel, in addition to the length, depth, or size. He winds up his paper with the following sentence, which may well be commended to the shipowning community. "I cannot help feeling that shipowners in their own interests would adopt a wise course by supplying correct data, and otherwise considering the question of framing rules, based on sound principles, which would take cognisance of all the surrounding elements affecting this complex question, and thereby enable rules and tables to be framed which would be accepted as a fair compromise, and equitable and sound reference for the future guidance of all interested in this important subject, and the result of which would, without doubt, tend to diminish the loss of much valuable property and the sacrifice of many human lives."

Messrs. Read and Jenkins, of *Lloyd's Register*, contribute a valuable investigation into the transverse strains of iron ships. This subject was, we believe, first investigated vigorously by Mr. W. John, who read a paper on the same subject in 1877, before the Institution of Naval Architects. The method of treatment pursued by Messrs. Read and Jenkins is too technical to reproduce at length in these pages. After investigating the strains of four steam-vessels, supposed to be docked when loaded with cargo of the density of coal, up to the height of the lowest tier of beams, they conclude with the important observation that the results demonstrate, in an unmistakable manner, how necessary it is to provide additional transverse strengthening in the engine and boiler space in steam-vessels, where the localised weights of the engines and boilers, and the want of support from the deck above, due to the small number of beams, increase the strain of the middle line and bilge.

The most interesting of the remaining papers were two by Mr. T. Harvard Biles, naval architect to Messrs. J. and G. Thompson, of Glasgow, on Progressive Speed Trials, and on the Curves of Stability of Certain Mail Steamers. The former paper was of great practical value to naval architects, as it affords to all the means of carrying out progressive trials with ease and rapidity. Mr. Biles abandons the measured mile trial, because of the inseparable inaccuracies which attended it. These were due to the varying and unknown rate at which the tide flows, and to the impossibility of knowing whether the ship, when she comes on the mile, is running at her proper speed, or is accelerating her own motion. Mr. Biles throws out from the bow of the ship a floating object which is observed as it passes a set of transverse sights fixed on the ship about one hundred feet from the bow, and again when it passes another pair of sights fixed at a given distance from the first pair. The time occupied in the transit is recorded by an electric apparatus, which also at the same time records seconds automatically, and also the number of revolutions of the engine. The floating object moves with the tide, and therefore the speed of flow of the latter need not be taken into account. By means of this apparatus, builders can measure the true speed at which their vessels are travelling when steaming right ahead, and consequently can derive all the information to be obtained from progressive trials, without resorting to the old-fashioned, tedious system of runs on the measured mile.

We regret that want of space prevents us from noticing the remaining papers read at these meetings, not one of which was deficient in interest.

NEW AND VERY RARE FISH FROM THE MEDITERRANEAN

On a long ichthyological excursion which I undertook by order of the Minister of Public Instruction in November and December last, during which I explored our Adriatic coast from Ancona to Lecce, the Ionian shores from Taranto to Reggio (Calabria), and visited the two seas of Sicily, collecting principally at Messina, Catania, and Palermo; I collected above 2000 specimens of fish, amongst which were many rare species, and several quite new to the ichthyofauna of the Mediterranean. Amongst the latter I may mention a large and perfect specimen of *Molva vulgaris*, found in the market of Catania; this is a North Atlantic species, and has not yet been recorded from the Mediterranean; there has been, it is true, for many years a dried skin specimen in the Genoa University Museum, which was figured in 1864 by Canestrini as *Haloporphyrus lepidion*, and six years afterwards corrected by the same author as *Lota vulgaris*. About a year ago Dr. Vinciguerra and myself determined it correctly, but as no data as to its capture had been preserved, we were in considerable doubt as to its being a Mediterranean specimen. At Palermo, where I went after leaving Catania, I found a third Italian specimen of this species. At Messina I collected two specimens of *Scorpæna ustulata*, Lowe, aud a fine specimen of *Umbrina ronchus*, Val., both new, to our fauna. I believe that most of the Madeira species will eventually be found in the Mediterranean, especially off the Sicilian coasts. Messina is a splendid locality for deep-sea or pelagic forms; it appears that during stormy weather, especially from the south-east, many abyssal species are in some way thrown up, and may be found in hundreds floating in the Messina harbour, which stretches like a net or trap across the Straits; such are *Chauliodus*, *Stomias*, *Argyropelecus*, *Microstoma*, *Coccia*, *Maurolicus*, *Gonostoma*, and some ten or twelve species of *Scopelus*. While there last November I secured a fine *Malacocephalus lævis*, and a singular fish of a deep black colour, with small eyes and a naked skin, and a most *abyssal* physiognomy, which is quite new to me, and which I have not yet been able to determine; it may be allied to *Malacosteus*.

I shall close these notes by mentioning the capture of a very strange fish (belonging to the singular *Notacanthi*), which may well be called the *rarest* of fishes. It is a small specimen evidently closely allied to *Notacanthus Rissoanus*, De Filip, but which appears to present some notable differences; I have not yet been able to compare it with the unique and type specimen of *N. Rissoanus*, from Nice, now in the Turin Zoological Museum, and of which no *scientific* description was ever published. My specimen was also caught near Nice in August of last year. *N. Rissoanus* should be generically distinguished from the other known species from which it differs in many essential characters. Lütken and I believe Günther have expressed the same opinion. I should, therefore, propose the name *Paradoxichthys*, and should that term be pre-occupied, the equivalent *Teratichthys*. Should the specimen I have turn out specifically distinct from *P. Rissoanus*, I should like to call it *Paradoxichthys Garibaldianus*, dedicating it to a great Nizzardo and fellow-countryman of Risso.

Florence, March 23 HENRY H. GIGLIOLI

PROF. BARFF'S NEW ANTISEPTIC

In a communication to the Society of Arts, March 29, 1882, a long and interesting paper was read by Prof. Barff on a "New Antiseptic Compound" applicable to the preservation of articles of food.

The compound in question is an ether of boric acid and glycerine of the composition $BO_3C_3H_5$ (the chemical description in the paper is inaccurate), first obtained by Schiff and Becchi (*Compt. Rendus*, 62, p. 397, and *J. pr. chem.*, 98, 184). Experiments made with this substance on various articles of food, both solid and liquid, seem to have yielded very satisfactory results, as far as the preserving action is concerned; but neither in the paper nor in the interesting discussion which followed its reading does it appear that the preserving action is due specially to the compound in question, or to one of its constituents.

That boric acid acts as a preventive of decomposition in organised bodies when present in considerable quantity there is no doubt, but very little is known of its action in those cases, and practically nothing is known of its action on the human economy, especially when taken in the considerable doses that would be contained in the substances preserved by this proposed compound. So that it seems at least desirable that a little more inquiry should be made as to the physiological action of boron compounds before it is proposed as a wholesale preserver of food stuffs.

Of the other constituent of this compound something more is known. It exists naturally in many articles of food or drink, and its physiological action has been to a considerable extent investigated, and proved to be on the whole quite harmless.

As a preservative against fermentive or bacterial action, it has also been investigated more fully than boric acid.

In a concentrated condition it will resist both ordinary fermentation and the fermentation of various bacteria in a high degree.

As the compound $BO^3C_3H_5$ is decomposed into boric hydrate and glycerine on contact with water, it would scarcely appear that there is any advantage in forming the etherial compound.

It would appear indeed that all the preservative effects claimed for this ether can be obtained by the use of glycerine alone, thus excluding a possible source of danger in the use of a comparatively unknown substance (physiologically) like boric acid (see Kletzinsky, *Dingl. pol. J.*, 171, 370; Kunath, *ibid.*, 193, 439; Wagner, *Jahresb.*, 1868, 523; Fleck, *Dingl. pol. J.*, 196, 487).

NOTES

WE are pleased to learn that the Imperial Government has granted a sum of 2500*l.* (1500*l.* this year, and 1000*l.* next), and that the Canadian Government has further voted $4000 for a station for circumpolar observations.

IN the discussion on the New Code, on Monday night, in the House of Commons, Sir John Lubbock pointed out several of its weak points as regards the teaching of science. He complained that children of the fourth standard were excluded from specific subjects, and that, as at present worded, children who take class subjects, might never be taught any science at all, as one of them must be English, and another might be history. It would certainly be disappointing, if, after so much thought had been expended in drawing up the New Code, the evident desire of its framers to encourage science teaching should have been defeated. Mr. Maskelyne, Lord G. Hamilton, and others, while supporting Sir John Lubbock's criticisms, pointed out other defects, which, we hope, will have Mr. Mundella's attention. Indeed, he promised to take the suggestions made into consideration, and, we believe, that if he does so seriously, he will see it to be advisable so to frame the regulations as to class and special subjects as to secure that the elements of natural knowledge will have a chance of becoming a regular part of elementary education. The old bugbear attached to the name "elementary science," and to scientific terminology, was alluded to again, but that is a bugbear long ago dissolved, and not worth a moment's consideration; by all who have given the matter any attention, or who have had any experience in teaching, it is admitted that nothing is more interesting to children of all ages than "object lessons," *i.e.* practical instruction in science, and nothing more dreary and unprofitable than "grammar" as usually taught. Our New Code as it stands is a contrast, so far as science is concerned, to the Primary Education Act of France, which has just been promulgated. The Primary Education which is compulsory in France comprises "Moral and civil instruction, reading, writing, geography, history, some notions of law and political economy, the elements of natural, physical, and mathematical science, their applications to agriculture, health, industrial arts, manual labour, and the use of the tools of the principal crafts, the elements of drawing, modelling, and music, gymnastics, for boys military drill, for girls needlework." We shall doubtless reach this standard some day, and one step to it would be to make attendance at school compulsory on all up to the age of fourteen years.

DR. NACHTIGAL, the well-known African explorer, has been appointed German Consul in Tunis.

M. PAUL BERT was on Monday elected a Member of the Paris Academy of Sciences, in the Medical Section.

THE directors of the Crystal Palace have appointed the following twenty-one British jurymen for the International Electric Exhibition:—Capt. Abney, R.E., F.R.S., Prof. W. Grylls Adams, F.R.S., Major R. F. Armstrong, R.E., Prof. W. E. Ayrton, F.R.S., Mr. Shelford Bidwell, Sir S. Canning, Prof. R. B. Clifton, M.A., F.R.S., Mr. T. R. Crampton, C.E., Mr. Horace Darwin, Prof. G. Carey Foster, F.R.S., Prof. E. Frankland, F.R.S., Capt. Douglas Galton, C.B., F.R.S., Lieut.-Col. W. Haywood, Dr. J. Hopkinson, F.R.S., Prof. D. E. Hughes, F.R.S., Prof. Fleeming Jenkin, F.R.S., Prof. J. W. Keats, Mr. W. H. Preece, F R.S., Prof. Silvanus Thompson, B.A., D.Sc., Mr. C. E. Spagnoletti, C.E., and Lieut.-Col. Webber, R.E., president, Society of Telegraph Engineers.

THE present season seems to have been as remarkably early and open in the Arctic regions as it has been with ourselves. The captain of the French steamer *St. Germain* reports having encountered an ice-floe of vast extent during his last outward voyage across the Atlantic. During the night of February 24-5 the vessel passed through two fields of ice estimated at from two to three miles in width. On the following morning there lay in the course of the ship an immense agglomeration of masses of ice, many of which resembled the *débris* of shattered icebergs, to which no limit could be seen west, north, or south. At this time the vessel was in lat. 46° N., and long. 50° W. The ice was drifting from north to south, and for two hours the ship steamed in a southerly direction along the eastern side of the ice-floe, at full speed, without seeing any opening, its eastern face being perfectly level. Soon after eight o'clock a channel about two miles wide, and running north and south, opened out, which the captain entered, hoping to reach the open sea to the south, but after about an hour's steaming the channel narrowed into a deep strait, when he decided to continue his course slowly and push through the ice, and after three hours perilous navigation, saw open water to the west, which he at last entered in lat. 44° N., and long. 51° W., or about 120 miles to the south, and 60 miles to the west of the point at which the ice-floe was first encountered. Even then the southern limit of the floe could not be seen, although the atmosphere was exceptionally clear at the time. Another report informs us that during the latter half of March quite a hundred icebergs were seen off Cape Race.

FROM Nottingham is reported the death this week, at the age of seventy-nine years, of Mr. Sydney Smith, the inventor of the steam-pressure gauge, and many other important engineering appliances. Mr. Smith was a native of Derby, and was educated at Repton Grammar School. By the invention of the steam-pressure gauge in 1847 his name became widely known in the engineering world.

