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SCIENTIFIC WORTHIES

XVI.—RICHARD OWEN

AMONG time-honoured sayings there is none the truth of which comes more frequently home to the scientific worker than that which reminds him that a prophet is not without honour save in his own country and among his own kin. Its very truth would seem to make it short of impossible for us to take full cognisance of our own Scientific Worthies. The subject of this notice, still in hale strength, though now in full years and full of honours, is however in a very great measure an exception to the above proverb. Foreign men of science and foreign countries when they came to offer him their rewards found him already decorated. That a life abounding in labour, some of the results of which will remain as the heritage of mankind, was not undeserving of human recompense the following lines will abundantly show.

Richard Owen was born on July 20, 1804. He matriculated in the University of Edinburgh in 1824. Entering Bartholomew's Hospital the following year, he took the diploma of the Royal College of Surgeons in 1826. In 1825 he visited Paris, making the acquaintance of Baron Cuvier. On the completion of his medical studies Mr. Owen settled down to practise in Serle Street, Lincoln's Inn Fields. While at Bartholomew's Hospital he had been one of Dr. Abernethy's dissectors, and in 1828, on Dr. Abernethy's suggestion, he was employed at the College of Surgeons to make the catalogue of the Hunterian Collection in that institution. Mr. Clift was the Conservator of the College Museum at this time. The first catalogue of the invertebrate animals in spirits was published by the College in 1830, and in the following year appeared the memoir on the Pearly Nautilus (*Nautilus pompilius*), with some excellent drawings from the author's pencil.

The Zoological Society of London had been at this time in existence for some years, but up to 1830 it can scarcely be said to have had any scientific life. Some few of the then Fellows determined it should be otherwise, and after some little opposition the Council of the Society allowed the formation of a committee of science, who were further permitted to publish their own *Proceedings*. The first meeting of this committee was held on November 9, 1830, at which Owen read a paper on the anatomy of the Orang-Utan. It is not without interest to note that at the next meeting, held December 28, 1830, a letter was read from Vaughan Thompson, mentioning his discovery of a metamorphosis in Crustacea. From 1830 to the present date the contributions to the *Transactions* and the *Proceedings* of the Zoological Society of Mr. Owen have been both numerous and important, and for many years he was the unpaid prosector to the Society. He also at this period read several papers on pathological subjects before the Medical Society of St. Bartholomew's and the Medical and Chirurgical Society of London, one of the most remarkable of which was that describing the anatomical results of the ligature of the internal iliac artery, by Dr. Stevens, at Santa Cruz in 1812.

In 1834 a Chair of Comparative Anatomy was founded for Mr. Owen at St. Bartholomew's Hospital. In the year 1835 he published an account of a remarkable nematoid worm found living in the muscles of the human body (*Trichina spiralis*), and giving rise to a serious and often fatal disease called trichinosis, since, unfortunately, too well known. In 1834 he was elected a Fellow of the Royal Society, and in the same year was appointed the first Hunterian Professor at the Royal College of Surgeons. This chair he continued to fill until 1855. Mr. Owen, on succeeding his father-in-law, Mr. Clift, as Conservator of the Museum of the College of Surgeons, gradually retired from professional practice, and after a short time devoted himself exclusively to scientific pursuits. Of the thirty years during which he worked at Lincoln's Inn Fields, the last twenty were mainly spent in the study of comparative anatomy. A very rapid survey of the immense amount of work accomplished by him during this period will not be without interest. The catalogue of the physiological specimens in the Hunterian Collection consists of five quarto volumes, which were published by the Council of the College of Surgeons between 1833 and 1840. The catalogue of osteological specimens is contained in two quarto volumes published in 1853, and that of the Fossil Vertebrates and Cephalopods in three quarto volumes published in 1855.

The great work on the study of teeth was issued between 1840–1845. In preparing the drawings for this work Prof. Owen was threatened with an attack of retinitis, and was compelled to commit the further preparation of the illustrations to the excellent artists Lens Aldous and Erxleben.

