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THURSDAY, DECEMBER 26, 1872

THE PROGRESS OF NATURAL SCIENCE DURING THE LAST TWENTY-FIVE YEARS

I.

ON the occasion of the celebration at Breslau of the twenty-fifth anniversary of Prof. Goeppert's presidency of the Silesian Society for National Culture, Prof. Ferdinand Cohn delivered an address characterised by eloquence of the highestk ind on the above subject. As the wanderer, he said, who is climbing towards a high mountain peak, feels from time to time the desire to stand still a little, and look back on the way over which he has passed, to enjoy the wider outlook which he gains from his higher stand-point; so he thinks there are moments in the uninterrupted progress of science, when we long in some measure to strike a balance, and see how much acquired property the present puts aside as useless, how much it uses only for temporary purposes, and how many enduring acquisitions have been made.

Dr. Cohn refers, no doubt with justice and some pardonable pride, to the foremost place held by Germany during the last quarter of a century, in the march of science. At the same time he awards due praise to other European states, and above all to England, which, during that time and more particularly at present, he thinks, abounds in men of the highest eminence, whose scientific achievements stand prominently out on account of their astonishing energy, clearness, depth, and independence of thought. Still, we cannot but admit that Dr. Cohn is right in asserting that Germany is free from the dilettantism which abounds in this country, and that as a rule science in Germany is both far more widespread, and far more thorough than it is among ourselves, and that the opportunities furnished there to all classes for scientific study at the ordinary educational establishments have until recently left us almost nowhere. But happily, signs of the beginning of the end of this state of things among us are becoming rife.

After briefly referring to the intellectual awakening of Germany along with the rest of Europe at the time of the Reformation, and showing how this start forward was, especially in the case of Germany, in a great measure frustrated by the Thirty Years' War, Dr. Cohn pays a high and justly-merited tribute to France, and especially to Paris, on account of the supreme place she took during the first thirty or forty years of the present century in nearly all the sciences. The glory of France in this direction has however, he thinks, departed, and Germany is becoming daily more and more the intellectual centre of the world. Had Dr. Cohn written his lecture now, he might have somewhat modified his language; for within the last few months, the signs have been many, that in the direction of science the French are determined to try to hold their own with the foremost in Europe. Their professors are prosecuting an amount of research which puts our own to shame, while they are at the same time forming a school of investigators. We do not grudge to Germany all the praise she well deserves, and the influence which the results of German research exercise on other nations, is likely to urge them to such vigorous and determined efforts, that, sooner or later, science and every other progressive influence shall be "great gainers." Meantime, however, Germany is doubtless in the ascendant.

In the year 1845 appeared the first volume, and in 1846 the second of Humboldt's *Cosmos*. As comprising a view of the whole created universe depicted with the most wonderful sympathy, the book is as it were a canon forming a key to everything that was known of nature at the time. No man was then more suited for such work than was in the highest degree A. von Humboldt. A *Divina Commedia* of science, the *Cosmos* embraced the whole universe in its two spheres, heaven and earth, Under the leadership of the great searcher of Nature, as Dante once by the hand of Virgil, we climb from the depths of the universe, with its furthest nebulæ and double stars, down through the star depths to which belongs our solar system, to the air and sea-enveloped earth, where form, temperature and magnetic condition are unveiled to us; then to the wealth of organic life, which, stimulated by the light, unfolds itself on its surface. It is an overwhelming picture of nature, of surpassing beauty of outline, abounding in grand perspective, with the most careful execution of the smallest detail.

But we cannot conceal from ourselves that the *Cosmos*, published twenty-five years ago, is in many of its parts now antiquated, not merely because it is wanting in many facts which have since been discovered, but most particularly because Humboldt was ignorant of some highly important questions which have since taken their place in the foreground of scientific discussion, while our scheme of the universe during the last ten years has been considerably modified by the introduction of new and influential ideas. Any one who to-day would attempt to recast the *Cosmos*, must proceed like the Italian architect who took the pillars and blocks of the broken temples of antiquity, added new ones, and rebuilt the whole after a new plan.

There are three discoveries which during the last quarter of a century have entirely changed the position of natural science:—the mechanical equivalent of heat, spectrum analysis, and the Darwinian theories.

Since, in the year 1842, an unknown physician in a Swabian country town, Dr. Mayer of Heilbronn, pointed out that a hammer 424 kilograms in weight, which falls from the height of a metre on an anvil, raises the heat of the latter by one degree centigrade, and that by this process of bringing a falling motion to a stand-still it is converted into a fixed quantity of heat—since then has science gained a new conception of the conditions of matter and of the powers of nature. This new doctrine appears in the mechanical theory of heat announced by Joule, Krönig, Maxwell, and Clausius, in the doctrine of the conservation of energy of Helmholtz and Thomson, and by means of the brilliant writings of Tyndall it has become the common property of the educated world. Electricity and magnetism, heat and light, muscular energy and chemical attraction, motion and mechanical work—all forces in the universe are only different forms of one and the same power, which has dwelt from the first in matter in invariable quantity, neither increased nor diminished, not the least trifle of it can be annihilated or created Only the phenomenal forms of power are changeable;

light can be converted into a chemical equivalent, this again into heat, heat into motion, and indeed a fixed quantity of one force always and only into an equivalent quantity of another. In like manner also the quantity of matter has remained unchanged from the beginning; not the least particle or molecule can be annihilated or created out of nothing, and only in the transformation of perishable bodies are the molecules formed into ever new combinations. What we distinguish as natural forces are only movements of molecules, for the least particles of matter out of which bodies are composed are not inseparably united to each other, but are loosely held together and in continuous whirling and undulatory motion; according to the swiftness and width of undulation of the molecule will this motion of our nerves be regarded now as sound, now as heat, then as light or as colour. Moreover, the chemical union of the elements of matter, the attractive power of gravitation in all the bodies of the universe, are but varied forms of this universal motive force. The unity and permanency of substance with its two attributes, matter and force, and their innumerable modifications, which go to form the bodies of the universe, were in the first instance enunciated as a philosophical maxim by the great thinker Spinoza. Now it is established as a philosophic fact by means of exact measure and weight.

Again, on the inner organisation of the system of the universe has unexampled light been thrown by the wonderful researches which were begun in 1859 by two men, united by the closest bonds of a friendship which bore rich fruit for science. After the light of the sun had, in the third decade of this century, been brought into the service of art by Nièpce and Daguerre, Bunsen and Kirchhoff* compelled it also to render service to chemistry and astronomy. Like those magicians of the legend, who, through the power of their knowledge, compelled the spirits of the elements to disclose their most recondite secrets, the genius of these men compelled the rays of light imprisoned in the spectrum apparatus to make revelation of things in the world of stars which the curiosity of men had deemed for ever inaccessible. Already had Kirchhoff ascertained what terrestrial elements were present in the sun's atmosphere, and what were not; quite recently has it been discovered that there is even present in the sun a substance (*helium*) which hitherto has been unknown on the earth. Moreover also, the inner structure of the sun, the distribution of its incandescent, liquid, and gaseous parts, its luminous and coloured envelope, the nature of its spots and protuberances—all this is no longer a playground for fantastic imaginings, but the subject of exact research. Since the great eclipse of 1868, Lockyer and Janssen, Zöllner, Huggins, and Father Secchi have observed, day after day, storms, whirlwinds, flame-sheaves, outbursts of burning hydrogen to the height of 20,000 miles: thus has been developed an entirely new science—the meteorology of the sun. Moreover, on other obscure regions of the heavens, on the physical and chemical conditions, even on the laws of the movements of the fixed and double stars, on nebulæ and milky ways, on planets and comets, on zodiacal and northern lights, has spectrum analysis thrown its enlightening rays. No less by rigorous mathematical method, through which astronomy, even at an earlier period, had been brought to a certain amount of perfection, has she in the most recent time enjoyed an unexpected triumph, by solving, through the researches of Schiaparelli, the riddle of the comets, in being able to recognise the identity of their nature with that of the swarms of shooting-stars whose remarkable brilliancy long ago made them universally known.

(*To be continued.*)

* In connection with this discovery it would have been a graceful act on the part of our author to have referred to the names of Stokes and Stewart.—Ed.

EXPLORATION OF THE SOUTH POLAR REGIONS

III.

AT the conclusion of the last article the drifting sea-weed was referred to as an important element in enabling us to ascertain the state of the sea about the Antarctic regions. Let us now see whether the conditions of temperature, so far as they have yet been determined, are in harmony with the ideas already developed. By reducing the ascertained directions for all the months of the year to a mean, there is obtained for the maximum of the temperature a curve which coincides with the intersections of the following meridians and parallels of latitude:—

33°	S. lat. and	33°	E. long.	44°	S. lat. and	65°	E. long
35	,,	35	,,	46	,,	67	,,
37	,,	40	,,	47	,,	68	,,
38	,,	43	,,	48	,,	70	,,
39	,,	47	,,	49	,,	71	,,
40	,,	50	,,	50	,,	73	,,
41	,,	55	,,	51	,,	73	,,
42	,,	60	,,	52	,,	74	,,
43	,,	63	,,	53	,,	75	,,

A glance at a map shows that this curve leads into the midst of the ice-free field, and is only distorted somewhat from its regular course by Kerguelen Island. This curve can be followed even as far as Macdonald Island, which is of high importance, inasmuch as it can be proved from direct observation that a higher temperature of the water exists in these regions, as Dr. Neumayer himself has witnessed. When he, in December and January, 1856-57, was sailing about 53° S. lat., he proved from hourly observations that there was an influx of a warm current between 62° and 72° E. long.

With respect to the higher temperature in the Pacific Ocean, it suffices to mention the circumstance that there exists on the Falkland and Campbell Islands a richer vegetable and animal life than is the case on other islands in the same latitude of the hemisphere. The unusual mildness of the regions is to be ascribed to the neighbourhood of the Australian continent, as well as to the prevailing west and north-west winds. If, on the other hand, a much poorer flora is found on Kerguelen Island than on the Auckland Islands, and if we should be at first inclined to regard this as evidence against the milder influx of warm currents, it should not be forgotten that Kerguelen does not enjoy the warming influence of a great continent, since it lies in the midst of the Indian Ocean, almost equidistant from the two nearest continents, and more than double the distance of the Auckland Islands from Australia. Both around New Zealand and near Kerguelen and south from Cape Horn, the cachelot (*Physeter macrocephalus*), which, it is known, seeks out the warmer waters, is found in abundance.

Dr. Neumayer quotes Bellinghausen's valuable journal for March 12, 13, and 14, 1820, from which it appears that at least as far south as 61° S. lat., under the meridian of 73·5° E. long., the sea is free from ice. Besides, it appears from his description that both in the sea and in the sky exists an active animal life, and the coruscation of the sea was observed for the first time by him in high latitudes. The occurrence of this phenomenon proves the existence of a very large quantity of organic remains which have been carried in this direction —a fact which, in conjunction with the other phenomena, Dr. Neumayer thinks has a positively demonstrative force.

After the slight sketch of the general phenomena of ice and currents, and the distribution of the warm districts lying immediately to the north of the south polar regions, it will be of interest to take a glance at the results of the several expeditions, with especial reference to the various meridians. If we understand by these results, in the first place, the greatest latitudes reached, and then the greatest stretches navigated inside the polar circle, we shall find, in reference to the former, the following points :—

Cook came to	71°	15′	S. lat. in	109°	0′	W.	long. in	Jan. 1774
Wilkes	,,	70	0	,,	103	0	,,	,,	March 1839
Bellinghausen	70	0	,,	93	0	,,	,,	Jan. 1821
Bellinghausen	69	30	,,	77	0	,,	,,	Jan. 1821
Weddell	,,	74	15	,,	34	17	,,	,,	Feb. 1823
Morrell (?)	,,	71	0	,,	50	0	,,	,,	March 1823
Ross	,,	71	30	,,	14	51	,,	,,	March 1843
Ross	,,	78	4	,,	173	0	E.	,,	Feb. 1841
Ross	,,	78	11	,,	161	27	W	,,	Feb. 1842

The first group of most southerly points refers to the regions west of Graham's Land, which according to Dr. Neumayer's theory, is rendered milder so far as climate is concerned, by one arm of the South American current; the second group contains the results of attempts to the east of Graham's Land, and the third, of the journeys of Ross to Victoria Land. Thus then, where the warm currents run towards the south, it is possible to penetrate farthest, and where also, in the regions around the polar circle the girdle of pack-ice is broken through, an open sea is seen in the high south, such as has been described by Ross and Weddell.

With regard to the regions where it is possible to cruise through great stretches inside the polar circle, we find that the most considerable stretch has been navigated between the meridian 30° W. and 50° E. long., where Bellinghausen, Biscoe, and to some extent also Moore, have shown satisfactorily that the land could nowhere extend much farther north than 70° Also between 70° and 160° W long. has a large part of the region inside the polar circle been sailed through, and it may with tolerable confidence be surmised that no land of any extent exists there, and that what land there is can extend northwards only a little beyond 70° From the researches of Ross we learn that from 160° W and 160° E. long. to far beyond the 70th parallel of latitude no land of any extent exists, while the Americans inform us of a great continent in the neighbourhood of the polar circle between 155° and 95° E. long. Whether this refers only to several island groups connected by ice, or to an actual coast of great extent, cannot, in the present condition of research, be decided.

The following figures show the mean latitudes reached on the several meridians :—

From	10°	W.	long. to	50°	E.	long.	70°	S. lat. has been reached.
,,	60	E.	,,	,,	90	,,	63	,,
,,	90		,,	,,	170	,,	66	,,
,,	170		,,	,,	160	W.	78	,,
,,	160		,,	,,	110	,,	67	,,
,,	110		,,	,,	50	,,	70	,,
,,	50		,,	,,	10	,,	74	,,

According to these numbers, the place where the least advance has been made towards the Pole, between 60° and 90° E. long., is the very part where the condition of the current would prove favourable to a voyage southwards. The question now forces itself upon us, what may be the reason for this, and whether a determined attempt under the meridian of Kerguelen would not lead to the penetration of the polar circle? Leaving out of sight Morrell's doubtful voyages, we see from the following the farthest distance reached at the place in question :—

Bellinghausen's highest	S. lat.	63·°	in March 1820
Biscoe's	,,	62·2	,, 1831
Kemp's	,,	63·5	,, 1833-3
Moore's	,,	64·3	,, 1845

With the exception of Kemp, all these made their way into the region in question in the direction of the parallel of latitude. Other voyagers until late in the season have frequented that part of the Indian Ocean, some even to the end of March. It is therefore evident, from the narratives of these voyagers, that, according to Dr. Neumayer's notion, no attempt has yet been made in the direction most highly favourable.

It should be especially noted here that, south of the 60th parallel of latitude, in the Austral summer, easterly and south-easterly winds prevail, which, towards the end of the season, frequently blow severe storms. It is, therefore, advisable to search the region to be explored from east to west, in order to find out the most direct possible course towards the south, in order to cut through in the shortest possible time the pack-ice, of the position of which in these regions we have got no idea.

Interesting is the course (says Dr. Neumayer) of the two isothermal lines of 0° (the freezing point of the air) for January, February, and for July, August. The isothermal line for the Austral summer assumes the figure of an ellipse, whose smaller axis falls nearly in the direction of the meridian, passing through Graham Land and Sabrina Land from 60° W. to 130° E. long.; the greater axis goes through 20° E., 160° W long., in the latter case through Victoria Land, which stretches far towards the Pole, and, in the former through a stretch of the Antarctic Sea, which is discovered as far as to 70°, and in which land has been conjectured to exist, but has not been seen, and according to Morrell, will not be found. Does not the bending towards the equator show the completely oceanic character of the greater axis? The limiting bend of this isothermal for the extreme seasons in the direction of the greater axis, and also the greater bend near the small axis, are unfavourable to the assumption of great stretches of land between Enderby and Graham Lands. With this consideration is connected the further question, whether the fact that the bending towards the equator is considerably less in the Pacific than in the Atlantic Ocean is not to be explained by the existence of Victoria Land, to which there is no equivalent on the opposite side. The

consequence of such a conclusion would be that Enderby Land and Kemp's Land, in whose neighbourhood it has already been assumed that no considerable land would be found, would be islands, and that between Kemp's Land and Termination Land chances of penetrating towards the south would be greater than under the meridian of New Zealand.