THE death is announced of Mr. William Menelaus, a gentleman well-known and highly esteemed in connection with the iron and steel industries of this country. He was in the sixty-fourth year of his age. Mr. Menelaus was past president of the Iron and Steel Institute, of which he was one of the first members. He was also the founder of the South Wales Institute of Engineers.

THE idea of conducting excavations in the Delta by means of an English fund has now assumed a practical form. The outline of operations as now prepared has received the approval, among others, of the Archbishop of Canterbury, Mr. A. W. Franks, V.P.S.A., Prof. Huxley, F.R.S., Mr. Stanley Lane Poole, the Right Hon. Sir A. H. Layard, G.C.B., Sir John Lubbock, M.P., Prof. Max Müller, Prof. Owen, C.B., Mr. Reginald Stuart Poole, Prof. Sayce, Hon. J. Villiers Stuart, M.P., Mr. W. Spottiswoode, P.R.S., Sir Erasmus Wilson, LL.D., F.R.S. At the first meeting a provisional committee was formed, with Sir Erasmus Wilson as hon. treasurer, Miss Amelia B. Edwards and Mr. Reginald Stuart Poole as hon. secretaries. The society is already in communication with M. Maspero with the object of going to work directly sufficient funds have been obtained.

A WORK of permanent value has been performed by Prof. F. W. Clarke, of Cincinnati University, in his Recalculations of the Atomic Weights, which has been published by the Smithsonian Institution as Part V. of "The Constants of Nature." Prof. Clarke concludes from his investigation that none of the seeming exceptions to Prout's Law are inexplicable. "Some of them, indeed, carefully investigated, support it strongly. In short, admitting half multiples as legitimate, it is more probable that the few apparent exceptions are due to undetected constant errors, than that the great number of close agreements should be merely accidental. I began this recalculation of the atomic weights with a strong prejudice against Prout's hypothesis, but the facts as they came before me have forced me to give it a very respectful consideration. All chemists must at least admit that the strife over it is not yet ended, and that its opponents cannot thus far claim a perfect victory."

TWO interesting discourses, delivered at a recent public *séance* of the Belgian Academy, appear in the *Bulletin* of that body. In one of them M. van Beneden makes the record of a huge whale (*Balænoptera*) captured at Ostend in 1827 (the skeleton of which was exhibited in most of the European capitals, was taken to America, and at length found a final resting-place (in St. Petersburg) the starting point for a survey of the large amount of cetological knowledge acquired since that time. In the other discourse, M. Folie laments the backwardness of his country as regards astronomy. "Modern Greece alone, indeed, can advantageously dispute with us the last place in Europe" as regards the history of that science. And it has four centuries of Mussulman tyranny for an excuse. M. Folie cites numerous facts against the view that observatories have mostly sprung out of the interests of navigation. The non-cultivation of astronomy in Belgium in the past he attributes to the country having been long without national independence and a national dynasty. Belgian astronomy only dates in reality from 1834, when the Royal Observatory was founded at Brussels. Astronomy and geodesy "are still taught throughout Belgium, as physics, botany, zoology, physiology, in a word, most of the natural sciences, were taught ten or fifteen years ago, that is, without a laboratory." And "in none of the Belgian universities, except, perhaps, Brussels, is it possible to produce an astronomer or geodesian." M. Folie looks for a speedy rectification of all this. In the outset of his lecture he notices the liberality with which the Government has lately met his proposal to annex an astronomical and geodesic institute to the University of Liège.

THE French military authorities lately announced a competition in designs for a soldier's bed. It was stipulated that the bed should be capable of being raised against the wall, and in that position present a small table at which the soldier might eat, write, &c.; the new bed should allow of utilisation of old ones; it should be as cheap as possible, and not need much repair, and it should afford no shelter to bugs (a great pest of the French army). More than a hundred models were sent in, and, after a large elimination about a dozen are on trial. Our contemporary, *La Nature*, in a notice of the more promising designs, gives final preference to a bed planned by Lieut. Bertillon. In it a piece of canvas is stretched within or slightly above a rectangular frame, by means of a rope passing through sixty-four eyelets and round an iron bar parallel with the frame, which supports it. To obviate tearing, the eyelets are encased in pieces of leather attached to the canvas. There is a simple vertical frame at the head, and the support below, at that end, consists of two bars, bent into a shape like that of the lower half of a broad capital D, the vertical part having a board attached, which serves as a table when the bed is tilted up on the curved bars against the wall (an easy operation). The support at the other end is a two-legged stool or short form, on which the soldier can sit at the table. The arrangement seems very convenient and suitable to the object proposed.

SIGNOR SELLA (son of the ex-Minister of Italy) ascended the Matterhorn on the 17th ult. with three guides, from the Italian side, and descended at Zermatt. No greater difficulties were encountered than are usually met with in summer.

SHOCKS of earthquake are reported from Ljubinge (Herzegovina) on March 25, at 6.2 p.m., lasting three seconds; and from Trebinje and Bilek on the same day, at 6 p.m., direction west to east.

OUR Paris correspondent inspected a few days ago, at Feil's workshop, the large flint-glass disk which has been cast for the Lick Observatory in California, and purchased by the trustees for 2000*l*. It is now on its way to Clarke's for polishing. Its diameter is 97 centimetres, its thickness 55 centim., its weight 170 kilog. The casting took place in four days, during which eight tons of coals were consumed. The cooling took thirty days. On the optical tests being made the glass was found perfect in all its parts. The crown-glass disk has been cast and is cooling.

THE Easter excursion of the Geologists' Association this year is to Battle and Hastings, and will extend over Monday and Tuesday, April 10 and 11.

THE seventh annual meeting of the Members of the Sunday Society was held on Friday, March 31, at its rooms, 9 Conduit Street, Mr. Hodgson Pratt presiding. The annual report, which was read by the Hon. Sec., Mr. Mark H. Judge, referred to the work of the Society having been pursued with unabated vigour during the presidency of Mr. Thomas Burt, M.P., and to the growth of public opinion in favour of its objects, and said: "The conviction is evidently gaining ground that the Government cannot much longer delay the extension of its Sunday opening policy to the national museums and galleries in the heart of the metropolis; for since 1854, when the Committee of the House of Commons recommended the opening of places of rational recreation and instruction after the hour of 2 o'clock p.m., both Liberal and Conservative Governments have continued to open on Sundays, the national museums at Kew, Hampton Court, Greenwich, and Dublin, with such results as have not only satisfied Her Majesty's Government, but have had the effect of inducing the Corporations of Birmingham, Manchester and other large towns in the provinces, to open municipal institutions of a similar kind on Sundays. The Sunday Art Exhibitions instituted by the Society had been continued and were being imitated both in London and the provinces. The Right Hon. Viscount Powerscourt, K.P., was unanimously elected president of the Society."

ON Saturday afternoon a meeting of the Essex Field Club took place at the Natural History Museum, South Kensington, on the kind invitation of Prof. Richard Owen, F.R.S., who conducted the members through the Palæontological Galleries, and gave most interesting demonstrations of many of the more remarkable fossils. Dr. Henry Woodward and Prof. Morris were also present, and did all in their power to interest the visitors. Afterwards the Club adjourned to the Exhibition Galleries, Cromwell Road, where General Pitt-Rivers, F.R.S., gave a demonstration of portions of his Anthropological Museum, particularly dwelling upon the developmental ideas underlying the inception and arrangement of that unique collection. The two meetings were entirely successful, considerably over 100 Members and friends being present.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Miss Richards; two Common Marmosets (*Hapale jacchus*) from Brazil, a Silky Hangnest (*Amblyrhampus holosericeus*) from Buenos Ayres, presented by Mr. George Jacobs; a Puffin (*Fratercula arctica*), British, presented by Miss Lane; a Smooth Snake (*Coronella lævis*), British, presented by Mr. Wm. Penney; twenty-five Madeira Snails (*Helix maderensis*), four Undated Snails (*Helix undata*) from Madeira, presented by Mr. George French Angas, C.M.Z.S.; a Diana Monkey (*Cercopithecus diana* ♂), a Talapin Monkey (*Cercopithecus talapin* ♀), a Water Chevrotain (*Hyomoschus aquaticus*) from West Africa, two Green-billed Toucans (*Ramphastos dicolorus*) from Guiana, a Yellow-lored Amazon (*Chrysotis xantholora*) from Central America, two Maguari Storks (*Dissura maguari*), an Orinoco Goose (*Chenalopex jubata*) from South America, a Common Night Heron (*Nycticorax griseus*), European, a —— Monitor (*Monitor*, sp. inc.) from Africa, purchased; two Little Bustards (*Tetrax campestris*), European, deposited; a Radiated Fruit Cuckoo (*Carpococcyx radiatus*, from Sumatra, received on approval.

OUR ASTRONOMICAL COLUMN

COMET 1882 *a*.—The following elements of the comet discovered in America on March 18, have been calculated by Mr. Hind from observations on March 19, 22, and 25, the first telegraphed from America, the two others made at the Observatory of Kiel:—

Perihelion passage 1882, June 12·07195 G.M.T.

	°	′	″	
Longitude of Perihelion	52	6	31	App. Eq.
,, ascending node ...	204	59	31	Mar. 22.
Inclination	73	42	44	
Log. perihelion distance	8·870371			

The heliocentric arc described between the extreme observations is only 33′, and the orbit is therefore to be regarded as a first approximation. Another orbit calculated by Dr. Oppenheim from observations on March 19, 23, and 27, gives the epoch of perihelion-passage, June 16·5818 G.M.T., and the log. least distance 9·07186. It is evident, therefore, that the comet will greatly increase in brightness as it draws near to the sun, and we may look for a naked-eye object a fortnight or so before perihelion. The elements, however, will not be well-determined in this case, without a much wider extent of observation.

Dr. Oppenheim finds the following places for Berlin midnight. We are indebted for them to Prof. Krueger, the editor of the *Astronomische Nachrichten*:—

	R.A. h. m. s.	Decl. ° ′	Log. distance from Earth.
April 6	18 28 53	+44 43·4	0·2500
7	— 31 14	45 29·4	
8	— 33 41	46 16·2	
9	— 36 13	47 3·9	
10	— 38 50	47 52·5	0·2323
11	— 41 32	48 42·0	
12	— 44 21	49 32·4	
13	— 47 16	50 23·6	
14	— 50 19	+51 15·7	0·2134

The mean of the above perihelion-distances is less than a tenth of the mean distance of the earth from the sun, and comparatively few comets out of the number calculated have approached the sun so closely; indeed, between the commencement of the seventeenth century and the present time we find only nine or ten cases that can be relied upon, in upwards of two hundred and twenty which have been computed.

VARIABLE STARS.—Amongst the objects of this class now in a favourable position for observation is one observed on the meridian at Bonn in May, 1864, and rated 9·0; its position for 1855·0 is in R.A. 13h. 22m. 58·1s., N.P.D. 98° 48′ 54″. It was 8·5 on April 16, 1855, 9·5 on April 30, 1853, and is entered 10m. on Chacornac's Chart, No. 41; on one occasion previous to 1853, it had been noted 8m. On April 5, 1874, it was a faint 9m. It was not observed either by Lalande or Bessel. It is 9m. on Bremicker's chart of the Berlin series. An eighth-magnitude (Santini calls it a sixth) follows about 10′ to the south.

Mira Ceti attains a maximum on May 23. A minimum of S Cancri occurs on April 14, at 9h. 9m. G.M.T.

GEOGRAPHICAL NOTES

THE following papers will be read at the German "Geographentag" which will meet at Halle on April 11–14:—On some scientific results of the voyage of the *Gazelle*, particularly from a zoogeographical point of view, by Prof. Studer (Berne); on the progress of our knowledge of Sumatra, by Prof. Kan (Amsterdam); on the alleged influence of the earth's rotation upon the formation of river-beds, by Prof. Zöppritz (Königsberg); on the colonies of Germans and their neighbours in Western Europe, by Herr Meitzen (Berlin); on the historical development of geographical instruction, by Dr. Kropatschek (Brandenburg); on the treatment of subjects relating to conveyance in geographical instruction, by Prof. Paulitschke (Vienna); on the introduction of metrical measures in geographical instruction, by Prof. Wagner (Göttingen); on the relation between anthropology and ethnology, by Prof. Gerland (Strassburg); on the ethnological conditions of Northern Africa, by Dr. Nachtigal (Berlin); on the Polar question, by Prof. Neumayer (Hamburg); on the geographical distribution of Alpine lakes, by Prof. Credner (Greifswald); on the true definition of the development of coasts, by Prof. Günther (Ansbach); on geographical instruction in its relation to natural sciences, by Prof. Schwalbe (Berlin); on the Guldberg-Mohn theory of horizontal air currents, by Prof. Overbeck (Halle); on the systematic furtherance of the scientific topography of Germany, by Herr Lehmann (Halle). The meeting will be combined with a geographical exhibition.