The well-known Lectures on Comparative Anatomy and Physiology appeared between 1843 and 1846. After a one-and-twenty years' study of the homologies of the vertebrate skeleton, Prof. Owen's era-marking work on the "Archetype and Homologies of the Vertebrate Skeleton" was published. After having made a certain progress in comparative anatomy the evidences of a greater conformity to type, especially in the bones of the head of the vertebrate animals, than the immortal Cuvier had been willing to admit, began to enforce on Prof. Owen a re-consideration of Cuvier's conclusions to which for long he had yielded implicit assent. The results of these reconsiderations were successively communicated to the Royal College of Surgeons of England in the Course of Hunterian Lectures for 1844–45, and a sketch of his general views on the subject was laid before the British Association at Southampton in 1846. In 1849 were published the memoirs "On the Nature of Limbs," and "On Parthenogenesis." The term "parthenogenesis" was devised to replace a phrase somewhat cumbrous and incorrect, which was to this time applied to designate a phenomenon as interesting as strange.

Nor was all this sufficient for the superabundant energy of the Hunterian professor. The Palæontological Society succeeded in enlisting his services for a series of monographs of British fossil vertebrates, and during this period were published a memoir on the "Fossil Chelonian Reptiles of the Purbeck Limestones and Wealden Clays" (1853), the various supplements to which date from 1859 to 1879; "On the Fossil Reptiles of the London Clay" (1849, 1850), the portion of this memoir relating to the Chelonia was in part written by the late Prof. Bell; "On the Fossil Reptiles of the Cretaceous Formations" (1851). A remarkable series of papers on the Fossil Birds of New Zealand and on some Fossil Mammals of Australia also about this date appeared in the *Transactions* of the Zoological Society, and a very elaborate memoir on the great American Megatherium in the *Philosophical Transactions.*

But even amid a scientific activity that rivalled that of his great friend Baron Cuvier, Prof. Owen had the energy to devote some time during these thirty years to the more direct benefit of his fellow men. He was appointed one of the Commissioners to inquire into the Health of Towns. This Commission sat during 1843 and 1846. A special report from his pen on the sanitary state of his native town, Lancaster, appeared in 1848, and the improved sewage of that town with a new water supply on the unintermittent system followed. He was appointed as one of the Commissioners on the Health of the Metropolis, 1846, 1848, and again on the Commission on the Meat Supply in 1849; as the result of this latter Commission it will be remembered that the famous market at Smithfield was suppressed, and the large Cattle Market was transferred to Islington.

Prof. Owen was also one of the Commissioners for the Great Exhibition of 1851; Chairman of the Jury on Raw Animal Products applied to Food and Manufactures, and Vice-Chairman of the Jury for "Les Substances Alimentaires" in the Great Exhibition of Paris in 1855. Labours so abundant were not without reward. In 1842 the Royal Society conferred on him the Royal Medal for his memoirs on the General Economy of the Monotremes and Marsupials. In 1846 the same society decreed to him the Copley Medal. In 1851 the King of Prussia sent to him the "Ordre pour le Mérite." In 1852 her Most Gracious Majesty assigned to him a residence in Richmond Park, and in 1855 the Emperor of the French bestowed on him the cross of the "Légion d'Honneur." The old Universities of Oxford, Cambridge, and Dublin conferred on him honorary degrees. The Royal College of Surgeons of Ireland made him an Honorary Fellow, and most of the learned societies of Europe and America numbered his name on their lists of Honorary or Corresponding Members.

John Hunter had left behind him a very abiding monument of his labours, some idea of which could now be obtained from the patient labours of the first Hunterian professor; but on terminating those labours Prof. Owen bethought him of yet another way in which he could make known the thoughts and works of the founder of philosophical surgery, which was, by the publication of Hunter's original papers. Between 1793 and 1800 Mr. Clift, F.R.S., had sole charge of the Hunterian collection and manuscripts, and during this period he had copied some proportion of the latter before they were removed from the Museum in Castle Street, Leicester Square, by the executor, Sir Everard Home. A short time previous to Mr. Clift's death he placed in Prof. Owen's hands the whole of his transcripts of the Hunterian manuscripts, with an autograph statement of the important fact. These were published in two volumes in 1861, and thus, after an entombment of nearly seventy years, were added "to the common intellectual property of mankind."