Dr. Neumayer appends the following sketch of the plan upon which he thinks any South Polar expedition should be conducted :—

1 A wooden sailing-vessel with auxiliary screw of at most 300 tons, thoroughly strengthened at the bow and properly arranged on the upper deck, should be sent out on such an expedition. 2. The ship should be equipped with all the most approved appointments and the most recent and best scientific apparatus suitable for the observation of phenomena of all kinds. 3. Men eminent in each of the principal branches of science should be chosen to accompany the ship, which should first make for the Cape of Good Hope, where all the necessary scientific arrangements and testing of instruments could be made. The Cape, indeed, might be considered as the real starting point of the expedition. 4. For the purpose of regular observations, soundings, and so forth, the expedition should set out about the beginning of the year from the Cape for the various groups of islands visited by Cook and Ross, making for Christmas Haven in Kerguelen, overhauling the observations which have been arranged for now thirty years, and attempting to fix the geographical position of as many points as possible. 5. On the Macdonald Islands, as they stretch farther to the south in this quarter (53° 5·5′ S. lat., 73° 17·2′ E. long.), a depôt should be established, the chief purpose of which should be to maintain an ample stock of coals for the use of the expedition, to convey which from the Cape a transport vessel would be useful. Besides a strongly-built astronomical magnetic observatory should be erected here, which would serve as a basis of observation for the operations of the expedition in the south ; for these islands are the outmost fore-posts of the Antarctic regions. 6. The ship could carry on its soundings and researches into the currents, the ocean-bed, &c., with diligence, and go as far south as the season would permit without danger. In December the attempt should be made to cross the polar circle, to force through the girdle of pack-ice, and begin research in the polar regions proper. 7. An attempt should be made, with all energy and circumspection, to winter inside the polar circle, when possibly a suitable harbour might be found on Kemp or Enderby Land. By this means the data for the winter climatology of the Antarctic regions would be ascertained, for which Science has sighed so long. On this position of observation a small contingent of eight or ten men and a whaling-boat should be left, furnished with every means for the preservation of their health and the furthering of scientific knowledge. After establishing this station, the ship itself should return to the Macdonald Islands, and pass the winter, as far as the season will permit, in pursuing scientific labours. 8. By the approach of the favourable season in September and October the work could be again transferred to the sea, and particularly a thorough survey of the Macdonald group should be made. In December the ship would again make for the south, take up the observers on Kemp's Land, and then proceed to further researches until the end of the favourable season urges a return to the Macdonald Islands. 9. At the conclusion of its work the expedition could sail for Melbourne, where the necessary arrangement of the observations could be made. 10. During the sojourn of the expedition in and around the Macdonald group, it might be arranged that a series of Australian-bound ships of all nations should from time to time sail southward and visit the island, which, during the Austral summer would be a matter of little difficulty. In this way a regular connection with Europe would be maintained, and intelligence could, now that we have telegraphic communication between Melbourne and England, reach Europe from the Macdonald Islands in from fourteen to eighteen days. Should the latter group, contrary to all expectation, prove unsuitable to a long stay, then must Christmas Haven in Kerguelen (48° 41′ 1″ S. lat. and 69° 3′ 35″ E. long.) be chosen for the purpose. Should an expedition be fitted out in connection with that for the observation of the Transit of Venus, the above plan would require to be materially modified.

Dr. Neumayer concludes with some sensible remarks on the qualifications necessary to form an efficient leader of an expedition such as he proposes ; the man selected for the purpose must be both a seaman and a man of science, and no mere *dilettante* discoverer. Should such an expedition ever be organised, the importance of these considerations cannot be overrated.

FAYRER'S THANATOPHIDIA OF INDIA.

The Thanatophidia of India. Being a description of the Venomous Snakes of the Indian Peninsula, with an account of the Influence of their Poison on Life ; and a series of experiments. By J. Fayrer, M.D., &c. 1 vol. folio, coloured plates. (London : Churchill, 1872.)

THIS is a handsome work, got up in good style, printed in large clear type, and illustrated with a number of highly-coloured plates. It is intended to supply a want which the author has often heard expressed—"that of reliable information on the venomous snakes of India."

Dr. Fayrer divides his subject into several sections, the first relating to the zoological and anatomical character of the venomous serpents of India, the others treating of the statistics of deaths caused by their bites, of the mode of treatment of such cases, and of numerous experiments undertaken by the author with a view of ascertaining the influence of snake-poisons, and the value of certain reputed antidotes. On each of these subjects we will make a few remarks.

As regards the more strictly scientific portion of the volume, Dr. Fayrer informs us candidly that we are not to expect anything original. "The classification and definitions are chiefly taken from, or based on, Günther, or other authors of repute, the anatomical descriptions from Owen and Huxley ; and to those authorities I make my acknowledgments for much valuable information, remarking, at the same time, that I have carefully verified their descriptions by comparison with, and by dissections of, the snakes themselves." In this passage we think that it is not made sufficiently clear that the whole of the first section of Dr. Fayrer's work is based upon Dr. Günther's

"Reptiles of British India."—in fact, the classification and descriptions are mostly copied literally therefrom. It is quite true that Dr. Günther's name is frequently introduced, and that frequent passages borrowed from his work are quoted in inverted commas; but, even under these circumstances, we fail to see that Dr. Fayrer is quite justified in appropriating so largely the results of another author's labours to his own use. It would have been easy to state at once that so far as arrangement and classification went, he simply intended to follow those given in "The Reptiles of British India," and to refer his readers to that work for information on these subjects.

In the second section of his work, Dr. Fayrer gives details as to the actual number of deaths caused by snake-bites in India. These statistics were principally obtained from replies to letters on the subject addressed by him to the secretaries and political agents of the several governments. The result arrived at is that the total number of deaths recorded in 1869 in Bengal, the North West Provinces, Oude, and certain other parts of India, embracing altogether a population of about 120,000,000, was 11,416. This total, however, large as it is, Dr. Fayrer fears cannot be regarded as the real mortality in these provinces, the information upon which it is based having been partial and imperfect. Were accurate statistics obtainable from the whole of Hindostan, Dr. Fayrer believes that it would be found that more than 20,000 people die annually in that country from the bites of poisonous snakes. Such being the case, there can be no question as to the importance of the subject discussed in the work before us.

In his third section Dr. Fayrer speaks of the treatment of snake-bite, concerning which, after a certain amount of discussion, he does not appear to have arrived at any very novel results. Ligatures, scarifications, liquor ammoniæ, and hot spirits and water, are the remedies in vogue on such occasions, and to these Dr. Fayrer gives in his adhesion. "The antidotes in addition," he remarks, "may be used by those who have faith in them; but I fear that there is reason to believe that they are of no use." These antidotes, we should have explained, comprehend snake-stones, arsenic, bromine, ipecacuanha, senega, and, "indeed nearly every drug in or out of the pharmacopœia."

Numerous reports of cases of snake-bite by medical officers of the Indian Service constitute the fourth section of Dr. Fayrer's work. These have been selected in order to give a fair idea of the symptoms and of the duration of life after the reception of the bite, and of the pathological appearances after the death of the sufferer.

In the concluding portion of the volume, Dr. Fayrer gives an account of numerous experiments undertaken with a view to ascertain the influence of snake-poison on the lower animals, and the value of certain modes of treatment. These experiments were commenced in October 1867, and continued during a period of three years, the object having been to determine the effect of the bite of venomous serpents by actual observation, and to test the value of supposed remedies both internal and external. The snakes with which the experiments were performed were the Cobra, the *Ophiophagus* or Hamadryad, and the two Indian species of the genus *Bungarlus*, belonging to the Elapidæ, some of the sea-snakes of family Hydrophiidæ, the *Daboia russellii*, and the *Echis carinata*, belonging to the Viperidæ, and one species of *Trimeresurus*, belonging to the Crotalidæ, or pit vipers. Of these Dr. Fayrer concludes that as regards deadliness the Cobra, *Ophiophagus*, and *Daboia* are very nearly on a par. "They are quite capable of destroying a full-grown dog in half an hour, sometimes in much less time; and frequently," Dr. Fayrer believes, "man has succumbed within an equally short period, though generally the time is much longer." The *Bungarlus cæruleus* is believed to be just as deadly as the above-named, but not to kill quite so quickly. The *Bungarlus fasciatus* is less fatal. The *Echis* is also very deadly, but from its small size less likely to be fatal to man. Of the sea-snakes much less is known, but it appears that human life would be in great danger from their bite. The Elapine snakes of the genus *Callophis* and the Pit-vipers of Hindostan, although capable of giving a painful and even a dangerous bite, are not nearly so deadly.

The symptoms produced by the bite of these different serpents vary slightly, but not so as to present any great physiological or pathological divergences. All alike point to "exhaustion and paralysis of the nerve-centres," every function falling rapidly, and life becoming quickly extinct. "The *post-mortem* appearances frequently reveal nothing except the marks of the fangs, or, if the creature has survived some hours, infiltration and perhaps incipient decomposition of the intestines." Warm-blooded animals are acted upon much more vigorously by snake-poison than cold-blooded animals. As regards the latter, poisonous snakes are not, according to Dr. Fayrer's experience, affected by their own poisons, or by that of one of their own species, although the less-poisonous seem to be subject to the venom of their more poisonous relatives. Lastly, although the blood of an animal killed by snake-poisoning destroys life if injected into another animal, there can be no doubt that the body of such an animal may be eaten with impunity. The fowls and pigeons killed in Dr. Fayrer's experiments were always eaten by the natives without any evil consequences following.

Such are some of the results arrived at from Dr. Fayrer's long and laborious series of experiments. We cannot say that there is any great novelty amongst them. As regards the treatment of snake-bite, indeed, it seems quite conclusively proved that the antidotes, commonly so called, are useless, and that it is hardly probable that any direct specific will ever be discovered. Cure failing, the large mortality now due to snake-bite can, therefore, only be materially diminished by prevention; and the simplest mode of prevention—slow as it may be—is, we think, that recommended by Dr. Fayrer in his circular of January 1870*, *i.e.* to offer small rewards for the destruction of the serpents. The sum expended in this way would, as Dr. Fayrer observes, no doubt be large, but the saving of human life thereby effected would be great.

OUR BOOK SHELF

Forstzoologie. Von Dr. Bernard Altum. I. Säugethiere. (Berlin: Springer, 1872. London: Williams and Norgate.)

DR. BERNARD ALTUM, Professor of Zoology in the Royal Academy of Forestry at Neustadt-Eberswald, gives us, in

See page 31 of Dr. Fayrer's work.

the present volume, the first of a series of essays which he proposes to write for the instruction of his pupils and others in "Forest-zoology," *i.e.*, in Zoology with especial reference to the wants of those who are engaged in the care and preservation of forests. The present volume is devoted to the class of Mammalia; a second will relate to the Birds; and a third to the other animal kingdom with which "forespectacts; these being the three principal divisions of brought into contact. Zoology in the ters" are most abstract, or "scientific zoology," Dr. Altum observes, is the foundation upon which all knowledge of the various applications of zoology must be based. Dr. Altum therefore adopts a strictly scientific arrangement for his work, commencing with a definition of the class of Mammals, and taking the various groups of this class in systematic order. The work being intended for those whose labours are to be in the forests of Central Europe, only European species are included. But the *Quadrumana*, *Prosimiæ*, and other orders restricted to foreign countries, are introduced in their proper places, and some general information concerning them, together with a short account of their leading divisions, is given. Special attention is paid to those species of Mammals which the forester is most likely to be brought into contact with, such as the squirrels, field-mice, beaver, deer, and others; and full particulars are given of the modes in which forest trees are injured or attacked by them.

Dr. Altum's volume, thus composed, seems to be in every way well adapted for the purpose for which it is intended. Dr. Altum is fortunate in having, in Blasius' well-known work on European Mammals, an excellent guide to the scientific history of other animals, which he wisely follows. An English writer on the same subject would not be so well off, for the only modern work on British Mammals is now long ago out of print, and there seems to be no prospect of a second edition of it being published. In this, as in nearly every other branch of science, we have constantly to go to Germany for assistance.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Meteorology of the Future

I CANNOT quite agree with Mr. Lockyer that the most important question in meteorology is the discovery of a cycle. Were it even so well proved, it would still be but an empirical law. In my opinion the chief desideratum of the science is a dynamical theory of barometric waves; and the data for this are to be found not merely in records of barometric fluctuations in one place, nor by comparing the records in several places at or near the sea level, but by comparing the records at places separated by the greatest possible vertical distance, though horizontally near each other. Such records do not yet exist, and they can be had only at specially chosen stations; the summit and the base of Teneriffe, for instance, or of Etna. The latter would probably be the best, as it is in the variables. It is not at all certain that the fluctuations of the barometer at the summit and at the base of a high mountain would be nearly alike. It is stated by Kaenitz that while the barometer in the hottest part of the day falls at the sea level, it rises at a height of a few thousand feet. The reason why it rises at the higher station is that the entire column of air is lifted up by the expansion due to heat, and thus a larger proportion of the column comes to be above the station. This cause does not act at the sea-level, and the barometer there falls in consequence of the outflow of air from the top of the column. It is much to be desired that the attention of scientific men and scientific committees should be directed to this subject, as without such sets of comparative observations we shall never have all the data for a complete theory of barometric waves.

Old Forge, Dunmurry JOSEPH JOHN MURPHY

Popular Science in 1872

SCIENTIFIC information in a popular form is one of the demands of the age, and we find it supplied even in publications by no means exclusively devoted to Science. It would be a great loss, however, to the professed students of science, if they should remain unacquainted with the following remarkable contributions to our knowledge of electricity, merely because they occur in the December number of *Belgravia*, in an article entitled "Is Electricity Life?" $\frac{dp}{dt}$

"The ocean, for instance, is compounded of water and salt; one is an electric, the other not. The friction of these causes the phosphorescent appearance so often observed at sea."

"That all created living bodies are electric there can be no question; and as little that some persons, animals, and plants, are more electric than others. Two forms of the latter are familiar. Few schoolboys are guiltless of experiments on poor puss, from whose much-enduring back electric sparks may be drawn, especially in dry frosty weather; and most young ladies have admired the elegant sensitive plant, whose leaves seem to move and feel,

"and with quick horror fly the neighbouring hand,"

that draws from it the electricity which it contains more than other plants; and its leaves at once fall flaccidly, until a new supply of electric force renders them once more turgid.

"But bodies have not only electricity within them, but an electric atmosphere, of the form of the body which it surrounds, and which is attracted by it. Without this we could not shake hands with a friend, or kiss a lip, without the danger of the excess of electricity flying off and destroying us, or the he or she that we would greet or kiss. Perhaps it is the commingling of these electric atmospheres that makes kissing so nice.

"Two conditions of the human body are also illustrative of its varied electric action. A person who has the small-pox cannot be electrified, while sparks of electricity may be drawn from the body of a patient dying of cholera. In the first instance it appears that the body is fully charged with its own electricty, since it is impossible to electrify a body beyond a certain degree; in the latter there seems to be a tendency to part with the electric force which is essential to the support of life, and which may account for the distressing and rapid weakness of cholera-patients."

Upon the Direction in which the North Magnetic Pole has moved during the last two Centuries

IN an article upon Terrestrial Magnetism in the current number of the *Edinburgh Review*, referring to the fact that the compass-needle does not now in England point due north and south, and that it changes its position slightly from year to year, but that from our present ignorance of the source and laws of this change we cannot say that it will hereafter be as much in one direction as it has been in another, the writer remarks (p. 424): "Still the strictly *progressive* character of this change compels us to regard it as the expression of some determinate cause or causes. The question then arises, Where are these to be found? Now, from whatever point on the earth's surface we contemplate the phenomenon, we find ourselves in the presence of two distinct magnetic systems. This was first clearly recognised by Halley as a necessary consequence of even the scanty information at his command, and the accumulated observations of two hundred years have corroborated in a very remarkable manner the conclusions at which he arrived—that of these two systems one was *fixed* and the other *in motion*."