WITH the sixth part of the volume for 1881 of the *Zeitschrift* of the Berlin Geographical Society we have the usual exhaustive Catalogue of geographical literature for the year, including works and papers in all departments of geography, systematically arranged, and covering about 150 pages. No such complete list is to be found anywhere else. Dr. Konrad Ganzenmüller has a paper in this number on the Climate, Flora, and Fauna of the Central Range of the North-West Himalayas. The first part of the *Zeitschrift* for the present year contains papers by Dr. Theo. Fischer, on the Italian Sea-Chart and Maps of the Middle Ages; on the Sierra of Cordoba, by Dr. Wien; on the Antarctic Flora compared with the Palæozoic, by Dr. Joh. Palacky; and on the Cartography of Bolivia, by Dr. R. Kiepert. No. 2 of the *Verhandlungen* of the Society for 1882 contains a long lecture by Herr Buchner on his three years' exploration in South-West Africa.

THE March number of *Petermann's Mittheilungen* contains an account, by Mr. Knipping, of a recent journey through the central mountainous part of the chief island of Japan; a paper on Capt. Gallieni's mission to the Upper Niger, 1880-81; an analysis, by Prof. Zöppritz, of Mr. Stanley's thermo-barometric observations on his journey across Africa; and a necrology for the year 1881.

THERE have been several books recently published on Manitoba, to which, at present, there is a great rush of emigrants. As a rule, such books give only the bright side of the emigrant's life and prospects in the colony, and it is difficult to get a perfectly trustworthy account of what the emigrant may expect. Two Manitoba books are before us: one by the Rev. Prof. Bryce, of Manitoba College—for education has been well provided for in Winnipeg already—is mainly historical, giving pretty full details of the Earl of Selkirk's attempts at settlement. Messrs. S. Low and Co. are the publishers The other modest little volume ("A Year in Manitoba, 1880-81") is published by Messrs. W. and R. Chambers, and contains a full and concise statement of the experience of an officer and his sons on a small farm which they took, about ten miles from Winnipeg. There were not a few hardships certainly, and these are clearly brought out; but the other side is quite as clearly and fairly stated, with a considerable balance in its favour. For any one contemplating emigration to the Canadian North-west, this is the book to get.

BESIDES Mr. O'Neill's paper on his three months' journey inland from Mozambique, the April *Proceedings* of the Geographical Society contain a *résumé* of the information just laid before Parliament on the subject of the Russo-Persian frontier east of the Caspian, accompanied by a map, which can only pretend to reproduce the Russian view of the question. The other paper describes the journey of a Russian officer from Geoktepeh to the Khivan oasis, and is a translation from the Russian. Perhaps the most notable matter in the geographical news is the treaty which M. de Brazza imposed on the native chiefs at Stanley Pool, and by which they undertook to admit none but Frenchmen; some late news is also given respecting Dr. Junker's journey in Central Africa, and Mr. J. M. Schuver's progress to the south-west of Abyssinia. We are glad to see, too, that the international polar meteorological expeditions are not neglected, some very interesting information being furnished respecting those of the Danes to Godshaab, in West Greenland, and of the Dutch to the mouth of the Yenissei. A note is also devoted to the recent Danish explorations at Mear, the Jacobshavn fjord. The French Geographical Society's meetings are very fully reported, as, indeed, they generally are.

A NEW Geographical Society was formed last month at Greifswald, in Pomerania.

A CORRESPONDENT points out, in reference to Dr. Rae's correction of last week, that a gold medal *was* awarded to Nain Singh in 1877, as will be found by reference to the *Journal* for that year, or in the *Proceedings* (old series), vol. xxi. A gold watch had previously been awarded to Nain Singh in 1868, for his route-survey from Lake Mansarowar to Lhasa.

MR. R. ARTHINGTON, of Leeds, who is well-known as the munificent benefactor of African missions, has just presented to the Baptist Society a further sum of 1000*l.* towards the cost of building a steamer for the Upper Congo.

THE Constantine gold medal of the Russian Geographical Society was not awarded this year; the medal of Count Lütke was awarded to Major-General Ernfeldt and Col. Lebedeff, for their geodetical and topographical work in the Balkan Peninsula; the great gold medal of the Ethnographical Section was awarded to M. Potanin for his explorations in North-Western Mongolia; that of the Statistical Section to M. Romanoff for his work on emigration from the Government of Vyatka. The small gold medals were awarded to the astronomer, F. F. Schwartz, the well known explorer of Eastern Siberia, for his determinations of positions in Turkestan and Central Asia; to M. Domojiroff, for anemometrical observations on board of ships; to M. Malakhoff, for ethnographical explorations on the Ural; and to M. Yadrintseff, for his work, "Travels in Western Siberia and on the Altai." Silver medals were awarded to Mydame L. Poltoratzkaya, for her album of photographs from Western Siberia; to M. Lakhmeyer, for photographs of Caucasus and Ural; to M. Kalitin, for maps of the route between Khiva and Akhal-Teke; to M. Ivanoff, for explorations of the Zerafshan glacier; to M. Agapitoff, for explorations of the black earth and loess, in the Government of Irkutsk; to M. Roubach, for meteorological observations on the island of Oesel; to M. Zagursky, for his works on the Caucasian languages and his biography of the well-known explorer of these languages, R. K. Uslar; and to MM. Stevanovsky and Rudinsky, for collections of Russian songs.

THE last number of the *Izvestia* of the Russian Geographical Society contains, among other interesting materials, two lists of points whose latitudes and longitudes were determined by the indefatigable explorer of Eastern Siberia and Turkestan, F. F. Schwartz, the Dorpat astronomer, during the years 1879 and 1880. After having determined, in 1879, the positions of ten points in Eastern Turkestan, he now publishes a list of twenty-four points in the Kulja territory, from Kulja along the two long valleys of the Kash and of the Kunghes rivers, which cross this territory from east to west, that of Kunghes having been explored to its source, and the most eastern point reached by M. Schwartz being the Narat Pass, at the south-eastern frontier of the Kulja territory. A series of determinations between Vernyi and the Narat Pass, along the Tekes river, were made during the same year. The numerous magnetic observations made by M. Schwartz during these two journeys, will be published as soon as calculated.

MATTER AND MAGNETO-ELECTRIC ACTION[1]

THE late Prof. Clerk Maxwell, in his work on "Electricity and Magnetism" (vol. ii. p. 146), lays down as a principle that "the mechanical force which urges a conductor carrying a current across the lines of magnetic force, acts, not on the electric current, but on the conductor which carries it. If the conductor be a rotating disk or a fluid it will move in obedience to this force, and this motion may or may not be accompanied with a change of position of the electric current which it carries. But if the current itself be free to choose any path through a fixed solid conductor or a network of wires, then, when a constant magnetic force is made to act on the system, the path of the current through the conductors is not permanently altered, but after certain transient phenomena, called induction currents, have subsided, the distribution of the current will be found to be the same as if no magnetic force were in action. The only force which acts on electric currents is electromotive force, which must be distinguished from the mechanical force which is the subject of this chapter."

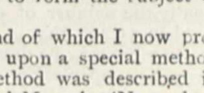
In the investigation on electric discharges, on which Mr. Moulton and myself have been long engaged, we have met with some phenomena of which the principle above enunciated affords the best, if not the only, explanation. But whether they be regarded as facts arising out of that investigation, or as experimental illustrations of a principle laid down by so great a master of the subject as Prof. Clerk Maxwell, I have ventured to hope that they may possess sufficient interest to form the subject of my present discourse.

The experiments to which I refer, and of which I now propose to offer a summary, depend largely upon a special method of exciting an induction-coil. This method was described in two papers, published in the *Philosophical Magazine* (November, 1879), and in the *Proceedings* of the Royal Society (vol. xxx. p. 173), respectively; but as its use appears to be still mainly confined to my own laboratory, and to that of the Royal Institution, I will, with your permission, devote a short time to a description of it, and to an exhibition of its general effects.

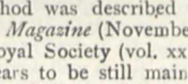
The method consists in connecting the primary circuit directly with a dynamo- or magneto-machine giving alternate currents. In the present case, I use one of M. de Meritens' excellent machines driven by an Otto gas-engine. The speed of the de Meritens machine, so driven, is about 1100 revolutions per minute.

In this arrangement the currents in the secondary are of course alternately in one direction and in the other, and equal in strength; so that the discharge appears to the eye, during the working of the machine, to be the same at both terminals.

The currents in the primary are also alternately in one direction and in the other, and consequently, at each alternation, their value passes through zero. But they differ from those delivered in the primary coil with a direct current and contact breaker in an important particular, namely, that while the latter, at breaking, fall suddenly from their full strength to zero, and then recommence with equal suddenness, the former undergo a gradual although very rapid change from a maximum in one direction through zero to a maximum in the opposite direction. The ordinary currents with a contact breaker would be represented by a figure of this kind,



while those from the alternate machine approximately by a curve of the following form. The rise and fall of the latter are, however, sufficiently rapid to induce currents of high tension and of great quantity in the secondary.



From these considerations it follows: first, that as the machine effects its own variations in the primary current, no contact breaker is necessary; secondly, that as there is no sudden rupture of current, there is no tendency in the extra current to produce a spark or any of the inconveniences due to an abrupt opening of the circuit, and consequently that the condenser

[1] Lecture at the Royal Institution, March 31, by Dr. W. Spottiswoode, Pres. R S.

may be dispensed with; thirdly, that the variations in the primary, and consequently the strength and period of delivery of the secondary currents is perfectly regular; fourthly, that the strength of the currents in the secondary is very great. With a 26-inch coil by Apps I have obtained a spark about 7 inches in length, of the full thickness of an ordinary cedar pencil. But for a spark of thickness comparable at least with this, and of 2 inches in length, an ordinary 4-inch coil is sufficient.

Owing to the double currents, the appearance of the discharge is that of a bright point at each terminal, and a tongue of the yellow flame, such as is usually seen with thick sparks from a large coil, issuing from each. This torrent of flame (which, owing to the rapidity with which the currents are delivered by the machine, is apparently continuous) may be maintained for any length of time. The sparks resemble those given by my great coil (exhibited in this theatre on Friday, April 13, 1877, and described in the *Philosophical Magazine*, 1877, vol. iii. p. 30) with a large battery-power and with a mercury break; but with that instrument it is doubtful whether such thick sparks could be produced at short intervals, or in a rapid shower, as in this case.

In order to contrast the effects of the two methods, I will excite the coil, first with a battery, and secondly with the alternating machine. You will notice that with the battery we can obtain either long, bright, and thin sparks, or short and comparatively thick discharges; but, unless the latter are made very short, they occur only at comparatively long and even perceptible intervals of time. On the other hand, with the alternate machine, although the method does not lend itself so readily to the production of long and bright sparks, we can produce a perfect torrent of discharges more rapid and more voluminous than by any other means yet devised. Long bright sparks can, however, be obtained by interrupting the flow of the currents from the machine, and by allowing only single currents to pass at comparatively long intervals. It may be interesting to know that the number of currents given out by the machine, and consequently the number of discharges issuing from the coil, is no less than 35,200, that is, 17,600 in each direction, per minute. The number may be determined by the pitch of the note which always accompanies the action of an alternate machine.

A comparison of the two methods may also be made when a Leyden jar is used as a secondary condenser. This application of the jar is well known as a valuable aid in spectroscopic research; and the employment of the alternating machine so materially heightens the effects that, judging from some experiments made in the presence of Mr. Lockyer, and from others of a different character in the presence of Prof. Dewar, I am led to hope from it a further extension of our knowledge in this direction. In order that you may form, at all events, some rough idea of the nature of such discharges, I venture, at the risk of causing some temporary inconvenience from the noise, to project the spectrum of this spark.