Prof. Owen's connection with the Royal College of Surgeons ceased in 1856, when he was appointed Superintendent of the Department of Natural History in the British Museum. He was the Lecturer on Palæontology at the School of Mines in Jermyn Street in 1856, and Fullerian Professor of Physiology in the Royal Institution of Great Britain in 1858.

When Prof. Owen entered on his duties at the British Museum his attention was at once called to the subject of the want of space wherein to stow the rapidly-increasing natural history collections. For several years already had Dr. Gray, to whom this Museum owes so much, urgently demanded additional space. In 1851, in 1854, and again in 1856, Dr. Gray implored for more room; scarcely half of the zoological collections was exhibited to the public, and their due display, he declared, would require more than twice the space devoted to them. Numerous suggestions were made to remedy this state of things, but without avail. Even such distinguished trustees as the late Sir Roderick Murchison and Sir Philip Grey Egerton, backed though they were by a large and most influential body of scientific memorialists, were powerless to obtain the least of the additions to the British Museum which they had recommended—additions which long ere this date would have been overcrowded in their turn. The Government declined to carry into effect any alterations in the present building in Great Russell Street, preferring the alternative of a severance of the Natural History Department from the British Museum. At this juncture it seemed to Prof. Owen to be unwise and indeed even wrong to hazard the safety and utility of these collections by persisting in the advocacy of a course which was futile, and having satisfied the then Chancellor of the Exchequer of the exigencies of the case, plans were obtained for a large new museum at South Kensington which would afford a superficial space for display of the collections, systematically arranged, of about five acres. Prof. Owen's report (1859) was approved of, but a vote on account of the new building was negatived by the House of Commons. This led to the publication of a pamphlet by Prof. Owen, "On the Extent and Aims of a National Museum of Natural History," in 1862, and as a final result the Government obtained the sanction of Parliament in 1872 to the erection at South Kensington of the magnificent range of buildings there just completed, in which in process of time the whole of the natural history treasures of the British Museum will be systematically arranged.

For long the propriety of moving this collection from Great Russell Street was hotly contested, and as in other great questions the weight of authority could at one time be quoted as against the move. Scientific men are however as a rule not often to be unduly swayed even by authority and they are generally philosophical enough to accept accomplished facts. In this immense building the State has provided ample accommodation, so far as space is concerned, for the present collections and for the probable increase of these for another generation; and not content with this, there is in addition room enough for future generations if they feel inclined, to nearly double the available space, and thereby even add to the beauty and completeness of the whole structure. In the obtaining of this splendid casket in which to display Nature's gems, Prof. Owen has seen accomplished one great object of his life; and even those who think it might have been better for science had their own peculiar plans been carried into effect, will hardly grudge Prof. Owen the palm of victory which he may have won from them.

The necessary and often arduous routine work required of Prof. Owen as head of so large a department did not in any great measure diminish the extraordinary activity with which he from time to time published original works. Nearly a quarter of a century has elapsed since he entered on his duty at the British Museum, and the record of his contributions to science during this period equals, if it does not surpass, that of the previous thirty years period. Among the more important of these we must notice: Memoir on the British Fossil Reptiles of the Mesozoic Formations—Pterodactyles, 1873-1877; on the British Fossil Reptiles of the Liassic Formations—Icthyosaurs and Plesiosaurs, 1865-1870; on the British Fossil Cetacea of the Red Crag, 1870; on the Fossil Reptiles of South Africa, 1876; on the Classification and Geographical Distribution of Mammals, 1859; a Manual of Palæontology, 1861. The long list of papers published in the *Proceedings* of learned societies, to be found in the Royal Society's invaluable Catalogue (numbering over 360), includes many, the scientific value of most of which would have given an abiding fame to their author. It would be impossible here to give even a tithe of their titles, but we quote a few to show that Prof. Owen left few of the classes of the animal kingdom unnoticed:—On the Andaman Islanders; on the Anthropoid Apes; on the Aye-Aye; on the Giraffe; on the Great Anteater; on the Great Auk; on the Dodo; on the *Apteryx australis;* on *Lepidosiren annectens;* on the *Argonauta argo;* on *Spirula australis;* on Clavagella; on *Limulus polyphemus;* on Entozoa; on *Euplectella cucumer* and *E. aspergillum*.