It is a matter of some interest to ascertain in what directions the system in motion has gone in the interval mentioned. Sir Edward Sabine gives us some information on this point. In his paper upon Terrestrial Magnetism, in "Johnston's Physical Atlas," p. 72, he says: "The change of longitude of the stronger pole, since Halley placed it on or about the middle of California, appears to have been small; but, on the other hand, the weaker pole, which is now found in Siberia, was placed by Halley near the meridian of the British Islands, and, adopting Halley's mode of reasoning, the present disposition of the lines of declination corresponds to this change."

Of the northern poles of the two magnetic systems in Halley's time, one appears to have been in the longitude of California, the

other in that of the British Islands, the former being stationary, the latter in motion; and as it is said now to be Siberia, its motion must have been from west to east. On the other hand, we find this motion described as being in the opposite direction, viz., from east to west. Sir George Airy, in his treatise on Magnetism, p. 93, remarks "that at Greenwich the dip and total force are diminishing. Interpreting these by the remarks, it would seem that the magnetic equator is approaching above Greenwich, or the north magnetic pole is receding from Greenwich; and remarking also the westerly change in direction of north magnetic meridian, from the sixteenth century to the year 1824, and its subsequent easterly motion, it would seem that the north magnetic pole has rotated round the terrestrial pole in a small circle from east to west, and, having passed the point where its westerly azimuth, as viewed from Greenwich, is maximum, is still continuing its course in that circle. It seems probable that in the fifteenth or sixteenth century it was situated between North Cape and Spitzbergen. It is now north-west of Hudson's Bay."

The north magnetic pole, which Sir E. Sabine supposes to have been in Halley's time in the meridian of the British Islands, would appear to be the same which Sir G. Airy says was probably in the 13th and 16th century in a meridian between North Cape and Spitzbergen; yet the pole referred to is in one case said to be now in Siberia; while in the other it is said to be to the north-west of Hudson's Bay; but it cannot at the same time have gone to the eastward and also to the westward.

In the two accounts there is a discrepancy, but perhaps this is apparent only, and some of your readers may be able to show how the accounts can be reconciled. X

Height of Thunderclouds

A FEW days ago I had an opportunity of estimating the height of a bank of thunderclouds, an account of which may interest the readers of NATURE.

I was camped at Gurpur, a place some eight miles from and within sight of the sea, with an elevation of about 480 feet. The evening was fine, and the horizon to westward remarkably free from haze, so much so that when the sun dipped it was still too bright for the naked eye to bear. Some fifteen or eighteen miles to eastward a heavy thunderstorm was raging, and the Western Ghâts were shrouded by immense masses of cumulus, which, piled up to an enormous height, and rosy with the beams of the setting sun, formed quite a study for an artist.

Having been in the jungles for three or four weeks, I noted, in order to get correct time, the moment the sun disappeared beneath the horizon. This was, by my watch, six minutes past six o'clock. A few minutes subsequently I noticed the earth-shadow creeping up the clouds to eastwards, its edge being singularly well-defined by the contrast of the cold grey beneath and the warm colouring above. Struck by the slow progress of the shadow, I timed it, and found that at seventeen minutes past six the last tinge of pink faded from the highest point of the cumulus, and at nineteen and a quarter minutes the cirrhi floating above the storm lost their hue, thus giving eleven minutes for the former and thirteen and a quarter for the latter. These times reduced and corrected for latitude (13° N.), give the respective approximate heights of the clouds as 14,075 and 25,590 feet, or, adding height of observer, about 2·75 and 4·93 miles.

To be on the safe side, but 10′ of arc have been allowed for the eastward position of the clouds. The nature of the observations of course renders correction for refraction unnecessary, so that the above figures are well within the mark.

I believe that in the tropics cumuli attain a considerably greater elevation than is generally believed. In 1864 I was on board a vessel in lat. 2° 53′ N., long. 10° 47′ W., when there were constant flashes of forked lightning visible among detached clouds directly overhead, yet not the faintest growl of thunder was heard by anyone on board, although a dead calm prevailed at the time. This fact I can only attribute to the combined effect of the immense altitude of the clouds and the consequent rarity of the air. E. H. PRINGLE

Mangalore, South Canara, Nov. 2

PERIODICITY OF RAINFALL

HAVING been working at the above subject for the last ten years, it occurs to me that a brief record of my failures and successes will form an appropriate supplement to the important article by Mr. Lockyer in NATURE for Dec. 12.

Meteorologists have been hunting for a Saros throughout the present century. Among them, perhaps, the most devoted to the subject were Lieut. George Mackenzie, author of "The System of the Weather," and Luke Howard, whose "Cycle of Eighteen Years in the Seasons of Britain" is a well-known work.

What little I have done in the subject is briefly told. Almost immediately after commencing the collection of British rainfall statistics, which has now reached a completeness excelling that of any other country, my attention was naturally drawn to the question of periodicity. Knowing, however, something of the care requisite to obtain long series of observations strictly comparable, I waited five years before printing anything bearing upon it; in 1865, however, I prepared and published * the following table for fifty years, based upon the mean of continuous records in different parts of Great Britain :—

TABLE I.—MEAN DEPTH OF RAIN AT TEN STATIONS, 1815—1864

Year.	Depth.	Year.	Depth.	Year.	Depth.	Year.	Depth.	Year.	Depth.
1815	27·12	1825	26·57	1835	28·56	1845	27·87	1855	23·37
1816	29·26	1826	23·76	1836	33·49	1846	29·57	1856	25·89
1817	29·73	1827	29·53	1837	24·54	1847	25·80	1857	25·70
1818	30·34	1828	33·02	1838	27·11	1848	35·98	1858	22·79
1819	30·46	1829	28·70	1839	31·27	1849	28·51	1859	28·53
1820	24·53	1830	30·83	1840	24·67	1850	26·35	1860	33·34
1821	29·92	1831	32·28	1841	33·51	1851	26·70	1861	26·98
1822	26·63	1832	26·20	1842	25·53	1852	35·53	1862	30·37
1823	31·09	1833	29·71	1843	30·40	1853	27·38	1863	26·93
1824	30·91	1834	24·52	1844	23·72	1854	22·38	1864	22·11
Mean.	28·999		28·512		28·280		28·607		26·601

I also called attention to two features in this table, which strongly tend towards the confirmation of Mr. Meldrum's views, viz. :—(1) that the wettest years are 1836, 1841, 1848, 1852, and 1860; (2) that of these, all but two form a 12-year period, viz., 1836, 1848, 1860, to which we may now add 1872†; (3) that the dry years were 1826, 1834, 1844, 1854, 1855, 1858, and 1864; (4) that of these, all but three form a 10-year period, viz., 1834, 1844, 1854, and 1864.

All this looked very satisfactory; but, to make assurance doubly sure, I determined to make up a longer period. This I accordingly did; and the approximate fluctuation of annual rainfall during *one hundred and forty years*, viz., 1726 to 1865, will be found in the British Association Report for 1866, page 286, *et seq.* These values were converted into ratios, and, subsequently, those for the years 1866 to 1869 were added, and the table was given in the following condensed form in an article on the "Secular Variation of Rainfall in England since 1725,"

TABLE II.—RATIO OF THE FALL OF RAIN IN EACH YEAR SINCE 1725 TO THE MEAN FALL OF SIXTY YEARS, ENDING WITH 1869

Year.	1720	1730	1740	1750	1760	1770	1780	1790	1800	1810	1820	1830	1840	1850	1860
0	...	88	65	61	70	108	75	86	90	100	92	111	89	91	122
1	...	71	58	108	87	70	79	105	96	98	109	108	128	88	92
2	...	83	65	82	71	111	131	117	91	97	100	98	91	138	107
3	...	71	60	87	118	113	93	86	77	92	117	106	110	101	89
4	...	114	89	76	101	120	96	104	85	92	117	90	85	74	73
5	...	102	80	83	82	123	77	84	75	99	96	90	97	88	108
6	100	101	70	100	77	107	127	83	96	107	77	118	108	93	115
7	102	110	95	93	91	89	96	106	94	100	102	87	90	97	103
8	109	70	65	84	128	102	65	88	99	102	120	96	130	86	102
9	97	89	50	81	86	83	110	106	88	99	102	107	98	102	104
Mean	...	89·9	70·6	85·5	91·1	103·5	93·5	96·5	88·2	98·6	103·2	101·4	102·6	95·2	101·5

in "British Rainfall, 1870." I was so disappointed at the total disappearance of both the ten- and twelve-year periods, that I cannot say that I have closely scrutinised

* Brit. Assoc. Report, 1865, p. 202.
† See *Times*, Nov. 12 and Dec. 3, 1872.

he values herein given; and as I doubt if better data could be obtained, I do not think that your space would be wasted by reproducing it, and affording your readers the opportunity of detecting any periodicity which may exist.

I now turn to the verification of Mr. Meldrum's conjectured connection between sun-spot and rainfall periodicity. But before giving the results I have obtained, I think it is worthy of consideration whether the total precipitation over the surface of the globe can be expected to be increased by increased cyclonic energy. Increased rainfall surely means increased extraction of moisture from the air, and that involves one of two facts—(1) increased evaporation to supply the increased demand, or (2) rapid and great dessication of the atmosphere. Without expressing a dogmatic or fixed opinion, it certainly seems to me

TABLE III.—ABSTRACT OF RAINFALL OVER THE GLOBE, 1832-68, ARRANGED ACCORDING TO SUN-SPOT PERIODS.*

	EUROPE.											ASIA.		AFRICA.			AMERICA.					
	BRITISH ISLES			FRANCE.					SWITZERLAND.		ITALY	PALESTINE	INDIA	ALGERIA.			CANADA	UNITED STATES.			S. AMERICA	W. INDIE.
	Guernsey.	Greenwich.	Sandwick. Orkney.	Tarn, Bassin de Saint Ferriol.	Haute Garonne, Toulouse.	Basses Pyrénées, Bages Beost.	Charente Inférieure, Courçon.	Paris.	Geneva.	Great St. Bernard.	Rome.	Jerusalem.	Calcutta.	Algiers.	Oran.	Constantine.	Toronto	Philadelphia.	New York, Fort Columbus.	Massachusetts, New Bedford.	New Granada, Maranato.	Barbadoes
Year.	in.	in.	in.	in.	in.	in.	in.	in.	in	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1832		19·3		23·5	21·4		18·9	21·4	20·7	39·8	22·8							39·3		43·8		
1833		23·0		34·2	33·2		22·9	23·4	29·8	73·1	26·0							48·4		37·9		
1834		19·6		24·6	20·4		18·1	18·2	24·4	58·9	13·0							35·1		40·1		
Totals		61·9		82·3	75·0		59·9	63·0	74·9	171·8	61·8							122·8		121·8		
1836		27·1		26·8	23·6		32·4	28·0	27·0	98·0	30·8											
1837		21·0		23·0	25·6		22·0	24·6	20·7	53·9	25·1							43·0	27·6	38·1	100·0	
1838		23·8		22·3	26·1		31·6	24·1	35·5	93·9	31·4							37·1	65·5	34·7	88·4	
Totals		71·9		72·1	75·3		86·0	76·7	83·2	245·8	87·3							44·3	41·9	34·0	113·4	
1843	37·7	24·6	38·4	29·0	31·9	51·4	30·9	24·1	36·5	34·9	21·3							124·4	135·0	106·8	301·8	
1844	27·7	24·9	32·1	35·3	34·8	52·0	29·8	27·0	34·4	66·1	30·6		64·3	30·1	10·9			46·5	41·4	45·0	64·8	45·3
1845	33·3	22·4	40·9	29·7	32·1	68·6	26·5	20·5	35·7	60·2	38·3		73·9	41·2	20·8			38·8	36·4	36·2	88·4	74·5
Totals	98·7	71·9	111·4	94·0	98·8	172·0	87·2	77·6	106·6	161·2	90·2		63·1	41·2	24·4			40·3	34·1	42·7	70·5	43·9
1847	29·2	17·8	40·8	17·7	19·0	27·3	19·2	19·6	27·3	42·0	31·6	67·6	201·3	112·5	56·1			125·0	111·9	123·9	223·7	163·7
1848	48·0	30·2	37·8	25·7	30·0	39·6	25·4	24·9	33·5	62·4	25·4	48·2	72·4	51·4	18·4				64·9			42·5
1849	36·4	23·7	40·5	29·1	23·6	41·0	22·0	20·3	33·9	57·5	20·6	66·0	58·7	40·5	23·1				36·8	40·8		62·8
Totals	113·6	71·7	119·1	72·5	72·6	107·9	67·5	70·8	94·7	161·9	77·6	175·8	65·5	22·0	12·6				31·7	30·2		53·0
1855	30·4	21·1	35·1	31·1	25·6	49·5	28·9	15·7	40·2	46·1	32·3	61·0	196·6	113·9	54·1				133·4	109·4		158·3
1856	34·4	22·2	27·4	44·6	31·9	48·8	27·4	25·0	41·0	44·1	28·3	94·0	70·4	21·5	21·5	16·1	41·6					
1857	31·9	21·4	31·9	31·9	26·8	40·6	31·0	21·5	21·1	22·9	30·2	104·2	64·2	28·7	20·5	15·4	28·1					73·5
Totals	96·7	64·7	94·4	107·6	84·3	138·9	87·3	62·2	102·3	113·1	90·8	259·2	69·0	35·4	35·7	24·7	40·6					46·4
1859	43·4	25·9	44·4	31·0	23·9	28·0	30·0	23·2	26·9	36·7			203·6	85·6	77·7	56·2	110·3					50·8
1860	48·0	32·9	38·0	29·3	25·8	40·0	37·0	29·4	41·3	56·3												170·7
1861	31·2	20·3	41·2	31·0	26·0	23·9	25·9	18·8	30·7	31·7				35·3	15·3	31·5	39·8					
Totals	122·6	78·2	123·6	91·3	75·7	91·9	92·9	71·4	98·9	124·7				26·5	18·4	23·0	28·0					55·1
1866	44·4	30·1	41·6											21·4	13·9	14·9	34·5					66·4
1867	37·1	28·5	30·4											83·2	47·6	69·4	102·3					71·1
1868	34·8	25·2	43·4																			186·6
Totals	116·3	83·8	124·4																			

more likely that the effect of cyclones is simply to alter the locality of deposition, than its aggregate amount. Therefore I should by no means hold the connection disproved by series in which exactly opposite results obtain, and I am not myself sanguine as to *direct* proof being forthcoming

I do not quite agree with my distinguished friend Mr Meldrum as to the "disturbing influence of continents." Their outlines and mountain ranges change not, and I am aware of no evidence to show that the annual fluctuation of rainfall is disturbed by continents. Moreover, in the case of some of the smaller islands, we have illustrations in support of the views of Becquerel and the Hon. G. P. Marsh which would completely mask any influence indicated by Mr. Meldrum's statistics. I have no doubt that Mr. Meldrum knows the facts respecting the rainfall in the Isle of Ascension better than I do, and I think that perhaps upon reflection he will be inclined to slightly lessen his claims for the superiority of insular stations.

* Want of space compels us to omit a similar column referring to the rainfall of Australasia.

I am aware of the rather "heavy" nature of the accompanying table, but the matter is one of much importance and entirely dependent on observed facts, therefore I think you will consider it worthy of the space it will occupy. I have condensed it as much as possible, and have, to the best of my knowledge, selected the most trustworthy and longest continued records at present in my hands.

Having thus placed the data before your readers, it seems undesirable to occupy space with remarks as to my own opinion on the evidence; but I cannot help thinking that it is quite clear that the question must not rest where it is. The evidence is no doubt conflicting; but I cannot think that it is chance alone that has given us (from Table I.):—

Maximum sunspot years	1837	1848	1860	1871 ?
Heavy rainfall „	1836	1848	1860	1872
Amount of rainfall	33·49	35·98	33·34	? 34
Per cent. above average	19	28	18	? 20
Minimum sunspot years	1833	1844	1856	1867
Small rainfall „	1834	1844	1858	1868
Amount of rainfall	24·52	23·72	22·79	? 28·8
Per cent. below average	13	16	19	+ 2

Almost identical results are given by Table II.