I will detain you with only one more instance of comparison. The ordinary effect of an induction coil in illuminating vacuum tubes is well known. The result is usually rather unsteady. Several instruments have been devised to obviate this inconvenience, *e.g.* the rapid breakers described in the *Proceedings* of the Royal Society (vol. xxiii. p. 455, and vol. xxv. p. 547), or the break called the "Trembleur" of Marcel Deprez (see *Comptes rendus*, 1881, I. Semestre, p. 1283). The use of the alternating machine, however, not only gives all the regularity in period, and uniformity in current, aimed at in these instruments, but also at the same time supplies currents of great strength. The result is a discharge of great brilliancy and steadiness, and it is perhaps not too much to say that the effects are comparable to those obtained with Mr. De La Rue's great chloride of silver battery. The configuration of the discharge produced in this way can also be controlled by a suitable shunt applied to the secondary circuit; for example, one formed by a column of glycerine and water, or the one consisting of a film of plumbago spread upon a slab of slate, constructed by my assistant, Mr. P. Ward, and here exhibited.

One test of the strength of current passing through a tube is the amount of surface of negative terminal, which it will illuminate with a bright glow. I have here a tube with terminals, in the form of rings, each of which would be regarded of ample size for currents obtaided in the ordinary way. These are now all connected together so as to form one grand negative terminal; and it will be found that with the currents from the alternate machine, the whole system is readily illuminated at once.

It should perhaps be here remarked that, while the strength of the secondary currents passing through the tube is partly due directly to the strength of the primary currents from the machine, it is probably also in part due to the rapidity with which the secondary currents follow one another. Owing to the latter circumstance the column of gas maintains a warmer and more conductive condition than would prevail if the inteval between the discharge was longer; and in consequence of this a larger portion of the discharges can make its way through than would otherwise be the case.

Before leaving the instrumental part of my discourse, I desire to bring under your notice a modification of the machine which we have thus far used for producing, by the intervention of the induction coil, currents of high tension. This consists of a machine of the same general construction as the other, but having the armatures wound with a much greater number of convolutions of much finer wire. The result is a machine giving off currents of sufficient tension to effect, by direct action, discharges through vacuum tubes, and even in air. The currents are of course olternate; but by diminishing the size of one of the terminals to a mere point, as well as by other methods described elsewhere, it is possible to shut off the currents in one direction, leaving only those in the other direction to discharge themselves through the tube. I hope on some future occasion to give a fuller account of this remarkabfe machine, which has only quite recently been completed.

Returning to the discharge in air, it will be noticed that when the terminals are set horizontally, the torrent of thick discharges assumes the appearance of a flame, which takes the form of an inverted V. This is the result of convection currents due to the heat given off by the discharges themselves. The discharges are by their nature, as it were, fixed at each end, but within the limits of discharging distance, free to move about and to extend themselves in space, especially in their central part. Further, it may be observed that the length of the spark which can be maintained is greater than that over which it will leap in the first instance. The explanation of this is to be sought in the fact, that when the sparks follow very rapidly in succession, the whole path of each discharge remains so far in a heated state, as to assist the passage of the next; and, further, that in the middle part of the discharge or apex of the Λ, where the heat is greatest, the heat prevails to such an extent as to render a portion of the path highly conductive. This may be illustrated by holding a gas jet near the path of the discharge. The flames will then leap to the two ends of the jet, which will perform the part of a conductor; and the real length of the discharge will be that traversed from terminal to terminal, minus the length of the intervening flame. The permanently heated part of the flame will act in the same manner in extending the effective length of the discharge.

The discharge which we are now examining is not homogeneous throughout, but consists of more than one layer. The flame, which, from the fact of its forming the outer sheath of the discharge, is the most prominent feature, consists mainly of heated but solid particles emanating from the terminals. That this is the case may be inferred in a general way from the colours which the flame assumes when different substances are placed upon the terminals; for example, lithium or sodium. The spectrum of the flame appears to be always continuous. A convenient substance to affix to the terminals is boron glass, on account of the brilliancy to which it gives rise in the discharge; this will enable us to project the phenomenon. Within this sheath of flame, the discharge consists of the pink light characteristic of air, and in the centre of all the true bright spark. There is reason to think that, under certain circumstances, there are more layers to be seen; but the above division is sufficient for our present purpose. In this somewhat complicated structure, the pink light corresponds to the arc, and the flame to a similar accompaniment which is seen playing about the upper carbon in electric lamps when a current of great strength is used.

From this account of the methods here employed I now turn to the main question. In the investigation, to which allusion was made at the beginning of this lecture, it occurred to us that an examination of the effects of a magnetic field on discharges of this character through air or other gases at atmospheric pressure, and a comparison with those obtained at lower pressures, might throw some fresh light on the nature of electrical discharges in general. It is these phenomena to which I now propose to ask your attention.

When the discharge, originally in the form of a vertical spindle, is submitted to the action of a magnet whose poles are horizontal, it spreads out into two nearly semicircular disks, one due to the discharges in one direction, and the other to those in the opposite direction. As the magnetism is strengthened, the flame retreats towards the edge of the disks, and ultimately disappears. The disk then consists mainly of the pink discharge; but with a still stronger magnetic field, it is traversed at intervals by bright semicircular sparks at various distances from the centre. In every case, bright sparks pass directly between the terminals at the opening of each separate discharge.

In order further to disentangle the parts of this phenomenon, recourse was had in the original experiments to a revolving mirror. The light in the disks is insufficient to allow of a projection of the effects, but the accompanying diagrams represent the appearances seen in the mirror. Fig. 1 shows the arrangement of the terminals and the magnetic poles; Fig. 2 the appearance of the discharges in a plane at right angles to that of Fig. 1; Fig. 3 the appearance of three successive discharges (in the same direction) with a weak magnetic field and a slowly revolving mirror; Fig. 4 the same, with a slightly more rapid rate of revolution; Fig. 5 a single discharge, with a

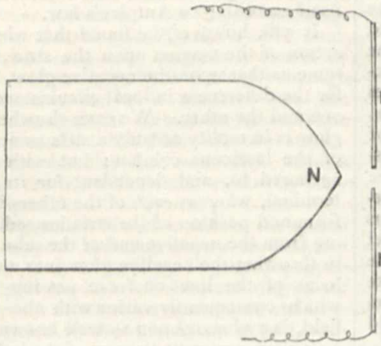


FIG. 1.

stronger field and greater speed of mirror; Fig. 6 a single discharge in a strong field, with a still greater speed of mirror. It should be mentioned, that in all these figures the images to the left are to be regarded as anterior to those on the right, and that they represent various phases of the left-hand discharge in Fig. 2.

If, however, we observe the right-hand discharges with a mirror revolving in the same direction as before, it is clear that the actual curvature of the discharge will be turned in the opposite direction (with reference to the motion of the mirror) to that

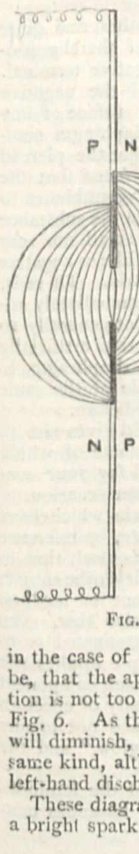


FIG. 2.

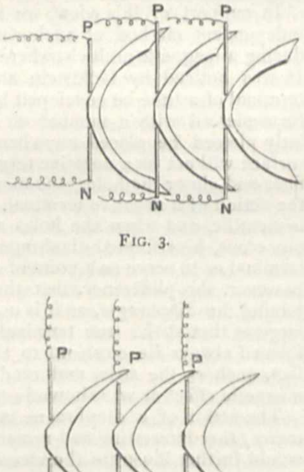


FIG. 3.

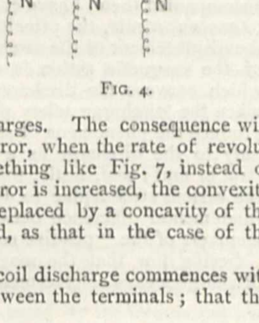


FIG. 4.

in the case of the left-hand discharges. The consequence will be, that the appearance in the mirror, when the rate of revolution is not too great, will be something like Fig. 7, instead of Fig. 6. As the speed of the mirror is increased, the convexity will diminish, and ultimately be replaced by a concavity of the same kind, although not so marked, as that in the case of the left-hand discharges.

These diagrams show that each coil discharge commences with a bright spark passing directly between the terminals; that this spark is, in general, followed by the pink light or arc discharge, which passes first in the immediate neighbourhood of the initial spark, and gradually extends like an elastic string in semicircular loops outwards; and that the flame proper is a phenomenon attendant on the close of the entire discharge. It should be added that observations with a mirror revolving on a horizontal axis, and with a horizontal slit in front of the discharge, show that the disk is not simultaneously illuminated throughout, but that it is a locus of a curvilinear discharge which moves outwards and expands in its dimensions from the centre.

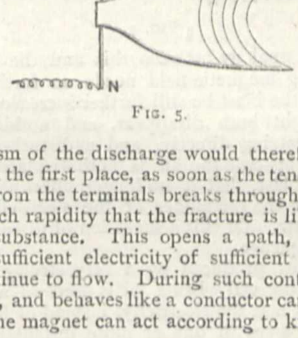


FIG. 5.

The mechanism of the discharge would therefore seem to be as follows:—In the first place, as soon as the tension is sufficient, the electricity from the terminals breaks through the intervening air, but with such rapidity that the fracture is like that of glass, or other rigid substance. This opens a path, along which, if there remains sufficient electricity of sufficient tension, the discharge will continue to flow. During such continuance the gas becomes heated, and behaves like a conductor carrying a current, and upon this the magnet can act according to known laws. As

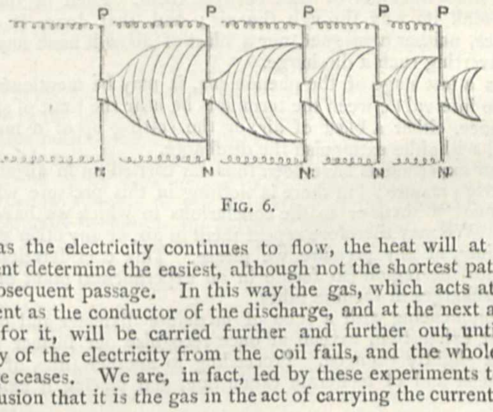


FIG. 6.

long as the electricity continues to flow, the heat will at each moment determine the easiest, although not the shortest path for its subsequent passage. In this way the gas, which acts at one moment as the conductor of the discharge, and at the next as the path for it, will be carried further and further out, until the supply of the electricity from the coil fails, and the whole discharge ceases. We are, in fact, led by these experiments to the conclusion that it is the gas in the act of carrying the current, and not the current moving freely in the gaseous space, upon which the magnet acts.

This explanation of the magnetic displacement of a discharge receives strong support from the phenomena represented in Figs. 5, 6, and 7. The successive bright lines there shown must be due to successive falls and revivals of tension within a single coil discharge. The existence of such alternations in coil discharges of large quantity is otherwise known. When the fall in temperature is such that the conductivity of the gas is insufficient to maintain the arc, the discharge can make its way through the air only by a fresh rent of the same kind as the first fracture. But how can this be reconciled with the fact that the tension can never reach its original degree, and must, on the whole, be gradually falling, and that, in addition, the paths represented by these various sparks are successively longer and longer? The answer to this question is to be found plainly written in the phenomena themselves. Any irregularity in one of these bright lines is always to be found accurately repeated in all of the same series. Now, it is scarcely to be conceived that, at successive instants of time and in different portions of space, irregularities in the discharge itself, and in the distribution of the gas, so precisely the same, would constantly and for certain recur; and we are therefore driven to the conclusion, that it is the same portion of gas which at first occupied the centre of the field, with its same, yet unhealed rent, which is moved outward under the action of the magnet. If this be so, we have in this repetition of minute details, nothing more than what would necessarily follow from successive reopenings of the weak parts of the gas, which would be surely found out by the electricity in its struggle to pass.