In 1857 he was elected president of the British Association for the Advancement of Science. In 1859 he was chosen one of the eight Foreign Associates of the Institute of France (in succession to Robert Brown). The King of Italy conferred on him the "Ordre de St. Maurice and St. Lazare" in 1862. The Emperor of Brazil in 1873 gave him the Imperial Order of the Rose, while in the same year the Queen conferred on him the Order of the Bath. In 1874 the Academy of Medicine, Paris, elected him as one of their Foreign Associates in succession to Baron Liebig.

At an age when most men have to cease from their labours, the subject of this necessarily brief notice works on. No better proof could there be of a spirit still young, than to witness the energy with which he has entered on the occupation of the new home for natural history at South Kensington; and who will not join in the hope that he may live to see its treasures arranged in an orderly sequence. In this sketch we have presented Prof. Owen as one eminently qualified to take high rank among our Scientific Worthies. What niche in the temple of fame he may permanently occupy is perhaps better left to a generation removed from our own to determine. To us it would seem as if a double portion of the spirit of Cuvier had without doubt fallen upon Owen, who has raised for himself a monument of work that is truly stupendous.

INSECT VARIETY

Insect Variety: its Propagation and Distribution. Treating of the Odours, Dances, Colours, and Music in all Grasshoppers, Cicadæ, and Moths; Beetles, Leaf-Insects, Bees, and Butterflies; Bugs, Flies, and Ephemeræ; and Exhibiting the Bearing of the Science of Entomology on Geology. By A. H. Swinton, Member of the Entomological Society of London. (London, Paris, and New York: Cassell, Petter, Galpin and Co. No date.)

WHEN Mr. Darwin published his "Descent of Man" in 1871 non-entomological readers were first made acquainted with a host of interesting facts connected with the various sounds produced by insects, the different colours in the two sexes, with their corresponding senses, emotions, and habits, so far as these bore upon the question of sexual selection. As in so many other cases Mr. Darwin's volume was the means of attracting the attention of working entomologists to this interesting field of observation, which has since been assiduously worked by Dr. Fritz Müller in Brazil, while in this country Mr. Swinton has for many years devoted himself to its study, both by personal observation and by collecting together the scattered observations spread over the entire literature of entomology, the result of his labours being embodied in the present volume.

No more interesting or instructive subject could be found for a great entomological work. The author appears to have spared no pains in the collection and elaboration of his materials. The book is full of original observations, and carefully drawn tabular statements of facts. It is copiously illustrated with roughly executed but characteristic figures; and the writer is evidently a man of wide information and some literary skill. But notwithstanding all these points in its favour, the book—except as a mere collection of facts—is a disappointing one. The arrangement is frequently defective; the style is often so vague and high-flown as to be actually unintelligible; while whenever an attempt is made to generalise the facts adduced, the writer appears to have no definite views of his own, or if he has is quite unable to convey them to the reader. A few examples will serve to illustrate the several merits and defects here pointed out.

In discussing the combats of male insects as tending towards a selection of powerful males from which to continue the race, our author well remarks that the law of the prior appearance of the males subjects them also to all atmospheric and other influences, "rendering them inured to manifold terrestrial strife previous to propagating their kind." This is a good observation; but what is probably a more important function of the early appearance of the males is, that the females should not have to wait long in order to be impregnated and thus be exposed to the dangers of destruction, owing to their usually slower flight and consequent defencelessness, before their great duty of oviposition has been safely performed.