G. J. SYMONS

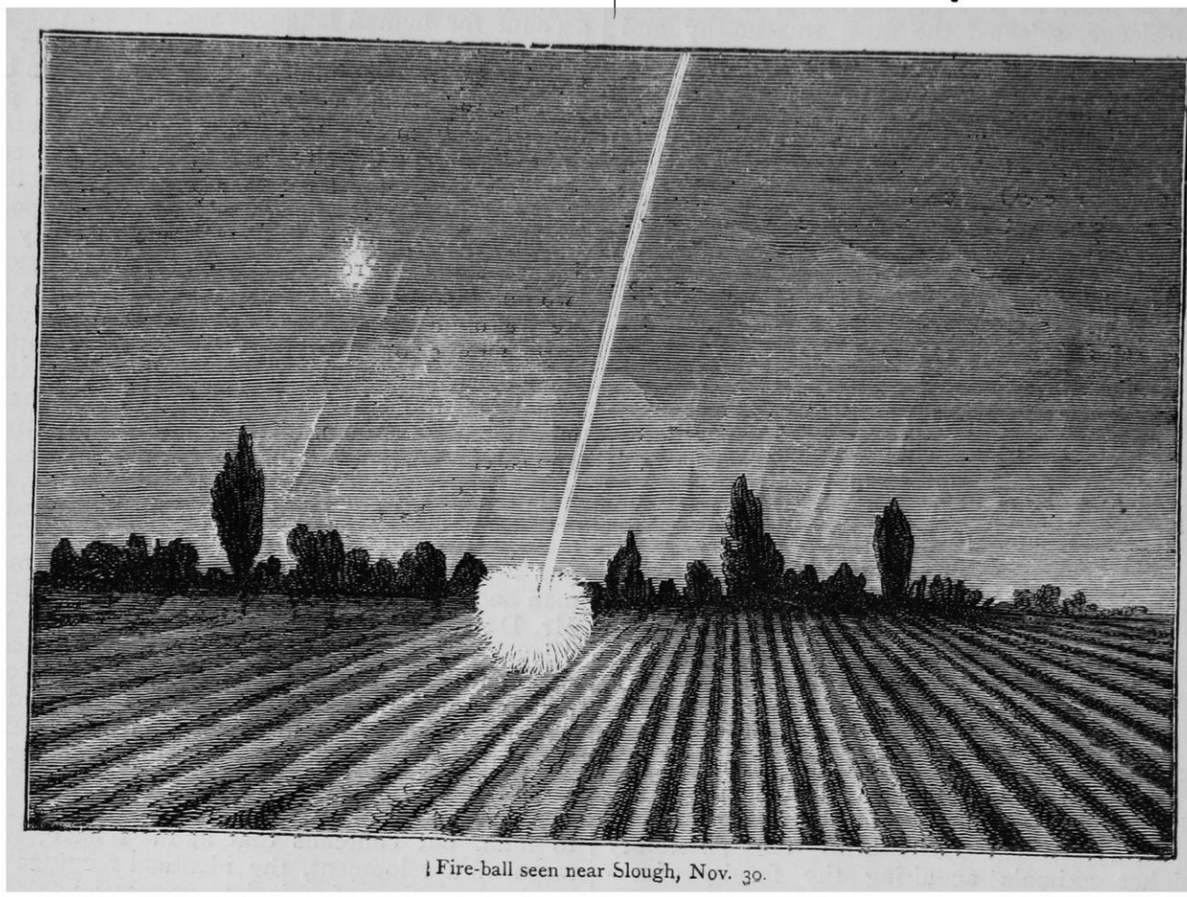
MAX MULLER ON DARWIN'S PHILOSOPHY OF LANGUAGE *

IN a lecture recently delivered in connection with the Liverpool Literary and Philosophical Society, Prof. Max Müller addressed himself to the phase of Mr. Darwin's theory, which deals with the possibility of the higher animals acquiring the faculty of articulate speech. He first cleared the ground by some general remarks on the previous phases of this old, old controversy touching the origin and destiny of man, referring to the contention between the Materialists and the Idealists, and to the durable impression left upon this controversy by Kant's wonderful "Criticism on Pure Reason," lamenting that Mr. Darwin and his followers should disregard the important conclusions resulting from previous controversies on this subject, and proceed as if their theory of evolution were new. Materialism, he said, is everywhere in the ascendant, while Idealism is almost become a term of reproach. In this riddle of mind and matter, the world is the theatre of a struggle for the primacy of mind over matter. But when the evolutionists contend that the development of the mind of man out of the mind of an animal is a mere question of time, the Professor felt inclined to treat the idea with impatience. Animals must be animals so long as they lack the faculty of abstracting general ideas. Darwin says: "I believe that animals have descended from at most four or five progenitors, and plants from an equal or lesser number. Analogy would lead us one step further, namely, to the belief that all animals and plants have descended from some one prototype. All organic beings have descended from some primordial form into which life was breathed by the Creator." Prof. Max Müller inferred that these four progenitors may be intended for the Radiata, Mollusca, Articulata, and Vertebrata; and said that Mr. Darwin holds firmly that man has been developed from some lower animal, that all animals have been so developed from the lowest to the highest order of organism, and that there is nothing peculiar in man which cannot be explained from germinal seeds or potential faculties existing in lower animals. This question of the descent of man may be called the controversy of the nineteenth century, and requires the whole knowledge of the century to answer it adequately. The lecturer, confining himself to the evolution theory as it affects language, essayed to show that between the language of animals and the language of man there is *no* natural bridge, and that to account for human language such as we possess would require a faculty of which no trace has ever been discovered in lower animals. If, as Mr. Darwin begs us to assume, there were a series of developments graduating insensibly from ape to man, it would of course be impossible to fix a definite point where the ape ended and the man began; but he asks us to assume that which does not exist, and without evidence to support this, of which there is none, the theory remains only a theory. Indeed, said the Professor, whenever the distance between two points in the chain of development seems too great, we are told again and again that we must only imagine a large number of intermitted beings representing gradations insensibly sloping up or sloping down, in order to remove all difficulty. So it is in the case between the monkey and the man. This point was illustrated most appositely by reference to the Hindoo notion that man is descended from the spirit of the Creator, through a series of links now extinct, the first descendant being 9-10ths God and 1-10th man, the second being 8-10ths God and 2-10ths man, and so on till man became 10-10ths man and ceased to be of the essence of the Great Spirit. Mr. Darwin's fallacy, he said, lurks in the very word "development," for the admission of this insensible gradation through a series of organised beings would eliminate not only the difference between ape and man, but likewise the difference between peat and coal, between black and white, between high and low—in fact it would do away with the possibility of all definite knowledge. Mr. Darwin admits that articulate language is peculiar to man, but contends that animals have, in a lower stage of development, the identical faculties necessary to the invention of articulate expressions. To this he replied that no development of mental faculties has ever enabled any animal to connect one single definite idea with one single definite word. He gave various illustrations of the essential difference between the expression of emotions and the expression of ideas or abstract conceptions, and argued at length as to the impossibility of mere emotional signs and sounds developing into articulate speech; and he ridiculed the notion that the materials of language being given, all the rest was a mere question of time, a natural gradation from the neigh of the horse to the poetry of Goethe. Man and animals possess emotional language in common, because man is an animal; but animals do not possess rational language, because they are not man. This distinction between emotional and rational language, so far from being fanciful and artificial, is radical, as proved by various evidence, especially by the testimony of pathology in reference to certain brain diseases. Rational language is to be traced back to roots, and every root is the sign of a general conception or abstract idea of which the animal mind is incapable. Mr. Darwin has said there are savage languages which contain no abstract terms; but the names for common objects, such as father, mother, brother, &c., are abstract terms, and unless Mr. Darwin is prepared to produce a language containing no such names, his statement, said the lecturer, falls to the ground as the result of a misconception of the real nature of a general idea as distinguished from an emotion. This phase of the controversy lies within the Professor's peculiar domain, and he was able to entertain his audience with technical illustrations that in ordinary hands must have proved tedious, but in the hands of the most accomplished linguist of the day proved a source of wonder and amusement to his hearers. He concluded as he had begun, by maintaining that language is the true barrier between man and beast.

* The following extracts have been forwarded to us by the lecturer, and are taken from the *Liverpool Gazette*.

CURIOUS FIREBALL

SIR J. C. COWELL has kindly sent the accompanying sketch of a fireball which he saw fall "one mile east of Slough at 2.8 P.M. on November 30 last," during the short and sharp thunderstorm which passed over North Hants and East Berks. "The flash fell about 150 yards south of the G. W. Railway, and terminated with the explosion of a fireball, which seemed (it was daylight) about 12 ft. in diameter. The explosion was similar to that of a heavy gun when fired, and the ball appeared to burst on the flash reaching the ground, exactly like a well-timed shell."



Fire-ball seen near Slough, Nov. 30.

RECENT DISCOVERIES IN THE GREAT PYRAMID OF EGYPT—ANCIENT EGYPTIAN WEIGHT

IN addition to the casing-stone of the Great Pyramid, mentioned in NATURE of Nov. 28 as having recently arrived in England, Mr. Dixon has also sent the following articles found by him in newly-opened passages of the Great Pyramid :—

1. A small double hook of bronze, with rivetted pins for attaching it to a handle.

2. A small rectangular rod of cedar, broken at one end, and some fragments.

3. A granite ball, supposed to be an ancient weight.

Not the least curious and interesting part of Mr. Dixon's discovery is that of the passages or channels in which these articles were found. The publications of Prof. Piazzi Smyth and others have made us acquainted with the position of the King's Chamber in the central part of the Great Pyramid, with its coffer, and ascending passages leading from it ; as well as with that of the Queen's Chamber, with its walls formed of the finest and whitest limestones, highly worked, this chamber having but one entrance by the horizontal passage leading to it, and its purpose proving such an enigma to our Astronomer Royal for Scotland. In examining the walls of the Queen's Chamber, with the view of ascertaining whether there existed any air channels communicating with it, similar to those of the King's Chamber, discovered by Colonel Howard Vyse in 1837, Mr. Dixon found, by inserting a wire between the joints of the masonry of the south wall, that there was a hollow space behind this part of the south wall.

On drilling a hole through the upper part of the second stone from the floor, about midway between the east and west walls, at five inches depth a cavity was found, and the hole was then enlarged sufficiently to admit a man's head and arm with a lighted candle. A passage or channel was thus disclosed, nearly nine inches by eight in rectangular section, which had been carefully cut through the stone to within five inches of the face of the wall in the Queen's Chamber, the end surface being accurately squared and finished off. This channel extended in a horizontal direction for the length of seven feet, and then ascended at an angle of about 32° The sides of the channel were found to be blackened with smoke, like the walls of the Queen's Chamber, and it was thought that a slight draught was perceptible. The bronze hook was discovered lying amongst a small heap of *débris* at the bottom of the ascending channel.

This channel on the south side of the Queen's Chamber having been discovered, which appeared to be precisely similar to the air channel of the King's Chamber, and to ascend at the same angle, an attempt was naturally made to find a corresponding channel behind the wall on the north side of the Queen's Chamber, though no indication of any such channel presented itself on the surface of the wall. After using measuring rods to mark a spot exactly opposite to the drilled hole on the south wall, a hole was bored in the north wall, and a similar cavity was at once found. By enlarging the opening as before, a second channel was discovered of the same dimensions, and which, after proceeding horizontally for seven feet, also ascended at an angle of about 32°

The surface of the stone in the channel on the north side appeared to be as clean as when originally cut, and the cement of the joints was perfectly white. There was

a handful or two of *débris* of lime at the bottom of the ascending portion of the channel, which had apparently fallen during the construction, and amongst this *débris* were found the granite ball and the piece of wooden rod and fragments. There was no indication of any draught in this north channel, and indeed the untarnished

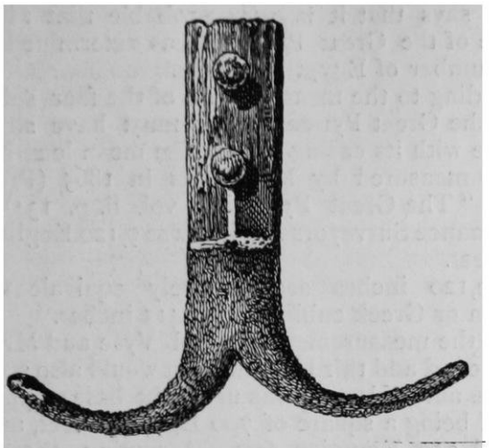


FIG. 1.—Bronze hook.

state of its walls, when opened, afforded the strongest proof that it was securely closed up. Hence the certain antiquity of the granite ball and wooden rod.

No trace of any outlet or opening to either channel could be discovered on the exterior of the Pyramid. Experiments were made by firing a pistol in the ventilating channel of the King's Chamber, at the same time holding a lighted candle at the opening of the channel in the Queen's Chamber, and *vice versâ*, with the view of ascertaining if there was any communication between them; but no such connection could be perceived.

Some borings were also made in the stones of the east and west walls of the Queen's Chamber, but without finding any cavity behind them. The discovery of these channels, which may be called "Dixon's Channels," in no way tends as yet to solve the enigma of the Queen's Chamber, but rather to increase the difficulties of the solution. The mystery of the interior of the Great Pyramid remains still to be fathomed.

1. The bronze hook (Fig. 1) is covered with green oxide of copper, but a small notch recently made in it with a file shows it to be of bronze or gun metal. The two pins have a large rivetted head on both sides. Its length is 1·8 inch, and the distance from the two extremities of the hooks is two inches. With a wooden handle attached by the two pins, it may have been used as a tool of some kind. It is probably the most ancient specimen of bronze now existing.

2. The fragment of the cedar rod (Fig. 2) is 5 inches in length, with a rectangular section of 0·5 inch by 0·4 inch. Its sides are not accurately planed, and they bear parallel lines like file marks. It may possibly have formed

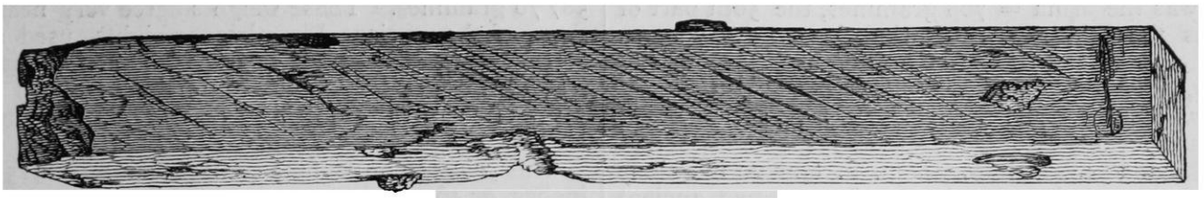


FIG. 2.—Fragment of cedar rod.

part of a measure of length; or it may have been part of the handle of the bronze hook, the remaining fragments showing that it must have been at least 3 inches longer. Tkere are no lines or marks upon it indicating a measure of length.

3. The gray granite ball (Fig. 3) has a mean diameter of $2\frac{3}{4}$ inches. Its form is that of an orange squeezed somewhat out of its natural shape. Its greatest diameter is 2·88 inches, and its least 2·65 inches. Its surface is uneven, and shows no mark of any tool, and it presents the appearance of having been roughly rounded by being shaken in a vessel with other stones. On the surface when found were several white spots of lime or plaster. In this condition it has been accurately weighed in the Standards Department, and its weight was found to be 8,324·97 grains. After this weighing, the lime or plaster was carefully removed and preserved, when the weight of the granite ball was found to be 8,322·4 grains, equivalent to 539·282 metric grammes.

It next remained for consideration how far the weight of this granite ball, which must have remained undisturbed in the Great Pyramid for not much less than 4000 years (the date more generally ascribed to the construction of the Great Pyramid, being 2200 B.C.) agrees with any of the ancient Egyptian weights.

According to Dr. Arbuthnot, as quoted by Dr. Young in his article "Weights" in the Enclycopædia Britannica, the ancient Egyptian Mina weighed 8,236 English grains, or 532·683 grammes, thus differing not very much from that of the granite ball. But later authorities do not agree with this weight of the Egyptian Mina. According to them the ancient weight nearest to that of the ball is the Babylonian Mina=544·5 grammes.