The view here taken of the material character of the luminous discharge is further borne out by the fact that the spindle of light is capable of being diverted by a blast of air. When the blast is gentle, the discharge becomes curvilinear, approximately semicircular, and the yellow flame may be seen playing about the outer edge in the same way as in a weak magnetic field. When the blast is stronger, the sheet of light becomes irregular in form, and it is traversed by a series of bright lines, all of which follow, even in their minute details, the configuration of

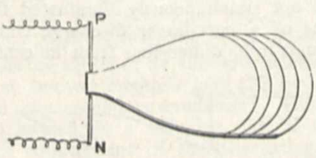


FIG. 7.

the sheet. The analogy between this and the phenomena produced in a strong magnetic field needs no further remark. If the strength of the blast be still further increased, the flame and the sheet of light both disappear, and nothing remains but bright sparks passing directly, and undisturbed, between the terminals. In this case the air is both displaced and cooled so rapidly by the blast, that it no longer offers a practicable conductive path for the remainder of the electricity, coming from the coil, to follow. Of this a succession of disruptive sparks is a necessary consequence.

The effect thus produced by a very strong blast is in fact similar to that observed when a jar is used as a secondary condenser. In this case the electricity, instead of flowing gradually from the coil, passes in one or more instantaneous discharges with finite intervals of time between them. Each of these has to break its way through the air; and that done, it ceases. Hence, neither a magnet, nor a blast of air will have any effect in diverting such a discharge.

As a last stage of the phenomena, it may be mentioned that, if the interval between the terminals be near the limit of striking distance, either a blast of air, or the setting up of a magnetic field, will alike extinguish the discharge.

Our experiments have been thus far carried on in air at atmospheric pressure; but there is nothing in this pressure which is essential to them or to the conclusions to which we have been led. We may therefore repeat them in air, or any other gaseous medium, at any pressure we please. This consideration leads us into the region (so fertile in an experimental point of view) of discharges in vacuum tubes.

Commencing with a tube of moderate diameter and of very slight exhaustion, we can at once recognise our former phenomena slightly changed. Proceeding to another tube, of larger diameter and of moderate exhaustion, and placing it axially or equatorially in a magnetic field, we see not only that the discharge (or rather the conductor carrying it) is displaced, but also that the displaced part is spread out into a sheet or ribbon, showing that the discharge is affected gradually, exactly in the same way as was found in the open air.

When the exhaustion is carried further, the phenomena become rather more complicated. At an early stage there is a distinct separation between the "negative glow" and the rest of the luminous column; and at a more advanced stage the column itself is broken into separate luminosities or striæ. When this is the case, it is usually said that the negative glow follows the lines of magnetic force, while the luminous column distributes itself according to Ampère's law.

It will, however, be found that when completely analysed the action of the magnet upon the striæ, taken individually, is the same as that upon the negative glow, due allowance being made for the differences in local circumstances subsisting between the one and the other. We eave elsewhere shown that the negative glow is in reality as truly a stria as any other individual member of the luminous column; but with this difference, that it is anchored to, and dependent for its form on, a rigid metallic terminal, whereas each of the others is dependent on the variable form and position of the stria immediately next in order, reckoning from the negative end of the tube. The action of a magnet in throwing the negative glow into a sheet of light, which is the locus of the lines of force passing through the terminal, and which consequently varies with the position of the tube in the field, is a phenomenon so well known that we need repeat only a single experiment by way of reminder.

Although it is not altogether so easy to show that the other striæ are directly affected by a magnetic field in the same way as is the anchored stria, we may still satisfy ourselves that it is the fact, from the consideration that when the striæ are well developed and the magnetic field is strong, it is quite possible to form a magnetic arch at any part of the column. In this experiment it will be noticed that for the formation of the arch in mid-column it is necessary that both poles of the magnet should act upon one and the same stria. This, in fact, means that the pole nearest the negative end anchors the stria, and thereby brings it into conditions similar to those of the negative glow. When this is effected the two exhibit similar modifications in the magnetic field.

In support of this view, we may adduce another and quite independent method of anchoring a stria, and of thereby producing a magnetic arch elsewhere than at the negative terminal. It was noticed by Goldstein and others that if the negative terminal of a tube be enveloped by an insulating surface of any form pierced with a number of holes or if a diaphragm similarly pierced be placed anywhere in the tube, that the pierced surface will act as a negative terminal. He also found that the finer and closer the holes, the more complete the resemblance to the action of a negative terminal. But even when the substance is metallic, and when the holes are neither very small nor very numerous, a perforated diaphragm will so far act like a negative terminal as to serve as a point of departure of a stria. There is, however, this difference, that the blank space immediately adjoining the diaphragm, as it is usually called, is not generally so large as that at the true terminal; and the striæ thus artificially formed always lie close up to the holes. The diaphragm, in fact, anchors the stria, and renders it susceptible of the same magnetic effect as was shown in the cases studied before.

The action of a diaphragm in a magnetic field gives rise to many other interesting and remarkable results; some of which would further illustrate the views now submitted for your consideration. But these must be reserved for another occasion.

In the foregoing experiments, and in the remarks which have accompanied them, I have endeavoured to illustrate, by reference to gaseous media, the principle enunciated at the outset, that in the displacement of the discharge in a magnetic field, the subject of the magnetic action is the material substance or medium which conveys the discharge. I have shown also that, even when the discharge takes place in media so attenuated as to produce the phenomena of striæ, the same principle applies not only to the discharge as a whole, but also to each component stria or unit; and, lastly, that the apparent diversity of effect on the various striæ is due to local circumstances, and not to any fundamental difference between the "negative glow" and the members of the "positive column."

Seeing now that the magnetic displacement of the luminous discharge means displacement of the matter in a luminous condition, and that a crowding of such luminous matter involves an increase of luminosity, may we not infer with a high degree of probability that the striæ are themselves aggregations of matter, and that the dark spaces between them are comparatively vacuous.

It is true that such a view of the case would seem to imply that, in gaseous media, the better the vacuum the more easily can the electricity pass; and that this might at first sight appear to be at variance with the known fact that the resistance of a tube decreases with the pressure until a minimum, determinate for each kind of gas, and then increases. But it has been suggested by Edlund (*Annales de Chemie et de Physique*, 1881, tom. iii. p. 199) that the resistance of a tube may really consist of two parts, first, that due to the passage of the electricity through the gas itself, and, secondly, that due to its passage from the terminals to the gas; and also that the former decreases, while the latter increases, as the pressure is lowered. On this supposition, the observed phenomena may be explained, without assigning any limit to the facility with which electricity may traverse the most vacuous space.

We may even carry the suggestion of a resistance of the second kind a little further, and suppose that there is a resistance due to the passage of electricity from a medium of one density to that of another, or from layer to layer of different degrees of pressure. And from this point of view, we may regard the striæ as expressions of resistance due to the varying pressure in different parts of the tube. Into the question, whence this variation of pressure, I am not at present prepared to enter; it must suffice for this evening, to have shown that the conclusions which we have drawn from our experiments, are not in discordance with other known phenomena of the electrical discharge.

The warning hand of time bids me not to prolong my discussion of the subject. But before closing, I would point out that these laboratory experiments are not unsuggestive in reference to larger questions. It has long been, and still is, a disputed question whether a display of the aurora borealis ever takes place at any considerable elevation above the earth's surface. On the one hand, observations are cited giving a not unfrequent elevation of nearly 200 miles; while on the other, experiments with vacuum tubes appear to limit the range to less than forty miles. The observation is perhaps a doubtful one at best; it is not easy to fix the position of so faint and flickering a phenomenon, and it is perhaps even more difficult to identify a particular phase of it when seen from two distant positions. But the recorded data are still entitled to some consideration, especially if it has been shown that the evidence furnished by vacuum tubes is not conclusive against the higher estimate.

It would be very pleasant, if, wafted by the breezes of scientific imagination, we were to set full sail, and navigate our bark into still more distant space. And, indeed, we are under no slight obligations to those strong minds and courageous spirits who thus adventure themselves out beyond well-known waters; for the treasures which they bring back from every such voyage are both valuable and strange, and they set men thinking on new and untrodden lines. But lest, less fortunate than my neighbours in any such venture, I should fail to fall in with a returning current, capable of recovering my expended energy, and of restoring myself to *terra firma*, I must here pause. It is, however, said, that in the mind of every one, even the most philosophic, there is a tender part; and therefore I must ask your indulgence, if, while resolutely turning my back on physical speculations, I still return for a moment to my first love, mathematical contemplation. For, in the region which we have been considering, namely, the magnetic field, explored and represented by its electric action, we seem to have entered upon a world which Riemann might have longed to see, a world wherein Lobatcheffski and Beltrami might have enjoyed the full fruition of realised ideas, and where even Clifford might have found abundant scope for the exercise of his inexhaustible powers of imagination and of thought.

FLORA OF NEW SOUTH WALES IN ITS GEOLOGICAL ASPECT

THIS, the oldest of the Australian settlements, may have its area grouped as follows:—(1) That of the sandstones or poor country represented by the Proteads and Epacrids; (2) the eastern slopes of coast range represented by the tree-nettles and the palms; (3) the cold mountain shrubs represented by sassafras, tree ferns, and myrtles; and (4) the interior plains represented by Chenopods and Compositæ. It may be wondered how the distribution of the vegetation has originated. That the Australian continent has risen slowly, is gathered from numerous proofs, among others the very apparent one of the strata exhibiting preponderately a horizontal plane. It may further be inferred that in its uplifting, the outer rim of the continent was slightly more elevated than the interior. This taken into consideration along with what doubtless at one time existed, namely, a great inland sea, abundance of marshes and mud, and a once probable greater rainfall, and particularly the latter, though one and all may have contributed to the present physical features, and consequently plant life. Another interrogatory arises, viz. Whence the coal-seams? As to these, there is some likelihood they are the remains of vegetation borne hence from a now sunken continent eastward of Australia; New Zealand, Norfolk, and Howes Island being outliers or now mere island vestiges of the said great land area in the Pacific Ocean.

Of the four local divisions above enumerated, the most typical vegetation of the first is the group Proteaceæ, a very ancient family, extending back to the secondary period of geology, from which time Australia apparently has never been submerged. A point of very considerable importance as bearing on this long-continued stability of the Australian continent may be derived from the remarkable close relationship and insensible gradation of some plants; for instance there is great difficulty in separating species of Eucalypti, Banksias, &c. Thus it may be said none or few of the connecting links have been lost, as must necessarily have been the case had submergence and elevation of the land have occurred.

Many curious problems yet await investigation, such as the fertilisation of the Proteads, including the Styleworts and Goodenia family. Again, have the Epacrids once been a family of trees, wherefrom the living species are but decadent examples? The Casuarineæ, or Beefwod tribe, are undoubtedly an ancient group, and like conifers, flourished in the dawn of life. The second division of the eastern slopes, Palms, and Tree-nettles possibly may have had an Asiatic origin, through the Malayan Archipelago. They appear not to be truly Australian in origin, but themselves only long established colonists. On the contrary, among the third division of the cold mountain scrubs, the Dorophoræ (Sassafras) hold a conspicuous place, and evidently are of Australian derivation. The peculiar vegetation of the interior plains or fourth division, the Chenopods and the Compositæ, are rapidly becoming one of the past, and the small species even now are sensibly giving place to the introduced grasses and weeds. Apart from the groups mentioned as most typical of the four areal divisions in question, as regards the Acacias and Eucalypts, they have the widest distribution and complicated genera. They both appear to be genera at their zenith, having existed long enough to pass into redundant forms, but not long enough to have been exposed to vicissitudes and decline. Their absence from Howe's Island and New Zealand shows they in all likelihood did not belong to the hypothetical submerged continent, nor are they old enough to be found along with the laurel and other remains of the gold drift. (Abstract of a communication by Mr. Robert Fitzgerald, F.L.S., read at the meeting of the Linnean Society, February 2, 1882.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The recent report of the Council of the Senate relative to the proposed Professorship of Animal Morphology, is creditable both to the University and to the Council. We think it desirable to quote some of its paragraphs entire. "The successful and rapid development of biological teaching in Cambridge, so honourable to the reputation of the University, has been formally brought to the notice of the Council. It appears that the classes are now so large that the accommodation provided but a few years ago has already become insufficient, and that plans for extending it are now occupying the attention of the Museums and Lecture-Rooms Syndicate.

"It is well known that one branch of this teaching, viz., that of Animal Morphology, has been created in Cambridge by the efforts of Mr. F. M. Balfour, and that it has grown to its present importance through his ability as a teacher and his scientific reputation.

"The service to the interests of natural science thus rendered by Mr. Balfour having been so far generously given without any adequate academical recognition, the benefit of its continuance is at present entirely unsecured to the University, and the progress of the department under his direction remains liable to sudden check."