The remarkable discovery by Dr. Fritz Müller of scent-producing organs in a variety of Brazilian butterflies, is here supplemented by an account of the numerous cases in which analogous organs, often of very varied kinds, have been found in moths, though in comparatively few instances has any odour been actually detected. It may however very possibly exist even though quite imperceptible to us. Most of these organs occur in male insects only, whereas it is undoubtedly the case that the males discover the females at great distances, and we should therefore anticipate that the latter would have the scent-producing organs, the former the sense-organ capable of perceiving the odour. The investigation of this obscure subject is however still in its infancy.

Whether the antennæ are organs of touch only or of some other sense is yet undecided, but the question might probably be solved by an experimenter as ingenious and persevering as Sir John Lubbock. Mr. Swinton speaks of the male butterfly or moth "running over his partner with snuffing antennæ," but this is begging the question; and the following observation, though interesting, does not throw much additional light on the subject: "One dull afternoon on the 4th of September during the wet season of 1879 my eye was arrested by the pretty dappled wings of a female of the large Magpie Moth who was flying most purposely from leaf to leaf along a hedgerow. She successively visited a reddening bramble, a hawthorn, clematis, and guelder-rose, fruitlessly touching over their glandular surfaces with a quick alternate vibration of her black antennæ, in search, as I at first supposed, of honey-dew. The crisping foliage of a thorny sloe finally arrested her, and seemed to confer satisfaction on her tactile perception; for raising simultaneously her feelers and crawling on to the centre of a leaf, she hung on at its upper surface, elevated her wings, and by curling her abdomen round its apex, began to methodically attach her oval and shagreened eggs to the underside close to the midrib. She could distinguish Souchong from Pekoe."

The account of light-giving insects is very unsatisfactory, the old theory of the light serving as a guide and attraction to the male being the only one given. Yet in the list of luminous insects appended to the chapter we find no less than six cases recorded in which larvæ or pupæ are luminous, a fact which might surely have suggested a doubt as to the use of luminosity as a sexual attraction in the case of the glowworm and fireflies. There being so many luminous larvæ, taken in connection with the fact (not mentioned by Mr. Swinton) that glow-worms are distasteful to birds, renders it almost certain that Mr. Belt's explanation is the true one, and that luminosity is, primarily, a warning of uneatableness, and is therefore a protective character, though it may of course, like colours, serve the purpose of aiding discovery and recognition by the opposite sex.

The whole subject of colour is treated with vagueness and indecision, and we find no systematic grouping of the facts nor any firm grasp of a principle by which to interpret them. The following characteristic passage will illustrate these deficiencies:—"The attractive quality of insects' colours from the foregoing appears nearly that presented to the human eye, and, utilised in sedentary or aërial display, originates phenomena of love and rivalry, battles, dances, and gregariousness in evident parallelism with those evoked by music. But this attractive virtue, which must be considered as stimulative, does not reside especially in either sex, as some at first sight might be inclined to assert; for we find conspicuous colorisation, though for the most part distinguishing the males, sometimes by a species of inversion appearing in the females; the sexes also are often very similar in hue. And the reason of this is that the females very generally attract the eager males by sedentary display, of which the moth kind affords notable instance. Here we may remark the paler hues of many heavy Bombycina females who exhibit on herbage, and the grey, white, or satiny shades of moths that repose on tree-trunks, sexually marked in the Gipsy Moth, who is rendered in measure terrestrial by her limp wings. Others more or less apterous, like the Vapourers and Psychidæ, owe what little chromatic attraction they possess to their conspicuous cocoons."

There is hardly a sentence in this paragraph that is not open to discussion or that is not more or less inconsistent with some other sentence; while the whole is completely neutralised by the succeeding paragraph which goes on to describe how the male moths are evidently attracted to their partners by odour, and not by sight at all!