Prof. Miller, in his account of the New Standard Pound, (p. 755) has shown that in frequent instances, the Imperial modern pound, or unit of weight, differs very little from, and is therefore derived from, the ancient Egyptian

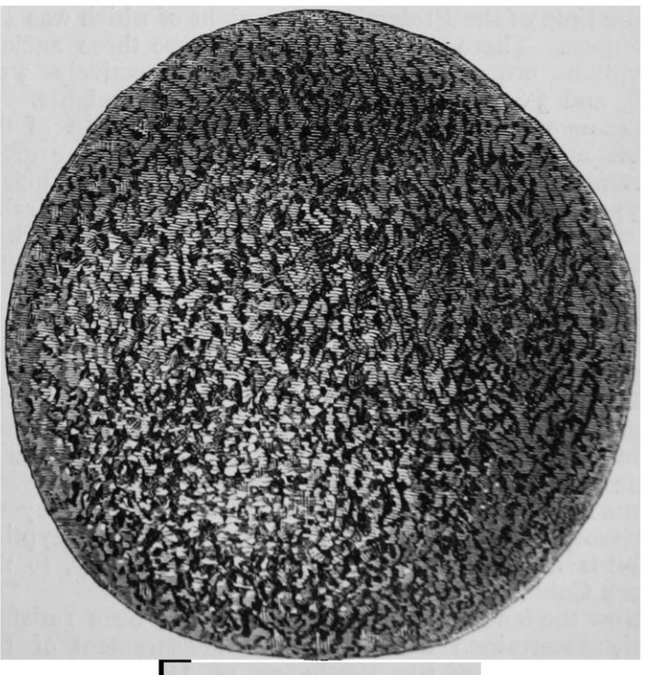


FIG. 3.—Gray granite ball.

Mina. It may therefore be interesting to pursue the inquiry more closely.

Perhaps the fullest account of ancient weights and

measures is to be found in Don. V Quiepo's *Essai sur les systèmes Métriques des Anciens Peuples* (Paris, 1849) which contains much curious and instructive information on the subject, as well as reference to the best existing authorities.

It would appear that very little is known of the system of Egyptian weights previous to the time of the Ptolemies, the first of whom, Ptolemy Lagus, one of the Generals of Alexander the Great, became King of Egypt, 323 B.C. It is also stated that there is no certainty of the existence of any Egyptian weights which were constructed much before that period. But there is evidence that the ancient system was continued by Ptolemy Lagus, when he reformed the Egyptian weights and measures, although it can hardly be imagined that the Egyptian unit of weight remained unaltered for nearly twenty centuries. The earliest systems of weights and measures not only in Egypt, but in Assyria and Phœnicia, were based on the same principle, that of the length of the cubit and of the foot, which were to each other in the proportion of 3 to 2. The Cubit was the unit of length measure; the measure of a cubic foot of water (*Metretes*) was the unit of capacity both for liquids and dry goods; the Talent or the weight of a cubic foot of water, was the larger unit of weight, whilst the Mina, either the 50th, 60th, or 100th part of the talent, and the Sicle or Shekel, either the 40th, 60th, or 100th part of the Mina, were the smaller units of weight.

The great Alexandrian Talent of Ptolemy Lagus has been shown to have weighed 42·480 kilogrammes. The 60th part was the Mina = 708 grammes, the 50th part of which was the Didrachma or Shekel = 14 grammes. This was also the weight of the Jewish Shekel of the Sanctuary, often mentioned in the Old Testament.

Another Talent was also in use which was half the weight of the Great Talent, its Mina weighed 354 grammes, and the Drachma 3·54 grammes. Don. V Quiepo mentions the fact of there being now in the Louvre two ancient Egyptian standard weights of roughly rounded stone, weighing 352·16, and 176·75 grammes respectively, evidently Mina and half-mina weights, as well as a similarly rounded stone weight, marked with six lines of hieroglyphics, found to weigh 414 grammes; this is thought to be an Attic Mina, known to be used in Egypt in the time of the Ptolemies, the weight of which was 425 grammes. There are also in the Louvre three ancient Egyptian bronze weights, weighing respectively 3·57, 3·56, and 3·62 grammes, evidently drachma weights.

Let us now endeavour to ascertain the length of the Cubit at the period of the construction of the great Pyramid, and thence deduce the weight of the ancient Egyptian Mina. In this computation it will be desirable to make use of metric weight and measure, from their great convenience in expressing the measure of length, capacity, and weight, by the same significant figures. The weight of water in relation to its bulk will thus be taken as determined for the metric system, that is to say, of pure water at its maximum density.

The latest and most satisfactory information on the length of the Cubit during the construction of the Great Pyramid, is to be met with in the Notes of Sir Henry James, published in 1866, with reference to the measurements made in the previous year by Ordnance Surveyors.

Herodotus, writing 450 B.C., says that "the Egyptian Cubit is equal to that of Samos" that is to say, to the Greek Cubit.

Now the length of the Greek Cubit has been satisfactorily ascertained from a recent measurement of the Hecatompedon of the Parthenon of Athens, being the platform on which the columns stand, and the exact length of 100 feet. The Greek foot has thus been found to be equal to 12·16032 English inches, and, adding half its length (6·08016 inches), shows the length of the Greek cubit to be 18·2405 inches. This, therefore, was the length of the Greek cubit 2,320 years ago, and, according to Herodotus, also the length of the Egyptian cubit.

But it has been considered by the greatest authorities that the length of the Egyptian cubit at the period of the construction of the Great Pyramid may be ascertained from the dimensions of the Pyramid itself.

Sir Isaac Newton, in his celebrated "Dissertation on Cubits," says that it is very probable that at first the Measure of the Great Pyramid was determined by some round number of Egyptian cubits.

According to the measurement of the four sides of the base of the Great Pyramid, as it must have stood when complete with its casing stones, the mean length of each side, as measured by Mr. Inglis in 1865 (Prof. Piazzi Smyth's "The Great Pyramid," vol. ii. p. 134), and by the Ordnance Surveyors in 1868, was 9,120 English inches, or 760 feet.

But 9,120 inches are precisely equivalent to 500 Egyptian or Greek cubits of 18·2415 inches.

From the measurements by Col. Vyse and Mr. Perring of the second and third Pyramids it would also appear that the same unit of length was used, the base of the second pyramid being a square of 700 Egyptian feet, and that of the third 350 Egyptian feet. Assuming, therefore, 500 ancient Egyptian cubits, or 750 Egyptian feet, to have been equal to 760 English feet, the Egyptian foot equals 1·013 English foot, or 30·86 centimetres.

The Talent derived from the weight of water contained in this Egyptian foot would be equal to 29·3892 kilogrammes, and the Mina, its fiftieth part, would equal 587·76 grammes. These weights agree very nearly with those of the ancient Phœnician weights, used as commercial weights in Egypt in the time of the Pharaohs—viz., the Kikkar (equal to 29·360 kilogrammes) and the Mina of the market (equal to 587·213 grammes), as shown by Don V. Quiepo.

This *common* or profane cubit (equal to 18·2415 English inches, or 46·319 centimetres) is to be distinguished from the *sacred* cubit or *cubit of Memphis*, as it has been termed by Sir Isaac Newton, equal to 20·628 inches, or 52·379 centimetres, which was derived by him from the *interior* dimensions of the Pyramid, and more particularly from the length and breadth of the King's Chamber, taken to be twenty and ten cubits respectively. The cubits cut on the Nilometer at Cairo now measure 20·699 English inches, or 52·559 centimetres, leaving no doubt of their being intended to be cubits of Memphis.

The double or *Royal cubit of Memphis* would thus, according to Isaac Newton, be 41·256 English inches. An ancient Royal cubit found at Cairath, is now in the British Museum, the length of which has been found to be 41·398 inches, or 105·118 centimetres, being exactly double the Nilometer cubit. It is divided into fourteen palms (of 2·956 inches, or 75 millimetres), and the palm into four digits (of 0·739 inches, or 18·7 millimetres). The length of its cubit differs only 0·071 inches from the length as deduced by Sir Isaac Newton.

The Chaldæo-Hebraic, or sacred Jewish Cubit was taken by Sir Isaac Newton to be $\frac{1}{5}$ longer than the cubit of Memphis, and thus to be equal to 24·84 English inches. This was the first result of his investigations, and it agrees with an actual measurement by Mersennus of 24·83 inches. This cubit was probably divided into six palms of 4·14 inches, ten of which would be very nearly equal to a Royal Cubit of Memphis, in terms of which the interior dimensions of the Great Pyramid appear to have been set out, as well as those of the second and third Pyramids.

It is very probable that the ancient cubit of Memphis, several of which have been found in buildings, was used in the measurement of buildings, whilst the cubit of 18·24 inches was employed for measuring land only.

The Egyptian foot corresponding with the cubit of Memphis, of 20·628 inches, derived from the Great Pyra-

mid, would be equal to 13·752 English inches, or 1·146 feet, and to 34·919 centimetres. The weight of water contained in such a cubic foot would be 42·578 kilogrammes, thus closely approximating to the weight of the great Alexandrian Talent in the time of the Ptolemies.

These investigations show that it is quite possible that the granite ball now found may have been an ancient Egyptian Mina weight. It has been suggested that it may have been used as a hammer, as it is known that at early periods stone balls were so used; and indeed, a part of the surface of the ball looks as if some of the granite had been knocked away. But even if so used, it by no means follows that it was not originally intended as a weight, for evidence was given before the Standard Commission by our Local Inspectors of Weights and Measures that brass standard weights not unfrequently show evident marks of having been used as hammers. If a portion of the weight had thus been knocked off, the difference between its present weight of 539·282 grammes, and the weight of the ancient Egyptian commercial Mina of 587 grammes, might be readily accounted for. Assuming the granite to have been really an Egyptian weight, it must be the most ancient weight now existing.

Some words may be added, in conclusion, upon the possibility of ascertaining the unit of ancient Egyptian weight from the internal dimensions of the coffer in the King's Chamber of the Great Pyramid, this coffer of red granite having been often considered to be a standard measure of capacity. Its internal dimensions were accurately measured by Prof. Piazzi Smyth, and were determined as follows:—

Mean length = 77·93 inches
„ breadth = 26·73 „
„ depth = 34·34 „

The capacity of the coffer is thus equal to 71·532 cubic inches, or 41·396 cubit feet, equivalent to 1171·129 cubic decimetres, showing its contents of water to weigh 1171·129 kilogrammes, equivalent to 2581·89 avoirdupois pounds; or, if the English weight of the cubic foot of water at its ordinary temperature, viz. 62·321 lbs., be taken, the contents of the water would weigh 2579·840 lbs. This result is in no way commensurable with the unit of weight derived from either of the before-mentioned ancient units of linear length, nor do the measurements of the coffer agree with any round number of such units of length. The coffer thus fails to afford an indication to the unit of ancient Egyptian weight, according to this mode of computation. H. W C.

THE DIATHERMANCY OF FLAME

IT will be seen by the following exposition that the criticism contained in the article written by W. Mattieu Williams, published in NATURE, vol. vi. pp. 506, 507, is based on wrong assumptions.

The apparatus illustrated in NATURE, vol. vi. p. 458, was constructed for the purpose of determining certain questions connected with the passage of solar rays through flame. Incidentally it admits of being employed for ascertaining the retardation suffered by artificial radiant heat in passing through a series of flames. The table before published contains the result of a recent preliminary experiment instituted to show that the transparency of flame is too imperfect to warrant the important inference which Père Secchi has drawn from Père Provenzali's experiment with a series of small flames.

The assumption that the experiment published in NATURE was intended to settle the abstract question of diathermancy is wholly gratuitous. Probably there is no problem within the range of experimental philosophy more difficult, or requiring more time, patience, and delicate instruments for its solution, than the diathermancy of flame.

Regarding the supposed imperfections of the apparatus under consideration, the following statement will suffice:—1. Mr. Williams asserts that the main pipe to which the burners are applied is too small to afford a full supply of gas. The internal diameter of this pipe is 0·75 ins. = 0·4417 square ins. Now, it has been long established in practice that an opening of 0·0037 sq. ins. is capable of discharging six cubic feet of gas per hour, under ordinary pressure. Mr. Williams's seventeen burners consumed, agreeably to his statement, *five* cubic feet of gas per hour. The sectional area of the supply pipe, imagined to be too small, is therefore $\frac{0{\cdot}4417}{0{\cdot}0037}$ = 119 times greater than the area of an opening capable of discharging more gas in a given time than the quantity consumed by the seventeen burners employed by the author of "The Fuel of the Sun." 2. The assumption that the prolongation of the axis of the conical chamber passes through "much of the blue portion of the flame" is groundless. The distance of the gas-pipe from the conical vessel, during the experiment, was so adjusted that the prolongation of the axis of the latter passed through the flames at the point of greatest intensity. But, had this adjustment been neglected, the radiant heat, acting on the thermometer, would not have suffered any diminution, since the intensity transmitted depends solely on the extent of the ignited portion of the flame. The criticism regarding the position of the axis of the instrument has therefore no bearing on the question at issue. 3. Mr. Williams's disquisition relating to the retarding influence of the vapour contained in flames, so far from establishing the perfect diathermancy assumed by Père Secchi, proves, if we admit the soundness of the reasoning, that radiant heat does not pass freely through flames when arranged in the manner adopted by Père Provenzali. It will be well to observe that the plan of igniting one flame at a time in order to ascertain the radiant power transmitted by each was resorted to with a view of deciding the question by a similar method to that adopted by the Italian physicists.

The apparatus contrived by Mr. Williams for determining the diathermancy of flame, as described by himself, is exceedingly faulty, the temperature it records being that produced by heat received from several sources. The radiant heat transmitted to the bulb of the thermometer by the flames, acting conjointly with the unknown degree of heat imparted by the surrounding medium, it will be evident that Mr. Williams's device is worthless as an indicator of radiant intensity. His thermometer, agreeably to the published table, indicated 19° C. when exposed to a single flame, and 53° C. when all the flames were ignited; but no information is afforded regarding the temperature of the enclosure (an imperfectly polished vessel) nor was the temperature of the air surrounding the bulb of the thermometer ascertained during the experiment. It is scarcely necessary to explain that in the absence of any indication of the temperature of the air surrounding the bulb of the thermometer, and the temperature of the vessel which radiates towards the bulb, the radiant intensity transmitted by the several flames cannot be determined. Again, Mr. Williams's table, as before stated, shows that the thermometer indicated 19° C. under the effect of the radiation of *one* flame, but this temperature being the joint result of heat radiated towards the bulb by the enclosure, and heat communicated by convection of the air surrounding it, together with the radiant heat transmitted by the flame, the temperature due to the radiation of the latter, viz., the true radiant intensity, cannot be established. Experimenters possessing necessary experience are aware that a thermometer of proper form exposed to radiant heat of moderate intensity requires from twenty to twenty-five minutes before the mercurial column becomes so nearly stationary that the indication may be safely recorded; hence, owing to the close proximity o the flames,

a considerable augmentation of the temperature of the air surrounding the bulb of the thermometer takes place unless the enclosure, by means of a circulating external cold medium, is maintained at a constant temperature.

Mr. Williams' assumption that the intensity of a gas flame is proportional to the quantity of gas consumed, requires some consideration. Persons practically acquainted with the subject of combustion are well aware of the fact that the intensity of a flame depends on its form and the manner of applying the oxygen, the quantity of combustibles consumed being a subordinate element in the determination of intensity. The annexed table exhibits the result of an experiment just concluded, instituted to determine accurately how far the radiant intensity transmitted by a single gas flame depends on the quantity of gas consumed ;—

Consumption of gas per hour.	Temperature of medium surrounding the thermometer.	Temperature indicated by thermometer.	Radiant intensity transmitted by the flame.
Cubic feet.	Deg. Fah.	Deg. Fah.	Deg. Fah.
1·0	60·0	60·63	0·63
1·5	60·0	60·90	0·90
2·0	60·0	61·12	1·12
2·5	60·0	61·30	1·30
3·0	60·0	61·47	1·47
3·5	60·0	61·61	1·61
4·0	60·0	61·74	1·74
4·5	60·0	61·84	1·84
5·0	60·0	61·93	1·93
5·5	60·0	62·01	2·01
6·0	60·0	62·08	2·08
6·5	60·0	62·14	2·14
7·0	60·0	62·19	2·19

It will be seen at a glance, on examining our table, that the radiant intensity transmitted to the thermometer (placed at a considerable distance from the flame, in order to reduce the subtended angle) is not proportional to the quantity of gas consumed. For instance, the differential temperature called forth by the consumption of 7·0 cubic feet of gas per hour is 2°·19, while a consumption of 3·5 cubic feet produces 1°·61, in place of the theoretical temperature $\frac{3{\cdot}5 \times 2{\cdot}19}{7{\cdot}0} = 1°{\cdot}09$; thus showing a discrepancy of 1·61 — 1·09 = 0°·52. Again, the consumption of 1·0 cubic feet per hour, instead of developing a temperature of $\frac{1 \times 2{\cdot}19}{7} = 0°{\cdot}31$, we find that fully twice that degree of heat is imparted to the thermometer. The reason is obvious ; but it is not intended on this occasion to enter into a discussion of the cause of the stated discrepancy, the object being simply to show the irrelevancy of Mr. Williams' criticism concerning the absence of a record of the quantity of gas consumed.