It is recommended that a Professorship of Animal Mythology shall be established, terminable with the tenure of the first Professor; the stipend to be 300*l.* a year; the Professor to be appointed by vote of members of the Senate on the Electoral Roll. The duty of the Professor is defined as "to teach and illustrate the principles of the structure and development of animals, to apply himself to the advancement of the knowledge of those subjects, and to promote their study in the University." The Grace will be proposed on May 11.

From the reports of the natural science examiners in the last Local Examinations, we learn that the Junior Chemistry paper was very feebly answered, many being unable to explain the difference between a chemical compound and a mechanical mixture; but the practical work was satisfactorily done. The senior boys did well in chemistry, though the girls did badly. In heat, there were many failures among the Juniors, with great want of exactness in the definition of important terms: the majority failed to do a very simple calculation concerning the expansion of a solid; the Seniors did better. In Statics and Hydrostatics the papers of the Juniors were unsatisfactory; the answers to one numerical question were mostly confused masses of figures without a single word to serve as a clue to the labyrinth. The Seniors also receive a bad report; the questions involving accurate definition were not either attempted or were poorly done. In Botany the Junior papers were moderately good; there was, however, a tendency to the indiscriminate use of technical terms without a due regard to their meaning. The Seniors in many cases showed complete ignorance of some of the most elementary facts; the description of specimens was especially bad. In zoology both Juniors and Seniors did fairly well; still there was a general absence of diagrams, and little evidence of practical work. One valuable remark of the examiner is that young scholars should not be informed of the erroneous ideas of the older naturalists, even though the errors are pointed out, as unnecessary trouble is thereby given, and confusion is likely to be caused. In Physical Geography, good papers were sent up; but in Geology the majority were altogether unsatisfactory.

The examination for a vacant Sheepshanks Astronomical Exhibition will be held in Lecture Room No. 7, at Trinity College, on Monday, April 24.

The Demonstrator of Comparative Anatomy will take an advanced class for instruction in the Sauropsida next term, beginning April 18.

EDINBURGH.—At the close of his lecture on Friday, 31st ult., Prof. Archibald Geikie was presented with an illuminated address by past and present students of the Geology class in the University of Edinburgh. Mr. John Murray, of the *Challenger* Expedition, presented the address, which was as follows:—

"Sir,—We, your present and former students in the University of Edinburgh, beg to pay you the tribute of a brief farewell. While rejoicing in the honour conferred on you by your appointment as Director-General of the Geological Survey of Great Britain and Ireland, we would record, along with the expression of our most hearty congratulations, our deep sense of the loss which both we and our *Alma Mater* will sustain by your departure. To the distinguished services you have rendered the science in which you have taught us to share your interest and enthusiasm, we will do no more than refer; though we cannot fail to remember with pride how signally you have maintained the reputation of the Scottish School of Geology, and of Edinburgh, its metropolitan seat. We would here simply recall the many happy hours we have spent with you, both in the geological class-room and in the field, and express, for ourselves and for others now scattered over the world, the feelings of gratitude and affection with which your name will ever be regarded. We are, sir, with much respect and affection."

Having read the address, the sentiments of which were warmly applauded, Mr. Murray said that Prof. Geikie would find in it the names of about 140 students, and they expected that a number more would yet be added. They did not intend the address to express all the deep feelings they had towards Professor Geikie, nor did they attempt to say all that one should wish about the admiration in which they held Prof. Geikie as a scientific man and as a teacher. Upon the face of the address were some sketches by one of his present pupils, which might serve to remind him of the instruments with which they had fought, and of some of the battle-fields upon which they had been employed together—engaged in a fight in which the students knew Prof. Geikie had been a most excellent general for them. After mentioning that a casket for the address would be presented at a social gathering to be held in a few weeks thence, Mr. Murray, in name of the past and present pupils of the class, wished the Professor health, strength, success, and distinction in the new sphere of work to which he had been transferred. Prof. Geikie, who was warmly applauded, said there were moments in a man's life when the depth of his emotion was best expressed by silence. Therefore he made no attempt to tell the students how much their kindly feelings always, and this especially hearty outburst, had touched every fibre of his heart. At the close of every session he had been accustomed to look forward to the final day with great depression of spirits. It had always been to him a sad thing to say "good-bye" to the young men with whom he had been brought into such close personal contact during the winter; but this was to be his last adieu to them, and he could hardly trust himself to shape into words the feeling of genuine sorrow with which he left that class-room. Eleven years ago he began the work of that class. The Chair of Geology in the University was founded by the munificence of Sir Roderick Murchison, who was struck down by illness before the arrangements for the foundation were completed, and he believed it was largely due to the present Parliamentary representative of the University, Dr. Lyon Playfair, that these arrangements were finally carried out. As the students had said in the address, his aspirations had been very strong towards reviving, as far as in him lay, the fame of the Scottish School of Geology. No one could be more sensible than he was, of how far he had fallen short of the aspirations with which he began his work. But although he did not for a moment attempt to justify his failures, he should try to show them how difficult his task had sometimes been. When he entered on his duties, there was not one diagram or specimen belonging to this class. He had to obtain diagrams from all sources, and to make many of them himself, there being no great endowment for the support of the Chair. One part of his work during the eleven years had been to gather together materials for a class-museum. These he had succeeded in obtaining, partly through purchase, and partly through the kindness of friendly benefactors to the University. This collection, which would be of the greatest value in the future work of the Chair, was at present in great part stowed away in boxes, for want of space to display it. He had much satisfaction in leaving it as a legacy to his successor, Having referred to the difficulties which had attended the conducting of the class, arising from the deficiency of accommodation, two, and sometimes three professors using the same class-room, the Professor said this Chair was the first started in Scotland for the special cultivation of geology and mineralogy. He believed he was the first in Scotland, if not in Britain, to organise a practical class for the study of mineralogy and the microscopic investigation of rocks. Owing to the transference of the medical classes to the new University Buildings, his successor would have a series of class-rooms, with laboratory and museum attached, and he had no doubt a great future was in store for the prosecution of geology in the University of Edinburgh. He had tried always to make the cultivation of field-geology a prominent part of the work of the class; and some of their pleasantest associations had been among the glens of the Highlands and the hills and shores of the lowlands. In concluding, Prof. Geikie thanked the students very heartily for their kindness in the past, and for this crowning mark of their regard. Though his voice would no longer be heard within these walls, his interest in the students remained as sincere and as hearty as ever it was. They knew him well enough to be assured that his students had been, and always would be, to him personal friends. "And now, gentlemen," he concluded, "long live our dear old *Alma Mater*, and God bless you all."

THE following is the award of the Public Schools' Prize Medals of the Geographical Society for 1882:—Physical Geography (Examiner Prof. H. N. Moseley, M.A., F.R.S.): Gold Medal, Hubert Llewellyn Smith, Bristol Grammar School; Silver Medal, Albert Richard Sharp, Dulwich College. Honourably mentioned: Andrew Claude Crommelin, Marlborough College; Montague Edward Fordham, London International College; Samuel William Carruthers, Dulwich College; Albert Lewis Humphries, Liverpool College. Political Geography (Examiner, Sir Arthur Blyth, K.C.M.G., Agent-General for

South Australia): Gold Medal, Frank Herman Becker, Dulwich College; Silver Medal, Sydney Charles Farlow, Harrow School. Honourably mentioned: Robert Galbraith Reid, Dulwich College.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, February.—On the behaviour of steam in the steam-engine cylinders, and on causes of efficiency, by R. H. Thurston.—What is the most economical point of cut-off for steam-engines, considered as a question of finance? by W. D. Marks.—Contribution to the history of the link motion, by J. L. Whetstone.—A new theory of the suspension system with stiffening truss, by A. J. Dubois.—Steamship performance, by J. W. Nystrom.—Radio-dynamics; atomic phyllotaxy and kindred harmonies, by P. E. Chase.

Bulletin de l'Académie Royale des Sciences de Belgique, No. 12, 1881.—On the probable cause of variations of latitude and terrestrial magnetism, by F. Folie.—Remarks on the electric phenomena which accompany variations of the potential energy of mercury, by G. Van der Mensbrugghe.—On compound ethers of hyposulphurous acid, by W. Spring and E. Legros.—On the action of chlorine in sulphonic combinations, and on organic oxysulphides, by W. Spring and C. Winssinger.—On the action of chlorine on tertiary butylic alcohol, by Baron d'Otreppe de Bouvette.—On the structure of gemmiform pedicellaria of *Sphærechinus granularis* and other Echinida, by A. Fœttinger.—Researches on the organisation and development of Orthonectides, by C. Julin.—On the respiratory oscillations of the arterial pressure in the dog, by L. Fredericq.—On the delimitation and constitution of the lower coal-formation of Belgium, by J. C. Purves.—On the oscillations of blood-pressure called Periods, of Traube-Hering, by L. Fredericq.—A page of the history of a whale, or cetology fifty years ago: lecture by P. J. Van Beneden.—History of astronomy in Belgium: lecture by F. Folie.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xv. fasc. iii.—Meteorological *résumé* of the year 1881, calculated from observations made in the Royal Observatory of Boera, by E. Pini.—On the achromasia of aphaneri (*i.e.* colourlessness of certain minute organisms), by L. Maggi.—On the toxical action of hydroxylamine, by C. Raimondi and G. Bertoni.

Atti della R. Accademia dei Lincei, vol. vi. fasc. 6.—On Hieratite, a new mineralogical species, by A. Cossa.—On monobromopyridine, by L. Danesi.—Observations in addition to the memoir entitled "On an Organ of some Vegetable Embryos," by G. Briosi.—On the extraordinary atmospheric pressure of January, 1882, by L. Respighi.

Bulletins de la Société d'Anthropologie de Paris, tom. iv. fasc. iii., 1881.—M. Thulié concludes his paper on the differences between the true Bosjesmans and Hottentots, the former of whom he regards as survivors of an aboriginal, and once predominant race.—M. Topinard's report of his observations on the indigenous races of Algeria during a brief sojourn in that province, has given occasion—through his disregard of his own rules of ethnological inquiry, and his hastily formed views based on mere appearance—to the most interesting of the papers and discussions reported in these *Bulletins*. Among these are the comprehensive expositions which M. Topinard gave at a subsequent meeting of his "Méthode d'observation sur le vivant à propos de la discussion sur l'Algerie," and the description of his own modification of "Broca's Goniometer for measuring Cuvier's facial angle on the living subject."—M. Sabatier, in a paper on the different appellations used by the ancients to designate the peoples of Africa, endeavours to prove the existence of close analogies between Sanskrit, Greek, and the Berber dialect, as shown in the names of leading African peoples, which he derives either from their predominant occupations, or the nature of the region in which they dwelt.—M. Ameghino describes the result of his recent explorations of the Chelles beds, in which no human remains have been found, while those of the elephant, rhinoceros, and cave-bear are numerous, together with an abundance of aqueous, but no terrestrial shells.—M. Cavaroz reports his discovery of an atelier of flint implements in the Jura, near Salines, which appears to belong to the Neolithic age.—M. le Baron presented his report on prehistoric osseous lesions, which forms the subject of his inaugural thesis, and is based on a study of the specimens contained in the Broca, and the Society's, Museum. The list of diseases includes most of the modern forms, common in infancy and advanced age, while the numerous instances of trepanning, and the not infrequent cases of well consolidated fractures show that primæval man was not wholly negligent, or unskilled in regard to surgical methods.—A new case of so-called hermaphrodism reported by M. Magitot, gave rise to considerable discussion, in the course of which it was agreed that the use of the term was not in harmony with the present state of physiological inquiry, and that the abnormalities in question ought to be included under the general head of malformations, or embryonic arrest of development.—We have further to notice papers by Madame Clemence Royer, on "Le Bien et la loi Morale"; by M. Zaborowski on the memory and its disturbances; by Mr. Foley, on the relations between the mode of life and character of tropical peoples, and the humid climate in which they live; and finally, two highly important communications, received from M. de Ujfalvy, on the craniometric and other measurements made by him while travelling in the Thibetian, Kashmir, and other Indian territories. His observations on the Baltis, Lhassas, Ladakis, Koulous, and Lahoulis—the two last-named of which practise polyandry, and follow a degraded form of Bouddhism—supply highly interesting, and hitherto unknown materials towards our better acquaintance with the ethnological and sociological history of these tribes.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 9, 1882.—"On the Spectrum of Carbon," by G. D. Liveing, M.A., F.R.S., Professor of Chemistry, and J. Dewar, M.A., F.R.S., Jacksonian Professor, University of Cambridge.