The chapter on the sounds produced by insects is crowded with interesting observations and is certainly of great value, yet here too we meet with the same looseness of remark and incapacity to see the importance of certain facts. Thus, we find the strange, and in the present state of our knowledge altogether unproved statement, that—"In Lepidoptera music is in direct relation to colour, sound to beauty;" while the fact that the *pupal* form of some Hemiptera stridulate, taken in connection with many proofs that the sound is produced under the influence of *fear*, shows that in some cases at all events these sounds are protective rather than sexual; and this opens up a field of inquiry analogous to that of the diverse uses of colour, but which our author passes over almost without remark.

Among the smaller errors and misconceptions in the volume we must note the statement that Darwin adopts the pressure theory of the formation of the bee's cell (p. 58); the total misconception of the theory of mimicry (at p. 81); and the extraordinary account of tropical colour, certainly evolved out of the writer's own consciousness. He says:—"In the Brazils, for example, all colours, whether of birds, insects, or flowers, are brilliant in the extreme. Blue, violet, orange, scarlet, and yellow are found in the richest profusion, and no pale faint tints are to be seen"! In the matters of Palæontology and glacial epochs the author's authority is Mr. Page; but the subject is evidently beyond him, for he confounds the precession of the equinoxes with the obliquity of the ecliptic, and winds up with "glacial phenomena at the poles now exposed to the continuous action of cold interstellar space, with a collapsing in the earth's superficies, giving birth to the ensuing wrinkling marked by earthquakes, volcanic action, and land depression, or *vice versâ*."

We also notice many errata, indicating some carelessness in passing the volume through the press. Dr. Falconer is called "Faulkener" (p. 15); anthropods is written for arthropods (p. 86); Leucanidæ for Lucanidæ (p. 99); Grophilus for Geophilus (p. 101); and Libuella for Libellula (p. 311); but the chief fault of the volume is a constant effort at fine writing, which, combined with an inveterate obscurity of style, often renders it utterly impossible to comprehend what is meant. Scores of passages might be quoted illustrative of this peculiarity, but the following will serve our purpose:—

"Dealing with geological chronology, the phenomena of generic and specific variation should also be applicable in explanation of certain plants and insects of constant character, being discovered confined to various geological soils within the radius of their distribution, or to favourite haunts postulating more than simple dispersion from a centre. And the pale blue of butterflies frequenting limestone and chalky downs need evoke no interference in the law of albinism if the honeyed cowslips and downy oxlips over whose leaves they flutter are, as reputed by Linnæus and Prof. Henslow, specifically identical with the shadow-seeking primrose, and may be raised from the same root. So likewise the local feature of melanism may be regarded as not only manufacturing annual varieties, but as pervading the black, brown, and drab tribes of the Alpine, Arctic, and woodland faunas, and may give a reason for their dark trait of beauty."

We give up the above in despair of extracting its meaning, if it has any; and cannot but regret that a book so full of valuable facts and good observations should be spoilt by constant efforts at philosophical disquisition, for which the tone of mind of the writer quits unfits him.

WEAPONS AND POLITICS OF THE ANCIENT HINDUS

On the Weapons, Army Organisation and Political Maxims of the Ancient Hindus, with Special Reference to Gunpowder and Firearms. By Gustav Oppert. (Madras: Higginbotham and Co.; London: Trübner and Co., 1880.)