J. ERICSSON

NOTES

WE are very glad to read the strong and earnest terms in which Mr. Gladstone on Saturday, at the distribution of prizes at the Liverpool College, spoke of the enormous waste of power shown in the administration of our English University endowments, the amount of which is probably equal to that of the whole of the endowments of continental universities taken together, whereas, perhaps, in no other country is there less absolute work to show. England contrasts most unfavourably in this matter with almost every other country in Europe, including her northern and certainly much poorer sister, Scotland. We hope the words of the Prime Minister are an earnest that he will do his best to put an end to this humiliating state of things.

IN the Washington daily *National Republican* newspaper of Dec. 4, a report of Prof. Tyndall's first lecture there is given. The contrast between the first and last paragraphs is very transatlantic.—"Every available inch of room in Lincoln Hall was occupied last evening by an audience distinguished for its appreciation of learning and its enthusiasm in the presence of a great teacher. Conspicuous in the vast assemblage were the faces of citizens eminent for their own advancement in science—citizens who have won imperishable laurels in scaling that mountain on whose jeweled and glittering apex the feet of Prof. Tyndall rest. They were there, the guests of a brother, at an intellectual feast so rich and rare that the profoundest learning, combined with the highest form of genius, was required to prepare and serve it. Prof. Henry, in a short introductory speech, presented Prof. Tyndall to the audience. The lecture throughout was of absorbing interest, and all the experiments and teachings were made so clear and simple that a child could understand them. However, if the old gentleman who was hugging and talking with a young girl all the time, will keep away from the next lecture, those who were annoyed by him will feel thankful." The Washington *Morning Chronicle* of Dec. 6 thus refers to the second lecture—"Another brilliant audience crowded Lincoln Hall to repletion last evening to listen to the distinguished English scientist. Conspicuous in it were President Grant and Miss Nellie, who evinced their interest by undivided attention to the lecturer and his brilliant experiments, Secretary Robeson, Postmaster-General Creswell, and many other of our chief dignitaries. Of course it is useless to protest against the dictates of fashion, but we would like to suggest to the ladies that if they must wear the two-story hats now in vogue, they leave out the tall feather for the benefit of those who have to sit behind them."

THE Council of the Zoological Society have conferred the silver medal of the Society on Mr. A. D. Bartlett, superintendent of the Society's gardens, "in recognition of his valuable services to the Society, and in commemoration of the birth and successful rearing of the young hippopotamus, born on Nov. 5;" and the bronze medal on Michael Prescot and Arthur Thompson, the two keepers who had had charge of the hippopotamus during the late eventful period.

THE Chancellor of the Exchequer has declined to accede to a representation from British horticulturists to increase the grant of 6,000*l.* in aid of the British contribution to the Vienna Exhibition of next year.

A SUM of 500*l.* having been placed at the disposal of the Council of the Society of Arts, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer prizes, including the Society's gold medal and 50*l.*, for each of the following objects :—1. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall with the least amount of coal answer best for warming and ventilating a room. 2. For a new and improved system of grate suitable to existing chimneys as generally constructed, which shall with the least amount of coal best answer for cooking food, combined with warming and ventilating the room. 3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room. 4. For the best new and improved system of apparatus which shall by means of gas, be best adapted for cooking, combined with warming and ventilating the room. 5. For any new and im-

proved system or arrangements, not included in the foregoing, which shall efficiently and economically meet domestic requirements.

THE Council of the Society of Arts have resolved to offer the Society's gold medal to that manufacturer who shall produce and send to the London International Exhibition of 1873 the best specimens of steel, suitable for affording increased security in the construction of locomotive and marine engines and boilers, and for other engineering purposes.

MR. JAMES MCNAB, Curator of the Royal Botanic Garden, Edinburgh, was unanimously elected President of the Botanical Society at their last meeting, in room of Prof. Wyville Thomson. The Society was founded in 1836, and Mr. McNab is one of the original twenty-one members, only eight of whom are now alive.

AT the suggestion of Mr. Carruthers, the time of competition for Lord Cathcart's prize for the best essay on the cause of and mode of preventing the potato disease, has been extended to November 1, to give candidates an opportunity for practical research on the subject.

MR. EMMANUEL DEUTSCH has obtained six months' leave of absence on account of his health. He intends to spend the time in Egypt.

WE hear that the proprietors of the *Daily Telegraph* have placed an unlimited sum at the disposal of the Society of Biblical Archæology, to enable Mr. Smith, the author of the paper on the Chaldee account of the Deluge, to proceed to the East for the purpose of further investigation among the Assyrian ruins.

WE understand that Mr. Cleminchaw and Mr. Jongstaff, who were placed in the first class in Natural Science at Oxford, and who are mentioned as having been educated at Rugby School, were students in Natural Science at King's College, London.

THE Berlin Geographical Society has opened subscriptions for the contemplated Congo Expedition. Dr. Güssfield, the glacier explorer, who is to be the leader of the enterprise, has himself contributed nearly 1,000*l.*, and there is every prospect that the full amount necessary will be forthcoming.

MR. EDWARD D. COPE, of the Academy of Sciences, Philadelphia, has just returned to that city from a geological expedition in the territories of Wyoming and Nevada, during which he has explored a large area of Eocene and Cretaceous strata, and made some fine discoveries. Remains of over fifty new Vertebrata have been obtained, amongst which is a new *Dinosaurian* allied to *Cetiosaurus*. Amongst the mammals are some new *Proboscideans*, which appear to have been furnished with horns, and to form a transition towards the *Perissodactyle Ungulates*.

MR. J. P. GASSIOT, F.R.S., has presented to the Royal Institution a marble bust of the late Mrs. Somerville by M'Donald, the sculptor, of Rome.

WE learn from the *British Medical Journal* that Dr. Apjohn of Dublin has been appointed to the Prælectorship of Chemistry in Caius College, Cambridge.

THE Birmingham and Midland Counties branch of the British Medical Association has decided to take steps to form a microscopical section.

THE Clifton College Scientific Society has just issued the third part of its "Transactions," wherein the officers speak favourably, and apparently not without warrant, of the present position of the Society. The list of members is always full and the attendance at the meetings most satisfactory. The amount of practical work done by the members is still a weak point, but signs of improvement are not wanting. Among the papers published in this volume the two which appear to show the largest amount of original observation are both geological—"Aust Cliff," and "The Oolite at Minchinhampton," both by H. Wills, and both illustrated by sections. The museum of the college has acquired many valuable additions during the past year. Altogether, we cannot doubt that the Society is doing a most useful work in fostering a taste for natural science.

THE last part of the Proceedings of the Bath Natural History and Antiquarian Field Club is more concerned with the latter than the former portion of their programme. There are, however, one or two short papers on subjects connected with Natural Science, and an interesting sketch of the biography of early geologists connected with the neighbourhood of Bath, by Mr. W. S. Mitchell. A summary of the Proceedings of the Club for the year 1871-72 is appended, together with the Address of the President, the Rev. Leonard Blomefield (late Jenyns) after the anniversary dinner.

WE have before us the eleventh Annual Report of the Lower Mosely Street (Manchester) Schools Natural History Society. The meetings of the society have been held weekly throughout the year. The number of communications to the Society during the year in the form of lectures and papers has been twenty-three, on a great variety of subjects in the various branches of natural science. All of them were well illustrated, some by means of the microscope, others by diagrams and objects combined. We cannot too highly commend the labours of a society doing its work in this quiet and unobtrusive way in the midst of one of our most crowded cities.

WE have received from the Hydrographer to the Admiralty a series of Physical Charts of the Pacific, Atlantic, and Indian Oceans.

THE scheme for establishing a Technical College in Glasgow is now assuming a somewhat tangible shape. A subscription list has just been issued, in which we find that thirty subscribers have among themselves contributed no less than 11,050*l.* Subscriptions of 1,000*l.* each have been given by the firm of Robert Napier and Sons, the eminent shipbuilders and engineers; Mr. W. Mongomerie Neilson, of the Hyde Park locomotive works, and son of the inventor of the hot-blast; and Mr. John Tennant, the head of one of the oldest and largest chemical firms in the world. Of the thirty subscribers, twenty-two are members of the general Committee. It is proposed, when 20,000*l.* is subscribed, to begin the actual organisation of the Technical College, establishing, in the first instance, chairs for—(1) naval architecture and marine mechanical engineering; (2) the theory and practice of weaving; and (3) the theory and practice of dyeing and printing on textile fabrics.

WE learn from the San Francisco *Morning Bulletin* that there is in course of construction at Woodward's Gardens a salt-water aquarium of modest dimensions, yet designed to be complete in all its parts. A year ago the proprietor of the Gardens sent Charles Schumann to Europe to examine the sea aquaria of Paris and other cities. After much time spent in investigation, Mr. Schumann determined to draw his plans on the model of the Berlin aquaria, though on a smaller scale. The building now in progress is the result. The aquarium will be mainly under the surface of the ground, in order to secure an even temperature. There are fifteen tanks in all, one of which is for freshwater specimens. The tanks vary in size from 300 to 1,000 gallons capacity, the largest containing eight thousand pounds of water. Several of the tanks are fitted up with sea-worn rocks obtained at the cliff-house, and some at Santa Cruz. There will be room for marine plants, shells, corals, &c. It is the intention to obtain deep-sea animals and other rare denizens of the deep, with a live shark or two, a devil fish, &c.

DR. NATHANIEL HAYCROFT has reprinted his inaugural address, delivered before the Leicester Literary and Philosophical Society, on the Limits of Scientific Inquiry; and we find also the abstract of a paper read at the last meeting of the Natural Science Section of the Sheffield Philosophical Society by the President, Dr. Hime, on Phenomena and Forces, both rather extensive subjects for an hour's discourse.

THE following is from the *Journal of the Society of Telegraph Engineers*:—"Thanks to the noble exertions of the illustrious president of the Italian Geographical Society, the idea of an Arctic expedition under the Italian flag is gradually working its way into their minds. Funds have been offered, and the prospect is brightening that the old voyage of the *Zeni*, though the first, will not be the last of the Italian Arctic expeditions." The same journal says that Signor Guido Cora announces his intention of editing an Italian geographical periodical, to be entitled *Kosmos*, the first number of which is to appear on January 1, 1873.

THE following is from the *School Board Chronicle*:—"New York has 101,883 scholars to rather over a million of inhabitants; these children receive their instruction from 2,765 masters (*i.e.*, one teacher to every thirty-six pupils); the educational budget amounts to very nearly 700,000*l.*, or 7*l.* for each child. In England, in one year, 35,999 men and 49,522 women were found unable to sign the marriage register."

NUMEROUS seals, very rare in these waters, are making their appearance at the mouth of Holy Loch and in Loch Long, in the Frith of Clyde.

WE learn from the *American Agriculturalist* that it has been finally decided to locate the arboretum, for which a large bequest was made to the Harvard University by Mr. Arnold, of New Bedford, on a farm, about ten miles south of Boston, where the School of Agriculture already exists. The details of the work are to be under the immediate control of Prof. Sargent, who is eminently well qualified for it. He proposes to lay out the ground (137 acres of well-diversified land) as a natural park, with drives and walks tastefully arranged, and leading from one family to another, in scientific order, of all the trees and shrubs hardy in that climate.

A "CENTENNIAL Commission" has been appointed by the American Congress to mature a scheme for the celebration of the nation's hundredth anniversary in 1876, by holding an International Exposition in Philadelphia, which shall be "the grandest the world has ever seen." The sum required to conduct it properly is estimated at $10,000,000, and each State is called upon to subscribe its share of the amount as definitely fixed by the Commission. At a recent public meeting in Philadelphia $100,000 worth of stock was taken in fifteen minutes.

THE American Palestine Exploration Society, of which we have already made mention in our columns, is about sending off an expedition for the purpose of carrying out the objects of that body. According to the *Independent*, it is to be under the direction of Lieut. E. Steever, U.S.A., who will have special charge of the topographical survey, and of the preparation of a reliable map. He will be accompanied by Prof. John A. Payne, late of Robert College, Constantinople, who will superintend the archæological department, and make what collections he can in natural history and geology; but, being himself especially a botanist, he will devote his principal attention to that branch. Mr. Van Dyke and other gentlemen will probably accompany the party to the field, and among them will be an artist of considerable reputation. This labour is one, of course, that will require some time for its completion; and, according to the *Independent*, at least six years will be necessary to accomplish its object thoroughly, even allowing for the assistance of a British society (organised for a similar purpose) in doing its share of the work.

*THE DIOSMOTIC PROPERTIES OF COLLOIDS**

DUTROCHET, in his researches on osmose, examined the properties of certain organic non-crystallisable substances (later named colloids by Graham).

Comparing the colloids gelatin, gum-arabic, and albumen (from hens' eggs) with cane sugar, he thus expressed numerically the endosmotic power of these substances:—Gelatin, 3; gum-arabic, 5·17; sugar, 11; albumen, 12. Thus the endosmotic force attributed to the colloids was considerable, in the case of albumen exceeding that of sugar.

These results must, however, be considered in great measure fallacious, as, while the specific gravities of the solutions were equal, (1·01) their degrees of concentration were very different. The solutions of gelatin and albumen contained 4·1 per cent. of these substances, while the sugar solution scarcely contained 2·5 per cent. of sugar. On this ground the sugar must be ranked above the colloids.

There is another circumstance to be considered. Dutrochet used the colloids in their natural state (common gum-arabic and albumen direct from the egg), and in this form they contain over 3 per cent. of mineral substances, chiefly salts of lime and potash. Since Graham pointed out the great difference between crystalloids and colloids, as regards diffusion in water and passage through a membrane, it was to be expected that the presence of crystalloids in the colloidal substance would considerably mask the diosmotic properties of the latter. In the writer's experiments he employed colloids freed from mineral substances, comparing their diosmotic properties with those of the same substances in the natural state. Contrary to the generally received opinion that these substances have a high endosmotic power, he found that this is not the case, though certain variations are met with, which will presently be explained.

Solutions of pure colloids showed, when of moderate concentration, a very weak endosmose. The properties of the membrane, however, distinctly affect the results. Animal bladder, parchment, and artificial cellulose, are very near one another in this respect. With the first two the concentration of an albumen or arabin solution might be raised to about 10 per cent. without any perceptible increase of volume in the solution, at the expense of the pure water. Tannin gave a slight endosmose; a 10 per cent. solution in 24 hours received 1·0 cc. water (the membrane being parchment). The degree of concentration now given may be considered about the limit within which, for these substances, and with the membranes named, no addition of water takes place. With the artificial cellulose, the limit seems to be somewhat lower, for a 9 per cent. arabin solution gave (with it) a perceptible, though very weak endosmose (about 0·45 c c) in 24 hours, and a tannin solution 7 per cent. increased in volume 0·8 cc. in the same time.

On comparing with colloids in the impure state, it was found that while a 10 per cent. arabin solution received hardly any water through the parchment, (about 0·5 cc.), an equally concentrated solution of common gum-arabic increased in volume, in the same circumstances, about 2·55 cc.