Angström and Thalén, in their memoir "On the Spectra of the Metalloids" (Nova Acta Reg. Soc. Upsal., Ser. iii. vol. ix.), give a map and table of wave-lengths of the lines due to carbon in the visible part of the spectrum, as distinguished from the fluted spectra given by compounds of carbon, namely, carbonic oxide, cyanogen, and acetylene. These lines, they state, always appeared when very powerful induction sparks were passed through the vapour of any compound of carbon, or between carbon electrodes. This line-spectrum is remarkable for simplicity, consisting of eleven lines, of which the single line in the yellow, followed by a triple group in the green, and a very strong line in the blue, recall vividly the spectrum of magnesium; and as we know two modifications of the spectrum of magnesium which seem to be due respectively to the oxide and a hydride, the parallel between the behaviour of the two elements is the more striking.

The authors figure the ultra-violet spectrnm of carbon to a scale of wave-lengths within the range of the rays transmitted through calcite. The lines figured have been observed in photographs of the spark of a large induction coil, having a large Leyden jar in connection with the secondary coil, between poles of purified graphite in air, carbonic acid gas, hydrogen, and coal-gas. The same lines have been observed in photographs of the spark between iron, and between aluminium poles in carbonic acid gas. By comparing the photographs taken under these different circumstances, they have, they believe, eliminated the air-lines, which are numerous and strong in the region between H and T, and also the metallic lines which graphite, purified with the utmost care, still exhibited.

The graphite was purified by being stirred in fine powder into fused potash, and subsequent treatment with aqua regia, by prolonged ignition in a current of chlorine, and by treatment with hydrofluoric acid. The well-washed powder was afterwards compressed into blocks by hydraulic pressure between platinum plates, and from these blocks the electrodes employed were cut. Notwithstanding the purification, the photographs of the spark between these electrodes still showed very distinctly lines of magnesium and iron.

The wave-lengths of the strongest carbon lines were determined by means of a Rutherford diffraction grating having 17,296 lines to the inch. The measures were made in the following way:—A small photographic slide, containing the sensitive plate, fitted the telescope in place of the eye-piece, and so could easily be turned about an axis coincident,, or nearly so, with the optic axis of the telescope. In taking a measurement of the position of a line the approximate wave-length was first found by interpolating between the nearest cadmium or other lines of known wave-length in photographs taken with calcite prisms.

The telescope was then set to the angle corresponding to this approximate wave-length for the spectrum of the fourth order. The lower half of the slit was closed by a shutter, and the photographic slide having been adjusted for level, the plate was exposed to the light which came through the upper half of the slit, and gave an image of the lines in the lower half of the field. When this exposure was completed, the photographic slide was turned round through 180° about the axis of the telescope, so as to bring to the top that part of the sensitive plate which had been before lowest. It was then exposed a second time, and thus two images of the same line were impressed on the plate, which were necessarily at equal distances on either side of the point where the axis of the telescope met the plate. By a subsequent measurement with a micrometer under a microscope of the distance between the two images, and the conversion of this distance into angular measure, a correction was found, which was added to, or subtracted from, the reading of the circle to get the exact deviation of the ray producing the line under observation. Another photograph of the same line was next taken in the same way as before, except that the telescope was placed at the corresponding angle on the other side of the collimator. From the two angles thus found, the wave-length of the line was calculated. The process was repeated three or four times for each line, and the mean wave-lengths thus found for carbon lines were 2296·5, 2478·3, 2509·0, 2511·9, 2836·3, and 2837·2. The wave-lengths of the remaining lines were obtained by interpolation from measures of photographs on which the iron as well as the carbon lines were shown. The wave-lengths of the iron lines used in the interpolations were deduced from photographs taken with the grating in the same way as that above described for the carbon lines. The wave-lengths thus formed for the remaining carbon lines are given in the table below.

Table of Carbon Lines

Authors.	Colour.	Wave-length.	Intensity.
Ångström and Thalén	Red ...	6583·0	2
		6577·5	1
	Orange.	5694·1	4
		5660·9	4
		5646·5	3
		5638·6	5
	Yellow ...	5379·0	6
	Green	5150·5	4
		5144·2	3
		5133·0	5
	Indigo ...	4266·0	1, diffuse
Liveing and Dewar	Ultra-violet.	3919·3	2, diffuse
		3876·5	4, ,,
		2995·0	4, very diffuse
		2968·0	5, ,, ,,
		2837·3	2
		2836·3	2
		2746·5	3, very diffuse
		2733·2	6, ,, ,,
		2640·7	4, ,, ,,
		2541·5	6
		2528·2	5
		2523·6	5
		2518·7	5
		2515·8	4
		2514·0	5
		2511·9	2
		2509·0	3
		2506·6	5
		2478·3	1
		2296·5	3

They have also examined the spectrum of Swan's incandescent lamps. So long as the carbon thread is unbroken, it emits a continuous spectrum, on which neither bright nor dark lines are visible. By gradually increasing the number of cells in the battery, until the thread gave way, they found at the instant of fracture, for a small fraction of a second only, that a set of flutings in the green appeared. In some of those lamps, when the current was nearly as much as the carbon thread would bear without rupture, a sort of flame appeared in the lamp. On examining the spectrum of this flame, it gave the flutings of carbonic oxide very distinctly. Closer examination showed that this flame was strongest about the junction of the carbon thread with one of the conducting wires, and that, on reversing the current, it shifted from one wire to the other, and the wire about which it appeared was always the positive electrode. In fact, the flame was the glow of the positive pole attending a discharge in rarefied gas; when the resistance of the carbon thread became too great in proportion to the intensity of the current, the discharge began to occur through the rarefied atmosphere within the envelope of the lamp. The spectrum showed that this atmosphere contained carbonic oxide.

By interposing different flames between the incandescent lamp and the slit of the spectroscope, they have made some comparisons of the probable temperatures of the flames and filament. When the flame was that of a Bunsen burner, in which was a platinum wire with sodium carbonate, the yellow sodium lines were seen bright above and below the continuous spectrum of the carbon thread, but reversed where they crossed it. When lithium was substituted for sodium in the flame, the red lithium line was also seen bright above and below the continuous spectrum, but reversed where they crossed it. When an oxyhydrogen jet was substituted for the Bunsen burner, and sodium carbonate held in it, the yellow sodium lines were not only bright above and below the continuous spectrum of the carbon, but showed as bright lines where they crossed it; in fact, they were conspicuously brighter than the carbon. When coal-gas was substituted for hydrogen in the jet, the same appearance presented itself, only the sodium lines were not so much brighter than the carbon as they were before. Fifty Grove's cells were used with the incandescent lamp, which were as many as could be used without danger of rupturing the threads. When barium chloride was held in the hydrogen flame fed with only a little oxygen, the bright green line of barium (wave-length 5534) was well seen above and below the continuous spectrum, but could not be traced either bright or dark across it. When a flame of cyanogen burning in air was interposed, the bright bands of that flame could be seen above and below the continuous spectrum, but could not be traced either bright or dark across it. When sodium carbonate was held in this flame, the yellow sodium lines were seen feebly reversed where they crossed the spectrum of the incandescent lamp. They infer from these experiments, that the emissive power of the carbon thread for light of the refrangibility of the D lines is nearly balanced by that of sodium in the flame of cyanogen burning in air, but is sensibly less than that of sodium, at the temperature of a jet of coal-gas and oxygen, much less than that of sodium in the oxyhydrogen jet. This seems to render it probable that the temperature of the incandescent thread is not far different from that given to sodium by a cyanogen flame burning in air, but is less than that of an oxyhydrogen flame, though this does not necessarily follow from the experiments, inasmuch as the radiation of the sodium is so much more limited as to range than that of the carbon. When a Bunsen burner or a gas blowpipe flame was interposed between the lens and slit, no reversal of the hydrocarbon bands could be seen. When magnesium was burnt between the lens and slit, the magnesium lines (*b*) were seen bright, eclipsing the carbon. Possibly the smoke of magnesia may have considerably helped to eclipse the light of the carbon.

Chemical Society, March 16.—Prof. Roscoe, president, in the chair.—The following papers were read:—On valency, by Dr. Armstrong. The bulk of this paper is taken up with a consideration of the valency of carbon in the hydrocarbons, and especially with the formulæ proposed by Kekule and others for benzene. The author concludes that a simple hexagon in which carbon acts practically as a triad, agrees best with the various reactions of benzene.—Contributions to the chemical history of the aromatic derivatives of methane, by R. Meldola. The author investigates the action of benzyl chloride upon diphenylamine, and the action of oxidising agents upon the product. The substance thus produced is a green dye, "viridin," which by the action of strong sulphuric acid forms sulphonic acids, the alkaline salts of one of these acids dyes woollen fabrics from an alkaline bath. This colour is the chloride of a base which the author has proved to be diphenyl diamidotriphenyl carbinol.—On some constituents of resin spirits, by G. H. Morris.—The lower fractions of resin spirit yield on standing a crystalline substance. This body has been examined by the author. It has the formula

$C_7H_{14}O_2H_2O$; it is formed from a hydrocarbon heptin C_7H_{12}, boiling at 103° - 104°, contained in resin spirit. The author has also studied the action of nitric acid, permanganate, &c., on heptin.—On pentathionic acid, by Watson Smith and T. Takamatsu. The authors reply to criticisms advanced by Lewes, Spring, Curtius, &c., on their previous work, and give further experiments on the subject.—On the preparation of diethyl naphthylamine, and the action thereon of sulphuric acid at high temperatures, and of phosgene gas, by B. E. Smith.

Chemical Society, March 30.—Anniversary Meeting.—The president, Prof. Roscoe, F.R.S., gave his annual address, and congratulated the Fellows on the satisfactory condition of the Society, both numerically and financially: 1175 Fellows are now enrolled on the register.—A ballot was then held for the election of Officers and Council, and the following were duly elected:—President, Dr. J. H. Gilbert. Vice-presidents: F. A. Abel, Warren De La Rue, E. Frankland, J. H. Gladstone, A. W. Hofmann, W. Odling, Lyon Playfair, H. E. Roscoe, A. W. Williamson, A. Crum Brown, J. Dewar, P. Griess, A. V. Harcourt, J. E. Reynolds, E. Schunck. Secretaries: W. H. Perkin, H. E. Armstrong. Foreign Secretary, Hugo Müller. Treasurer, W. J. Russell. Ordinary Members of Council: E. Atkinson, W. de W. Abney, F. D. Brown, F. R. Japp, H. McLeod, G. H. Makins, E. J. Mills, L. O. Sullivan, C. Schorlemmer, J. M. Thomson, W. Thorp, T. E. Thorpe.