"WHILE pursuing my researches into ancient Indian history," says Dr. Oppert, "I lighted upon two ancient Sanskrit manuscripts containing interesting information on many new and important topics. One of them, the Nītiprakā'sikā, has been, I believe, up to now utterly unknown, and the other, the 'Sukranīti, though known to exist, has never been described and published." The manuscripts relate to the weapons and military organisation of ancient India, a subject upon which fresh light was much needed. If for no other reason, therefore, they deserved to be edited and translated. But one of them at least also contains statements sufficiently novel and startling to claim for them a special hearing. If we may believe it, not only was gunpowder invented in India long before the days of Berthold Schwarz or Roger Bacon, but firearms, including both cannon and guns, were known and used. The guns were even provided with sights and flints. "The tube" of one of them, it is said in the 'Sukranīti, "is five spans long, its breech has a perpendicular and horizontal hole, at the breech and muzzle is always fixed a sesame-bead for aligning the sights. The breech has at the vent a mechanism which, carrying stone and powder, makes fire by striking. Its breech is well-wooded at the side, in the middle is a hole, an *angula* broad; after the gunpowder is placed inside, it is firmly pressed down with a ramrod. This is the small gun which ought to be carried by foot-soldiers. . . A big gun is called (that gun) which obtains the direction of the aim by moving the breech with a wedge; its end is without wood; but it is to be drawn on cars. . . . The ball is made of iron, and has either small balls in its inside or is empty." Dr. Oppert believes that the Nītiprakā'sikā also contains references to firearms, though the passages he quotes seem rather to refer to supernatural weapons or to fire-machines like those used by the Greeks of the Eastern Empire. A work, too, which mentions the Hūnās ("Huns," or Europeans) cannot be of the antiquity to which he would assign it.

Dr. Oppert seeks further support for the early use of firearms in India in a passage from a portion of the Atharvaṇarahasya, which he renders: "the fire prepared by the combination of charcoal, sulphur, and other material depends upon the skill of its maker." It is plain, however, that there is no necessary allusion to gunpowder in these words, much less to firearms. A quotation from Manu, in which fighting with "darts kindled by fire" is forbidden, is equally inconclusive.

The statements of the 'Sukranīti must therefore stand by themselves. In spite of Dr. Oppert's arguments to the contrary, it is difficult to admit that in its present form it can be earlier than the thirteenth century. The prohibition to use firearms in "fair" fighting would not account for the total absence of any reference to them in the law-books and epics and other literature of ancient India, and had they existed in the seventh century, or had the Hindus been acquainted with gunpowder at that time, we can hardly suppose that the fact would have remained unknown to the inquisitive Buddhist pilgrims from China who have left us accounts of their travels in the Peninsula. The Greek fire had nothing to do with gunpowder, and we do not therefore see why Dr. Oppert introduces it into the discussion, while there is no proof that the *manjanīk* or machine employed by Mohammed Kasim at the siege of Daibal (A.D. 711) was propelled by gunpowder. The flaming thunderbolts launched by the Indians against the army of Alexander, according to the pseudo-Aristotle, belong to the region of myth, like the storms of lightning with which Herakles and Dionysos were received when they invaded India, as related in the romance of Philostratos. Gunpowder may indeed have been invented in India, as Beckmann believed, but if so we want further evidence before we can admit that the invention was earlier than the twelfth or thirteenth century of our era.

Among other interesting points noticed by Dr. Oppert are the (ideal) rate of pay received by the officers and privates of a Hindu army at the time the Nītiprakā'sikā was composed, and the identification of Manipura, the capital of the Pāndya kings, with the modern Madura. He also points out that the boomerang is well known in many parts of India, especially in the south, and that he himself possesses four wooden ones, besides an iron one, which he obtained from Pudukoṭa. Two ivory ones, from the armoury of the late Rajah of Tanjore, are preserved in the Madras Museum. The Tamil name of the boomerang is *valai taḍai*, or "bent stick," and it is employed in hunting deer. It is one of the weapons described in the Nītiprakā'sikā under the name of *astara* or "scatterer."

OUR BOOK SHELF

Lehrbuch der organischen Qualitativen Analyse. Von Dr. Chr. Th. Barfoed. (Kopenhagen: Andr. Frest und Sohn, 1880.)

THERE is no branch of qualitative chemical analysis in such an unsatisfactory condition as that which deals with organic acids and bases. The plans on which examinations in practical chemistry are generally conducted are probably largely to blame for this unsatisfactoriness. Examiners require a knowledge of the separation and identification of organic acids, in addition to the ordinary power of analysing a mixture of inorganic substances; one day is probably considered sufficient time to devote to the examination. Candidates must make themselves acquainted with a few of the tests for organic acids; they find these in all the text-books of analysis; they repeat the tests, and manage to stumble through the examination. The truth is that the detection of organic compounds, even when but a few of these are present, is far too complex and difficult a process for repetition in the hurry and bustle of the examination-room. Were all organic compounds omitted from the examinations in practical chemistry at the leading schools of medicine and science, we have no doubt that in a few years the processes for detecting these compounds would be largely improved.