When a pyroxilin membrane was used with the pure colloids, the endosmotic action was considerably greater than that which took place in the other membranes. Thus with pyroxilin a 10 per cent. solution of albumen increased 9 0 cc. in volume, and an equally concentrated arabin solution 14 0 cc.; while, in the same time, when the membrane was animal bladder or parchment, the endosmose was hardly perceptible (0·5 cc.). This shows that the weak endosmotic action of colloids, when particular membranes are used, is not to be attributed to their weak attraction for water, but rather to the properties of the membrane. And in the above case it appears that the different behaviour of the membranes corresponds to their different absorptivity for water. Especially does this appear from the fact that a very different endosmose takes place with one and the same membrane, according as it is employed as pyroxilin, or after its reduction as cellulose (by a process described in a previous part of the paper). Thus a 7 per cent. arabin solution received, through a pyroxilin membrane, 5 3 cc. water; when the membrane was reduced, an equally concentrated solution showed no endosmose, and a 9 per cent. solution of the same substance only received about 0·45 cc. water.

For substances largely soluble in water, the attraction of their particles to water may have wide limits of variation, according

* Abstract of part of a paper in "Poggendorff's Annalen," by J. Baranetzky.

to the measure of concentration. Those substances, on the other hand, which can only receive limited quantities of water, as *e.g.* cellulose, are, when brought into contact with water, soon saturated, and have thereafter an unvarying attraction for water. When, therefore, an arabin or albumen solution of certain concentration receives no water through the animal bladder or parchment, this only shows that with the concentration given, these colloids have less attraction for water than the membranes have. If, however, the concentration is raised above a certain limit, the attraction of the membrane for water is overcome, and endosmose occurs. This limit, the same membrane being used for different colloids, must evidently depend on the attraction of these for water. My experiments show that in equally concentrated solutions tannin gives the greatest endosmotic action; then follows arabin, and next albumen, an order agreeing with the stability of these substances in their aqueous solutions, which may in general be taken as a measure of their affinity for water. From membranes like pyroxilin, in which the water is held with little force, it can be withdrawn by weak colloid solutions; hence a much greater endosmotic effect is seen in this case.

In further support of the explanation now given, we have the fact that with membranous substances chemically the same the colloid solutions show greater endosmotic force the less dense the membrane is, *i.e.* the wider its water-filled interstices are. Indeed the attraction of water to the substance of the membrane must diminish greatly with the distance.

The particles of water in the central parts of the interstices will be less attracted the wider these interstices. This may be illustrated by using two pyroxilin membranes of different densities. Thus, employing a 7 per cent. arabin solution, it was found that in 24 hours 5·3 cc. water passed through the denser membrane, whereas 9·5 cc. passed through the other. Similarly with two pieces of parchment from different manufacturers, a 10 per cent. arabin solution gave in one case 0·5 cc., and the other 1·6 cc. endosmose, and after expanding in all directions, the more compact of the two, an equally concentrated arabin solution, gave, with it, 3·5 cc. endosmose.

If we consider the case of the impure colloids, it is not easy to see in what way the presence of so small a quantity of crystalloid substance increases the endosmotic action so greatly; for the same quantity of crystalloid, taken by itself, does not give the weakest perceptible endosmose. In the converse case, addition of a small quantity of colloid to a crystalloid solution, the endosmose of the latter is increased also.

Fick observed that endosmotic equivalents must be higher the more mobile the particles of the salt solution employed. The presence of colloids in the solutions makes the latter denser; when, however, a crystalline substance is dissolved in a dense fluid, its particles must be less mobile than in solution with pure water; and this is the most probable explanation of the action of colloids in exalting the endosmotic force of crystalloid substances.

It is, however, found that when a colloid solution is submitted to diosmose of water containing even a small quantity of a crystalline salt, instead of to pure water, the endosmose of the colloid is considerably diminished.

The action of the crystalloid in this case cannot be attributed to an endosmotic current originated by it; none of the salt solutions that were employed showed, in direct experiment with water, the slightest increase of volume at the cost of the water. The phenomenon is one requiring further experiment in order to arrive at its explanation.

A. B. M.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, No. 10, 1872.—This number commences with a paper by Dr. Herwig on the expansion relations of superheated vapours. In his experiments he used a U-tube, one limb of which contained the vapour and the other dry air, these being separated by a little mercury, and the instrument being heated in a bath. The general result arrived at is that, at certain low pressures, with constant volume, superheated vapour has a smaller coefficient of expansion than that of perfect gases (viz. 0·003663). The numerical results for sulphide of carbon, chloroform, and alcohol, are tabulated.—J. Baranetzky communicates a long and interesting paper of researches in diosmosis.* Sketching the history of the subject, he points out several defects in previous investigations. Nearly all the experimenters from Vierodt's time have sought to determine the endosmotic equivalents of salts, and the results are very discordant. The diosmotic properties of colloids have been imperfectly studied and misconceived. The membranes employed have mostly been animal, and the influence of the nature of the membrane is a question which, M. Baranetsky thinks, has hardly been touched. Having directed his experiments to some of these points, he shows the influence of various kinds of membrane (parchment, bladder, artificial cellulose, pyroxilin), and various thicknesses of membrane on the endosmose of various salts. As to the colloids, he found that, when of moderate concentration (say 10 p. c.) *and freed from mineral substances*, they showed little or no endosmose; and for the same degree of concentration, pyroxilin and cellulose gave more endosmose than animal membranes. The writer further discusses the influence of adhesion, and concludes by applying his observations to animal and plant life.—G. Vom Rath gives his concluding mineralogical paper, treating chiefly of the chemical composition of some Vesuvian products; and this is followed by an account of some studies in micro-mineralogy (last of a series also) by Dr. V. Lasaulx.—In a note by H. F. Weber, on the specific heat of carbon, the discrepancy of various observations is attributed to the fact that the specific heat (in this case) varies with the temperature, being tripled, in the case of the diamond, between 0° and 200°.

* See ante, p. 152.

THE *Lens* for July 1872, contains—"Algæ Rhodiaceæ, a list of Rhode Island Algæ," by Stephen T. Olney, including the Desmidiaceæ and Diatomaceæ.—"The Cell," by J. N. Danforth, M.D., commences an examination of the theories of cell development.—"The Flora of Chicago and its vicinity," by H. H. Babcock, is continued from the previous numbers.—"The Markings of the Test Podura Scale," by F. W. S. Arnold, M.D., accompanied by an Albert-type plate from negatives produced by the author. It contributes very little to the controversy. "A Conspectus of the Families and Genera of the Diatomaceæ," by Prof. H. L. Smith, is continued, with an "Index to Synonym Register."—"Microscopical Memoranda for the use of Practitioners of Medicine," by Dr. J. J. Woodward, is also continued from the previous number.—"Fungi in Cows' Milk," by Prof. James Law. In this case the fungi are presumed to have originated from impure water supplied to the herd.—"Hepatica," by H. H. Babcock, and "Puccinea on Paper," by Thomas Taylor, are short papers; as are also those by F. W. S. Arnold, on "Hæmatoxylin as a staining material for animal tissues;" and A. Prazmowski, on "Draw-tubes *v.* deep eyepieces."

IN No. 1 of the *Proceedings of the Swedish Academy of Sciences* for the present year (Ofversigt af Kongl, Vetenskaps Akademiens Förhandlingar, Arg. 29, No. 1) M. A. E. Förnebohm gives a geognostic section of the central chain of Scandinavia between Ostersund on the east and Levanger on the west. The section includes primitive Cambrian and Silurian rocks, and the author remarks that the most striking point in it is, that fossiliferous Silurian rocks are covered in the Areskuta by two great schistose non-fossiliferous formations resembling the typical rocks of what he calls the primitive formation (gneiss, hornblende, schists, &c.). A short summary in French is appended to this paper, which is illustrated with woodcuts and a folding plate.—M. E. Edlund communicates a continuation of his attempt to explain the phenomena of electricity by means of the luminiferous ether.—From M. O. J. Fahrœus we have a long series of Latin descriptions of Caffrarian *Longicorn Coleoptera* collected between the years 1838 and 1845 by J. A. Wahlberg. The species here described (58 in number) belong to the divisions *Prionidæ* and *Cerambycidæ*, and include the types of several new genera.—M. H. Gyldén gives formulæ and tables for the calculation of the distance at which lighthouses may be visible.—M. Hjalmar Stolpe communicates the results of natural history and archæological investigations in Björkö and Mälaren.—The tendency of the trichomata of plants to changes of form is the subject of a paper by M. P. G. E. Theorin, in which the author describes and figures certain forms of those organs occurring in the common yellow water-lily.—M. Gustaf Eisen notices some Arctic oligochætous annelides, including three species of *Lumbricus* and a *Rhynchelmis* from Newfoundland, and a *Lumbriculus* from Greenland. *Lumbricus puter* (Hoffm.) is briefly described, and *Enchytræus Pagenstecheri* (Ratzel) from Greenland, in more detail, for comparison with a new species, *E. Ratzeli*, from the northern parts of Norway. Figures are given of the characteristic parts of the last two species.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, Dec. 12.—Dr. Hirst, F.R.S., president, in the chair, Prof Cayley read a paper "On the mechanical description of certain quartic curves by a modified oval chuck," and exhibited the action of the instrument. Mr. S. Roberts spoke on the subject of the paper.—Prof. Cayley then gave an account of his communication "On geodesic lines, especially those of a hyperboloid."—Mr. J. J. Walker made a few remarks on the breaking up of the anharmonic Ratio Sextic—Mr. J. W. L. Glaisher next gave a description, and worked out part, of his paper "On a deduction from Von Stavdt's property of Bernoulli's numbers."—Prof. Clifford read a paper, "Geometry on an Ellipsoid."

Linnean Society, Dec. 5.—Mr. G. Bentham, president, in the chair.—On the skeleton of the *Apteryx*, by Thos. Allis.—On new and rare British Spiders, by the Rev. O. P. Cambridge.

Dec. 19.—Mr. W. G. Smith exhibited a fine specimen of *Batarrea phalloides* (one of four specimens found in the grounds of the Earl of Egmont, near Epsom), and read a brief paper thereon, in which he commented on the great rarity of the plant and the peculiarity of its form. Mr. Smith gave some details of its structure, especially as regards its possession of so-called spiral vessels, and referred to its position among other fungi, especially the genera *Clathrus*, *Phallus*, *Cynophallus*, and *Geaster*, a complete set of drawings of these genera, showing every stage of growth, being exhibited to the meeting.—On the development of the flowers of *Welwitschia mirabilis*, by W. R. M'Nab. These investigations were made on a beautiful series of flowers of both sexes forwarded by Dr. Hooker, whose previous paper was based on the examination only of immature specimens. Prof. M'Nab's conclusions differed in some respects from those of Dr. Hooker. He believes the male and female flowers to be constructed on a different plan. In the female flower the ovule is truly naked, what has been taken by some to be the carpel being in reality the integument of the ovule. In the male flower, on the other hand, the (rudimentary) ovule has a true carpellary coating. In the male flowers, therefore, *Welwitschia* shows a close approximation to Angiosperms. Several other points in the structure and development of this remarkable plant were exhaustively gone into.—On the General Principles of Plant Construction, by Dr. M. T. Masters, F.R.S. The chief objects of this suggestive paper were to attempt to introduce greater exactness into botanical terminology, the definition of parts and organs according to their morphological rather than their external significance, and to frame a classification of the facts of morphology in accordance with our present knowledge of the laws of development.

Geologists' Association, Dec. 6.—The Rev. T. Wiltshire, M.A., president, in the chair.—"On coal seams in the Permian at Ifton, Shrpshire, with remarks on the supposed glacial climate of the Permian period," by D. C. Davies, F.G.S. The author showed the existence of three well-defined and workable seams of coal *above* the red sandstones and marls which are generally held to form the base of the Permian strata. He then proceeded to show the identity of these red beds with similar beds overlying the coal throughout several of the Midland Counties, and with the red sandstones of the North of England, and also that the overlying sandstones, shales, and coals were the equivalent of the magnesian limestones and calcareous conglomerates which occupy the same horizon in widely distant places. After referring to the former probable extension of these beds over a large area, the author pointed out that in the neighbourhood described the gap or break which is usually supposed to occur between the Coal Measures and the Permian was partly, if not quite, bridged over. He also noticed how the different geological formations were dovetailed into each other, the old passing upward into the new, and not divided by sharp, well-defined lines. From the identity of the age of these coal seams with the Permian conglomerate of Alberbury only fifteen miles distant, he questioned the probability of that conglomerate being of glacial origin, since two climates so dissimilar as a glacial one and that in which a carboniferous flora flourished could not exist together within so limited an area. In conclusion, Mr. Davies pointed out the necessity for alterations of the boundaries of the Permian and the coal measures in any future geological maps of the district.—Note "On a well section at Finchley," by Caleb Evans, F.G.S.

Entomological Society, Dec. 2.—Prof. Westwood, F.LS., president, in the chair.—Prof. Westwood exhibited a drawing of a variety of *Pyrameis cardui* captured many years since on Margate sands.—Mr. Bond exhibited several curious varieties of British Lepidoptera, including a female *Lycæa ægon*, the wings of which on one side were coloured as in the male, *Acronycta megacephala*, &c. He also exhibited *Anomalon fasciatum*, a species of *Ichneumonidæ* new to Britain, bred by Mr. Mitford from the larvæ of a supposed variety of *Lasiocampa trifolii*.—Mr. F. Smith, in answer to a question put to him by Major Mann, as to whether queen-bees sting, stated that he had never been stung by one, and Prof. Westwood said that was also his experience.—Mr. Champion exhibited *Thyamis distinguenda* Rye, and *Lithocaris picea* Kraatz, two species of beetles recently detected in Britain. Mr. Müller read notes on the manner in which the ravages of a species of *Nematus* or *Salix cinerea* are checked by *Picromerus bidens* L.—Mr. Dunning read supplementary notes on the genus *Acentropus*.—Mr. Baly sent the first portion of a catalogue of the phytophagous *Coleoptera* of Japan, partly drawn up from materials collected by Mr. George Lewis.—Mr. F. Bates communicated descriptions of new species of *Tenebrionidæ*.—Mr. R. Trimen sent descriptions of new South African butterflies.

Photographic Society, Dec. 10.—James Glaisher, F.R.S. president, in the chair.—A paper was read on landscape photography by F. C. Earl, in which that gentleman detailed his method of photographing large landscapes. Lenses of different focal length, but covering the same extent of field, were employed in the camera, so that foreground, middle distance, or horizon might be rendered more or less prominent at will.—Mr. J. R. Johnson read a paper on a new actinometer recently invented by Mr. Burton, the translucent films of which were formed by bichromate films, coloured with pure Indian-ink; the scales were arranged in true geometrical progression.—Mr. George Croughton read a paper on mezzotint effects.

Royal Microscopical Society, Dec. 4.—W. Kitchen Parker, F.R.S., president, in the chair. A new form of micro-spectroscope was described by Edward Gayer, Surgeon of H.M. Indian Army. Mr. Gayer claims for his invention the following advantages, more light, more dispersive powers, and the possibility of using it even with high powers.—Dr. Royston Pigott drew attention to a new method of using the micrometer.—The President read a paper "On the Histology and Growth of the Skull of the Tit and Sparrow Hawk."

EDINBURGH

Royal Physical Society, Nov. 27.—Mr. Charles Williams Peach, one of the presidents of the society, delivered an opening address, his subject being "The Fossil Flora of the Old Red Sandstone of the North of Scotland." The history of the Old Red sandstone, he said, whether of its rocks, plants, or fishes, was still to be written. Slowly light was breaking in upon the organisms found in the formation; but much inquiry and search required yet to be made before a full catalogue of these could be drawn up. Not long ago it was believed that the only organisms to be found in the Old Red sandstone were of a marine character, such as fucoids, but he ventured to say that the flora of the formation was not so poor as was supposed. He had investigated the Old Red, particularly in the north of Scotland, and found many land plants. They were rarely to be found in beds of limestone, seldom or never in the pavement beds of commerce, but were far from rare in the coarse beds that underlie the last-named. He believed that if these coarse beds were exposed a perfect forest of plants would be discovered. The state of knowledge of the fosilliferous character of the Old Red sandstone stood thus:—In 1844 land plants were *nil*, fucoids abundant; 1849, of land plants, one genus and one species; fucoids as many as you please; 1855, five genera of land plants and five species; fucoids abundant; 1872, thirteen genera and twenty-three species of land plants; sea-weeds *nil*.