Meteorological Society, March 15.—Mr. J. K. Laughton, F.R.A.S., president, in the chair.—The following gentlemen were elected Fellows of the Society:—T. H. Baker, J. T. Barber, W. H. Jackson, Capt. J. Simpson, R. F. Sturge, and Sir B. J. Sulivan, K.C.B.—The president (Mr. J. K. Laughton) gave a historical sketch of the different classes of anenometers. He remarked that anemometers are instruments for measuring the strength of the wind; they are of different classes, according as the strength is estimated by the pressure on a surface, or by the velocity, by its power of suction, or by its cooling effects. Those that measure pressure may do so either by causing the plate which receives the wind to swing backwards along a graduated quadrant, or by bridling, that is, restraining that motion, and observing the resistance called into play; or by receiving the wind on a plate which can only move backwards, against either a spring, a lever attached to a weight, or a column of liquid. Others, again, receive the wind on the surface of the liquid, and show the pressure by the disturbance of the equilibrium in a siphon tube. At the present time, and in this country, instruments that measure velocity are more generally preferred, the type now commonly adopted being that known as Robinson's cups, in which four hemispherical bowls placed at the arms of a horizontal cross cause it to rotate freely as the wind blows against them. But many very different instruments have been used for measuring velocity, the most primitive of which was a disc of cork, fringed with light feathers—a species of shuttlecock—travelling freely along a considerable length of fine wire stretched in the direction of the wind. Rotation has, however, been the favourite way of bringing the motion of the wind within reach of the observer, and to get that rotation almost every conceivable form of wheel or fan would seem to have been tried. What are known as suction anemometers depend on the hydraulic principle of the lateral communication of motion by a stream. A current of air blowing across the open end of a pipe draws the air out of that pipe, causing within it a partial vacuum, which, by various arrangements, can be measured, the relative vacuum depending on the strength or velocity of the wind which gives rise to it. Several different methods have been adopted for measuring this vacuum; but, though anemometers constructed on this principle take hold of the imagination by their neatness and simplicity, the unknown amount of disturbance due to friction, or—when long pipes are used—to vibration, prevent their being received at present as satisfactory gauges of the wind's velocity. Other anemometers have been made on the principle that the evaporation of water, or the cooling of a heated surface—other things being equal—goes on at a rate proportional to the velocity of the wind; but, in practice, it has been found difficult to insure the equality or uniformity of conditions, or to make correct allowance for their difference, and at least one very ingenious instrument, by receiving the air into different pipes, opening different valves according to its varying strength, causes them to give out two simultaneous but distinct musical notes, the one of which answers to a definite direction, the other to a definite velocity. Such things can, at present, only be considered as pretty and ingenious toys: they can, undoubtedly, mark a difference between one wind and another, but are quite unequal to giving any exact measure of relative and still more absolute force. Even the more generally recognised types of anemometer, the very commonly used pressure plates of Mr. Osler, or the revolving cups of the late Dr. Robinson, are by no means entirely satisfactory. The action of stream lines in front, or of the partial vacuum behind the exposed surface, leads to curious vagaries, difficult to understand, and as yet impossible to correct. But till they are understood and corrected, anemometry, as a science, stands on a very uncertain basis. The President, in conclusion, said that what we want is not so much new and improved apparatus for registering or recording; for though those we have are not perfect, they are far superior to the anemometers they are applied to. What we want is rather some radical improvement in the instrument itself or in the theory which translates its action. It is to this that we would wish more especially to call the attention of all meteorologists.—In connection with this meeting there was an exhibition of instruments, consisting of anemometers and new meteorological apparatus, &c. The anemometers exhibited were forty-five in number, and included, among others, those of Beckley, Biram, Cator, Hagemann, Howlett, Lind, Lowne, Osler, Oxley, Robinson, Ronalds, Somerville, Whewell, and Wild. There were also photographs and drawings of old forms of anemometers, damage caused by whirlwinds, &c.

Zoological Society, March 21.—Prof. W. H. Flower, F.R.S., president, in the chair.—Mr. J. E. Harting, F.Z.S., exhibited and made remarks on a mummified bird of the genus *Sala*, and some eggs from the guano-deposit of an island off the Pacific coast of South America.—Mr. Sclater made some remarks on "lipotypes"—a new term which he considered convenient, in order to designate types of life, the absence of which are characteristic of a particular district or region. Thus, *Cervus* and *Ursus* were "lipotypes" of the Æthiopian region.—Dr. A. Günther exhibited and made remarks on the skin of a pale variety of the Leopard from the Transvaal. Dr. Günther also exhibited and remarked upon a specimen of a new Turtle (*Geoemyda*) from Siam.—Mr. R. Bowdler Sharpe exhibited a specimen of a Goldfinch from Hungary, sent to him by Dr. J. von Madarasz, of the Museum of Buda-Pest, which that gentleman had described as *Carduelis elegans albigularis*. Mr. Sharpe observed that a white-throated variety of the Goldfinch was by no means unknown in England.—Dr. Hans Gadow, C.M.S., read a paper on some points in the anatomy of *Pterocles*, with remarks on its systematic position. Detailed descriptions of the alimentary organs and of the muscles were given. The author took the opportunity of discussing the classificatory or systematic value of the cæca in birds. Then, after pointing out the difficulties of placing the Sand-Grouse in the Avian system, he came to the conclusion that the *Pterocletes* (Sclater) should be considered as a group co-ordinate to the Rasores, Columbæ, and Limicolæ, between which they formed a connecting link.—Mr. W. A. Forbes read a note on a peculiarity of the trachea in the Twelve-wired Bird of Paradise (*Seleucides nigra*) as observed in a male specimen that had recently died in the Society's Gardens.—Mr. Bowdler Sharpe read a note on the *Strix oustaleti* of Hartlaub, and pointed out that this bird was none other than the Grass-Owl (*Strix candida*).—Capt. G. E. Shelley gave the descriptions of some new species of birds which had been obtained in the neighbourhood of Newcastle, Natal. These the author proposed to name *Anthus butleri* (a very interesting Yellow-breasted Pipit), *Sphenœacus natalensis* (the Natal representative of *S. africanus*), and *S. intermedius* (an intermediate form from Kaffraria).—Messrs. Godmin and Salvin read a paper, in which was given the descriptions of some new species of Butterflies of the genus *Agrias*, from the valley of the Amazons.—Mr. E. J. Miers read an account of a collection of Crustaceans which had been made by M. V. de Robillard, at the Mauritius. The author called special attention to a fine Spider-crab dredged up from a depth of eighty fathoms, which he proposed to name *Naia robillardi*.

Geological Society, March 22.—J. W. Hulke, F.R.S., president, in the chair.—William Brown, George Thomas Parnell, and Edwin Alfred Walford, were elected Fellows of the Society.—The following communications were read:—On a fossil species of *Camptoceras*, a freshwater mollusc, from the Eocene of Sheerness, by Lieut.-Col. H. H. Godwin-Austen, F.R.S.—Note on the os pubis and ischium of *Ornithopsis eucamerotus* (synonyms—*Eucamerotus*, Hulke; *Bothriospondylus* (in part), R. Owen; *Chondrosteatosaurus*, R. Owen)," by

J. W. Hulke, F.R.S., Pres.G.S In this paper the author reviewed the various contributions to the knowledge of this Dinosaur, for which he adopted Prof. Seeley's generic name *Ornithopsis*, and employed the name *eucamerotus*, originally applied by him to the genus, as the specific name. He also discussed the affinities existing between *Ornithopsis* and certain other Dinosaurs, such as *Ceteosaurus* and the American genera *Camarosaurus*, *Atlantosaurus*, and *Brontosaurus*. He then described the pubis and ischium which have recently been acquired by the British Museum from the collection of the late Rev. W. Fox, by whom they were purchased, together with the finest typical thoracic vertebræ of *Ornithopsis*.—On *Neusticosaurus pusillus* (Fraas), an amphibious reptile having affinities with the terrestrial Nothosauria and with the marine Plesiosauria, by Prof. H. G. Seeley, F.R.S. These remains come from the Lettenkohle, a stratum between the Upper Muschelkalk and Keuper, and were obtained at Hoheneck, about 9 miles north of Stuttgart. They have been already noticed by Dr. Fraas under the name of *Simosaurus pusillus*; but the palate differs much from that of this genus, and from all others that are known. *Neusticosaurus* is the smallest representative of the Plesiosauria yet known, and has a special interest as exhibiting hind limbs with the characteristics of a terrestrial animal, while the fore-limbs are modified into paddles.

Victoria (Philosophical) Institute, April 3.—A paper on materialism was read.

PARIS

Academy of Sciences, March 27.—M. Jamin in the chair.—The following papers were read:—Double decompositions of haloid salts of silver, by M. Berthelot.—On the velocity of propagation of explosive phenomena in gases, by MM. Berthelot and Vieille. Small detonators (of fulminate) had been used, breaking circuits as the waves passed; and the velocity observed is now shown to be independent of these. It is also found independent of the diameter of the tubes beyond 5 mm.—Instantaneous photographs of birds in flight, by M. Marey.—On the variations observed in the herring fishery on the Norwegian coasts, by M. Broch. These variations, long recorded at Bergen, seem to depend on the movements of large banks of animalculæ, which are the herring's food, towards or away from the coast; and these displacements are probably due to variations in marine currents and dominant winds, which require investigation.—First succour to the wounded on the battlefield, by M. Fournier. He indicates, in photographs, means that may be used, where ambulance-aid cannot be had.—Comet discovered in America, on March 19, 1882; observations at Marseilles Observatory, by M. Coggia.—Observations of the comet at Paris Observatory, by M. Bigourdan.—Observations of solar protuberances, faculæ, and spots at the Observatory of the Roman College during the fourth quarter of 1881, by M. Tacchini. *Inter alia*, the protuberances diminished in number, from a maximum in September; but they were nearly twice as numerous as in the same quarter of 1880. Their height and extent had increased very little. Spots and faculæ showed, as before, two maxima between $\pm 10°$ and $\pm 30°$.—On hypercycles, by M. Laguerre.—On Pfaff's problem, by M. Darboux.—On a group of linear substitutions, by M. Picard.—On discontinuous groups, by M. Poincaré.—On the application of the resistance of materials to the pieces of machines, by M. Léauté.—On the compressibility of gases, by M. Sarran. Clausius' formula represents, with much exactness, the compressibility of six gases studied.—On the relation $\phi(v, p, t) = 0$ relative to gases, and on the law of dilatation of these substances at constant volume, by M. Amagat.—On a certain class of equipotential figures, and on M. Decharme's hydraulic imitations, by M. Guébhard.—Telephonic indicator of the torsion and velocity of rotation of the motor-axis of machines, and consequently of the work, by M. Resio. This enables a single observer to make the measurements at a distance. The principle is that of the induction balance.—Action of telephonic currents on the galvanometer, by M. de Chardonnet. Sounds of uniform intensity do not affect a sensitive galvanometer, but the needle is deflected when the intensity varies, the direction being opposite in increase and decrease. This is easily explained.—On the absorption-spectrum of ozone, by M. Chappuis. The spectrum is more characteristic than any other properties; the author specifies the wave-lengths of the bands, and describes their appearance and order of occurrence under varying conditions.—Researches on ozone, by Abbé Mailfert. This relates to action of ozone on organic matters, on several metallic oxides and sulphides, and on salts whose bases are susceptible of suroxidation.—Action of alkaline solutions on protoxide of tin, by M. Ditte.—Experimental researches on the constitution of cements and the theory of their hardening, by M. de Chatelier. He examined thin plates of Portland cement with the polarising microscope, and indicates the substances present and those produced in hardening.—On campholurethane, by M. Halles.—Action of cyanogen on sodised menthol, by M. Arth.—Preparation of pure carbon for electric lighting, by M. Jacquelain. The method is, directing a current of dry chlorine for thirty hours on several kilogrammes of crayons of retort-carbon heated to a bright red, and afterwards letting carburet of hydrogen vapour circulate slowly among them for five or six hours; another method, action of fused caustic potash or soda; a third, action of hydrofluoric acid. The author also prepares directly pure graphitoid carbon by decomposition of organic substances through heat. A photometric table of different carbons is given.—Intestinal digestion, by M. Duclaux.—The microzymas of the stomachal glands and their digestive power; reply to the question, Does the stomach digest itself? by M. Béchamp. The stomachal mucous membrane is digested by the microzymas, but the production of new cells is superior to the consumption.—Researches on pancreatic albuminoses, by M. Béchamp.—On trichinæ in salt meat, by M. Colin. American salt meat, as now imported, may, only in rare cases, transmit trichinosis where the pieces are recent, or large and badly-impregnated.—Similarity of effects of central and cortical lesions of the brain, by M. Couty.—On the reproductive apparatus of star-fishes, by MM. Perrier and Poirier.—Development of the ovum of *Podocoryne carnea*, by M. de Varenne.—On the present state of monetary and note circulation, with some indications as to modifications following on extension of the metric system, by M. de Malarce. England uses relatively the fewest monetary instruments (metallic or note money); France much more. The total for the former is 4,800 million francs, for the latter 8,600 million.

VIENNA

Imperial Academy of Sciences, March 30.—L. I. Fitzinger in the chair.—J. Barrand, "Système silurien du centre de Bohême" (vol. vi., containing the Acephala, with 361 tables).—M. Kovatsch, on the sand covering of Venice and its causes.—H. John, on the vapour density of bromine.—On the knowledge of amine bases of secondary alcohols, by the same.—F. Reinitzer, studies on the reaction of acetates of chromium, iron, and aluminium.—An analysis of a vegetable fat, by the same.—T. Puluj, on radiant electrode-matter (ii.).—E. Tangl, on the division of nuclei of Spirogyra cells.—F. Berwerth, on the chemical composition of amphiboles.—Dir. Steindachner, batrachological contributions.—G. Tschermak, on the meteorites that fell near Mocs (Transylvania).—E. Weiss reported on the elements and ephemeris of the comet discovered by Mr. Wells at Boston (U.S.A.) on March 18, computed at the Vienna Observatory by E. Holetschek.

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