Edinburgh Naturalists' Field Club, Nov. 29.—Mr. R. Scott-Skirving, president, in the chair.—The secretary, Mr. J. D. Brown, read the annual report, which stated that during the year the club had had twenty-three excursions. The secretary of the Largo Field Society offered a prize—of fifty mounted specimens of *Musci Fifenses*, to be competed for by ladies present at the club's excursions to Kilconquhar and Elie. This prize was gained by Miss Masson. Two additional prizes were offered by two members of the club, to be competed for by the ladies—one at North

Berwick and the other at Linlithgow. The total membership of the club was seventy-eight, showing an increase of eight over last year.

CAMBRIDGE

Philosophical Society, Nov. 25—On the appearance of an extra digit on the hind limbs and then on both fore and hind limbs in two successive generations, and its bearing on the theory of Pangenesis, by Mr. N. Goodman. A cow had three well-developed toes on each hind limb, besides the two ordinary rudiments. Her calf (by a normal bull) had the same peculiarity. This has two calves (by normal bulls). The first, a cow, had the toes as in the other cases, but rather less developed; the second, a bull, had three toes on all four feet. The writer pointed out that this peculiarity might be explained by (1) atavism, (2) certain modifications of the proliferous function by external causes (3) correlation of growth, supplementing the former. He thought it could not be explained by atavism, nor by the second cause, but by the third, and discussed its bearing on his theory of Pangenesis.—A communication was received from Mr. W. H. Stanley on a Pneumatical design for saving life at sea. The process was by the expansion of condensed air stored in reservoirs.

LEEDS

Naturalists' Field Club and Scientific Association, Nov. 26.—Mr. J. W. Taylor on behalf of Mr. W. Nelson, of Birmingham, read a paper on "The Lymnæidæ of the Birmingham district," giving a catalogue of nineteen species found within five miles of Birmingham, against the twenty-three at present included in the British fauna. He also recorded twenty-four varieties for that district. The absence of the remaining four species was readily accounted for, on the ground either of their extreme rarity, or of their recent introduction into these islands. *Planorbis dilatatus* has recently been imported along with cotton; *Lymnæa involuta* has never been found away from its original locality, Killarney; while *Planorbis lacustris* and *Lymnæa glutinosa* are excessively rare. The following is a list of the nineteen species found within five miles of Birmingham. *Planorbis nitidus, P. nautileus, P. albus, P. glaber, P. spirorbis, P. vortex, P. carinatus, P. complanatus, P. corneus, Physa hypnorum, P. fontinalis, Lymnæa peregra, L. auricularia, L. stagnalis, L. palustris, L. truncatula, L. glabra, Ancylus fluviatilis, A. lacustris.*

RIGA

Society of Naturalists, Jan. 24 (Feb. 5, N.S.)—M. C. Berg noticed the damage done to some peas by the larva of *Endrosis lacteella*.—M. Gögginger called attention to a yellow lucerne, identified by him with *Medicago media*, which he found near Hapsal, and recommended for cultivation, especially on account of its deep roots. Dr. Buhse doubted the identification of the plant, and stated that *Medicago media* is a hybrid of *M. sativa* and *falcata*, and that when cultivated it reverts to the type of the former species in a few years.—The aurora of February 4 was referred to by M. Schroeder and Prof. Schell. The former found no traces of polarisation, but in the spectroscope a broad greenish yellow line made its appearance. Prof. Schell's paper included notices of the phenomenon from various sources.

February 7 (19 N.S.)—Dr. Nauck exhibited and described a maximum and minimum thermometer constructed on a new principle. It is a U-shaped tube, having one upright limb terminating in a bulb, and the other bent inwards and then downwards into a large cylindrical portion. The lower part of the U-tube is filled with mercury, and the rest with alcohol, except the bulb of the upright tube, the greater part of which is empty. The floats are of glass, enclosing an iron wire, and are fixed in the tubes by means of bent human hairs.—Dr. Buhse gave a detailed description of the parasitic fungi of infectious diseases, in which he referred to those affecting plants, animals, and man, and especially noticed the relation of *Bacteriæ* to disease.

February 21 (March 4, N.S.)—M. Schroeder announced that two days previously (March 2, N.S.) he observed a distinct zodiacal-light about 8 o'clock P.M.—M. Frederking read a second part of his memoir on the History of Chemistry, in which he referred first to the discovery of oxygen by Priestley and Scheele, and then passed to the consideration of Lavoisier's labours.

February 28 (March 11, N.S.)—M. H. Westermann reported upon a work by Fechner entitled "Experimental Æsthetics," in which the author endeavours to investigate experimentally the general principles of symmetry. This report presents some curious and interesting points; the questions raised by it were discussed by several of the members present.

GOTTINGEN

Royal Society of Sciences, Aug. 3.—M. G. Meissner communicated a paper by Dr. Hartwig on the passage of substances from the blood of the mother into the fœtus, in which he showed, in opposition to Gusserow, that iodine administered in solution to the parent speedily passes into the fœtus.—M. Felix Kleim presented a contribution towards the interpretation of complex elements in geometry.—M. H. Hübner presented a paper by M. G. Spezia on the determination of iodine in the presence of chlorine, by means of protonitrate of thallium. This process is founded on the fact that whilst chloride of thallium is soluble in a large quantity of water, iodide of thallium is insoluble.—M. Wilhelm Weber communicated a paper by M. E. Riecke on the law of electro-organic reciprocal actions proposed by Helmholtz.—M. Clebsch exhibited and described two models prepared by M. Weiler, and relating to a particular class of surfaces of the third order.

Sept. 18.—M. A. Clebsch read a paper on a new fundamental form of the analytical geometry of planes.

Sept. 25.—M. F. Kohlrausch presented a paper on the electromotive power of very thin strata of gas upon metal plates.

Oct. 9.—M. A. Clebsch communicated a paper by M. A. Mayer on Lie's method of integration of the partial differential equations of the first order.

Oct. 30.—M. A. Clebsch communicated a long contribution by M. Sophus Lie to the theory of partial differential equations of the first order, and on their classification.

Nov. 13.—M. A. Clebsch presented a note by M. H. Grassmann on the theory of curves of the third order.—M. Weber communicated a paper by M. E. Reicke on the magnetisation-function of a sphere of soft iron.—Prof. Henle presented a note by M. Oscar Grimm on the olfactory organ of the sturgeon, in which the author describes certain peculiar cells which occur on the surface of the olfactory grooves.—M. Oscar Grimm also forwarded a note on *Synura uvella* and *Uroglena volvox*, belonging to Häckel's Protistan group of the Catallacta, indicating a probable genetic connection of the Catallacta with the sponges.

VIENNA

Imperial Academy of Sciences, Oct. 10.—The completed MS. of a catalogue of observed Polar lights was forwarded by Dr. Herrmann Fritz of Zürich. Prof. Hlasiwetz communicated a memoir by Dr. F. Hinterberger on excretine. The substance was prepared by the author from fresh human excrement, and found to be free from sulphur and with the formula C^{20} H^{36} O. With bromine it forms bibromexcretine, with the formula C^{20} H^{34} Br^2 O.—Dr. Kretschmar presented a memoir on the influence of morphine, and carbonate and sulphate of soda in *diabetes mellitus*. The first-mentioned substance acted beneficially, and reduced the secretion of sugar to zero.—Prof. L. Boltzmann communicated two memoirs, one containing further investigations on the heat-equilibrium among gaseous molecules, the other an experimental investigation on the behaviour of non-conducting bodies under the influence of electrical forces.

October 17.—M. Otto Hermann presented a memoir entitled "The Noble Siebenburgian Horse," intended to correct statements in Dr. L. J. Fitzinger's essay on the origin of the domestic horse and its races.—Prof. E. Mach, of Prague, communicated a memoir on the stroboscopic determination of musical notes. His stroboscopic scale is a uniformly rotating white cylinder covered with black longitudinal streaks, the closeness and number of which rapidly increases from one end of the cylinder to the other. This is observed through radiating fissures in a paper disc attached to the axis of the sirène, and the streaks are always seen simple at the spot where they pass before the eye in the vibration-number of the sirène.—The same author forwarded two papers prepared by him in conjunction with Dr. J. Kessel. In the first of these, on the function of the tympanic cavity and of the eustachian tube, the authors show by experiment, not only that the tuba is usually closed, but that this closure is necessary for the production of effective vibrations of the tympanic membrane. In the second they treat of the accommodation of the ear, and show that, although alterations of the tension of the *tensor tympani* may cause a limited accommodation, such alterations do not occur in the living ear during hearing and listening.

October 24.—Prof. L. Gegenbaur, of Krems, communicated a memoir entitled "Integral Expressions for the Functions Y_n^m." Dr. Peyritsch presented a memoir on Peloric formations, in which he described the types of pelorism in the Labiatæ, Verbenaceæ, Scrophulariaceæ, and Ranunculaceæ, and endeavoured to show the probability that in the Labiatæ we have to do with a quaternary and not with a quinary type.

PHILADELPHIA

Academy of Natural Sciences, May 28.—Professor Cope exhibited some vertebræ of a Plesiosauroid reptile and also those of a smaller species, probably a *Clidastes* which were found in close proximity near Sheridan, Kansas, by Mr. Joseph Savage, of Leavenworth. According to this gentleman, the vertebral column of the *Clidastes* was found immediately below that of the Plesiosauroid and in a reversed position, as though it had been swallowed by the latter or larger reptile. The largest vertebræ of the *Clidastes* were about three-quarters the length and one-fourth the diameter of those of the Plesiosauroid, and the animal must have furnished a large, or at least a long, mouthful for its captor. The bones of the *Clidastes* were not in good condition, but resembled those of *C. cineriarum* Cope, though smaller. The Plesiosauroid was new to science, being the third species discovered in the Cretaceous of the Niobrara group. Specifically it was nearest to the *Elasmosaurus platyurus* Cope, but was readily distinguished by the relatively shorter cervical vertebræ, and the regular acute ridges on the exterior surfaces near the margin of the articular faces, as well as the less contracted form of all the vertebral centra. Associated with these remains were those of a turtle of the size of some of the large *Cheloniidæ* of recent seas. The only portions were the scapulo-procoracoid, the coracoid, and the mandible nearly complete. The general characters of this form were thought to agree with *Cynocercus* Cope, though the individual was larger than that on which the *C. incisus* was established.

June 4.—Mr. Thomas Meehan presented some specimens of the common asparagus, and remarked that in consequence of observing last year so many plants that had evidently flowered producing no seeds, he had this year examined them in a flowering condition and found them perfectly dicœcious. Imperfect stamens existed in the female flowers, but they were never polleniferous. An occasional gynœcium in the male flower would make a weak attempt to produce a pistil, but no polleniferous flower ever produces a fruit. There was a great difference in the form of the male and female flowers. The former were double the length of the latter, and nearly cylindrical, while the female flower was rather campanulate. Other observers had nearly made the discovery of division in this plant. The old "English Botany" of Smith gave it the character of being occasionally imperfect, and the authors of "Deutchland's Flora" considered it as occasionally polygamous. But Mr. Meehan was satisfied from a half day's investigation among many plants that in this region at least the asparagus is never perfect, but truly dicœcious. He had observed another matter, small, but which might be of importance to systematic botanists, as well as to those engaged in evolutionary studies. One flower had a quadrifid stigma, and a four-celled ovary. The trinate type, or its multiple, is so closely associated with the endogenous structure, that he considered this circumstance particularly worthy of note. The male flowers seem very attractive to insects, various kinds of which seem to feed on the pollen. The honey bee was a frequent visitor. None seemed to be attracted to the female flowers. In the division into separate sexes the plant had gained nothing in the way of aid by insect fertilisation. Fertilisation seemed wholly accomplished by the wind. The male flowers are produced in much greater abundance than the female ones. Mr. Meehan added that this discovery had a more than usual practical importance. Many attempts had been made to improve the asparagus, as garden vegetables and the farm cereals had been improved; but it had often been questioned whether these improved forms would reproduce themselves from seed as other garden varieties did. The tendency of thought the few past years had been in the direction of the belief that permanent varieties could be raised, and several improved kinds had been sent out by seedsmen, and were popular to a considerable extent. He said he had himself inclined to this opinion; but this discovery of complete dioecism in asparagus, whereby two distinct individual forms were required to produce seed, rendered a true reproduction of one original parent impossible, as the progeny must necessarily partake of both forms.

"On the Fishes of the Ambyiacu River," by Edward D. Cope. The collection on which the present examination is based was made by our correspondent at Pebas, John Hauxwell. It embraces fishes of the small streams tributary to the Ambyiacu, as well as those of the river itself. The Ambyiacu is an inconsiderable river, which empties into the Amazon near to Pebas, in Eastern Equador, some distance east of the Napo. The results of the examination will be mentioned at the close of the list. As was to have been supposed, it consists almost exclusively of representatives of the three great families which abound in the neotropical region; the *Chromididæ*, representing Physoclystous fishes, and the *Characinidæ* and *Siluridæ*, representing the Physostomi. The number of new species, 45 in a total of 74, constitutes a considerable addition to ichthyology, especially as the number of new generic forms is also rather large. The author adds a list of the species obtained by Robert Perkins, of Wilmington, Delaware, on a trip between the mouth of the Rio Negro and the Peruvian Amazon or Ucayale River. There are several interesting novelties in this collection, but their special localities are, unfortunately, not preserved. The specimens generally were large, and in fine condition.

BOOKS RECEIVED

ENGLISH.—A Budget of Paradoxes: A. De Morgan (Longmans).—Physics and Politics: W. Bagehot (H. S. King and Co).—Grotesque Animals: E. W. Cooke (Longmans) —Owens College Junior Course of Practical Chemistry: Roscoe and Jones (Macmillan).—The Hygiene of Air and Water: W. Procter (Hardwicke).

PAMPHLETS RECEIVED

ENGLISH.—The General Glaciation of Jar-Connaught and its Neighbourhood: Kinahan and Close.—Proceedings of the Geologists' Association, Vol. ii., No. 7.—Razi: W. Soleman.—Ninth Report of the Belfast Naturalists' Field Club.—The Curability of Cancer, 2nd edition —Introductory Lecture on Geology: E. Wilson.—The Examination Questions in Geology, with answers.—Transactions of the Institute of Engineers.—Annual Report of Vigilance Association.—A Catalogue of a Collection of Models of Ruled Surfaces, constructed by M. F. de Lagrange.—Journal of Anatomy and Physiology, No 2.—Weather Report of the Meteorological Office, January–March, 1872.—Transactions of the Clifton College Scientific Society, Part 3 —Journal of the Society of Telegraphic Engineers, No. 1.—Report of the Lower Mosely Street School Natural History Society.—Ocean Highways, Parts 1, 2.—A Table of the relative value of different Articles of Food: C. Ekin —The Advantages of Gas for cooking and heating: M. Ohren.—Twelve Months' Experience with the A.B.C. Process of Purifying Sewage: W. Crookes.—Provident Knowledge Papers, Nos. 1-12.

AMERICAN AND COLONIAL.—Canadian Naturalist, vol. iv., Nos. 9-10.—New Remedies: H. J. Wood, vol. ii., No. 2.—The Birds of Florida: C. J. Maynard, No. 1.—Proceedings of the American Philosophical Society, January-June, 1871.—Deductive and Inductive Training: B. Silliman.—The Australian Mechanic, Nos. 8 and 9.—Indiana Journal of Medicine for September.—Lippincott's Magazine for November.—Proceedings of the Asiatic Society of Bengal for August.

FOREIGN.—Sitzungsb. der geologischen Reichsanstalt zu Wien, No. 13.—Zeitschrift für Meteorologie, Nos. 20-23.—Zeitschrift für Ethnologie, No. 21.—Le Physiometre: P. Harting.—Ofversigt af kongl. Vetenskaps Akad. Forhandlinger.—Bulletin de l'Académie Royale de Belgique, Nos. 9 and 10. Sitzungsb. der k. k. Akad der Wiss. zu Wien, Nos. 24, 25.—Bulletin de la Societé de Geographie de Paris, September.

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ERRATA.—No. 150, p. 28, col. 1, line 8 from bottom, for "microscope" read "spectroscope;" col. 2, lines 16-19 from bottom, for "an absolute" read "one, absolute," and for "impossible" read "improbable."