We should strongly advise all students who wish to acquire just that amount of knowledge of organic analysis which may perhaps enable them to pass an examination *not* to procure Dr. Barfoed's book, and as strongly advise all who wish to study this branch of analysis in a thorough and accurate manner to procure the book, or rather that part of it which is now published, at once. The publishers of this work announce that the book will be completed in three parts; if the second and third are as fully and accurately compiled as the first, the book will undoubtedly be the standard work of reference in the department of organic qualitative analysis.

The first part, extending to 192 pp., contains the more important acids, cellulose and starch. A full account is given of the properties and reactions of each compound so far as these are of value in qualitative analysis; methods of separation, varying according to the conditions of complexity of mixtures, are also given. The book is not arranged after the ordinary plan of the text-books of inorganic analysis; it is rather a full and accurate store of information regarding the reactions of organic compounds from which the student may select materials according to the special conditions of the problem presented to him.

The work contains no preface or indication of the ground to be covered by the completed book; judging however from the scope of the first part, the author would seem to aim at presenting a complete account of the reactions of all those commonly occurring organic compounds which can, with a fair degree of certainty, be identified by qualitative analysis.

A Synopsis of Elementary Results in Pure and Applied Mathematics; containing Propositions, Formulæ, and Methods of Analysis, with Abridged Demonstrations. By G. S. Carr, B.A. Vol. i. Pp. xxiv. 256. (London: C. Hodgson and Son, 1880.)

We shall not enter upon any discussion as to the utility or inutility of such a work as the present, but simply confine ourselves to an account of its contents. It is not a work of yesterday, for the author tells us that it is compiled from notes "made at various periods of the last fourteen years, and chiefly during the engagements of teaching." Mr. Carr's chief aim has been so to arrange his matter that the student may be assisted in the revision of bookwork, hence he generally confines himself to indicating the main features of a proof or to a mere reference to the theorems by which the proposition is proved. To aid in this end he has employed a system of cross-references, each article being numbered progressively in "large clarendon figures." A feature to which the author rightly draws attention is the compression he has attained without sacrificing clearness in his "last section, in which in the space of twenty-four pages are contained more than the number of propositions usually given in treatises on geometrical conics," together with clear large figures, and in most cases the demonstrations. This, we think, he has done well. This first part he divides into seven sections. The first contains a large collection of mathematical tables (Factor Tables, Values of the Gamma-function, and many other useful and frequently-recurring constants), in addition to an introduction on the C.G.S. system of units. Algebra is treated of in articles 1-380; Theory of Equations, 400-593; Plane Trigonometry, 600-859; Spherical Trigonometry, 870-910; Elementary Geometry, 920-1099; Geometrical Conics, 1151-1267. It will be seen from the above numbering that there are breaks; these have been "purposely made in order to leave room for the insertion of additional matter, if it should be required in a future edition, without disturbing the original numbers and references." It is obvious to object here that the new matter may not fit into the plan adopted in this edition.

Owing to causes which Mr. Carr names, the earlier part of his work contains a rather long list of errata; most of these are pointed out, but not all. The utility of such a work greatly depends upon its reliability for purposes of reference, and our confidence is somewhat shaken when, on opening the work casually, as we did at p. 6, we find "$\log_{10}\pi = 1{\cdot}4971499$, $\log_e\pi = 0{\cdot}6679358$," and this not corrected elsewhere.

Having carefully read the whole of the text, we can say that Mr. Carr has embodied in his book all the most useful propositions in the above subjects, and besides has given many others which do not so frequently turn up in the course of study. The work is printed in a good bold type on good paper, and the figures are admirably drawn.

Estudio Micrográfico ne Algunos Basaltos de Cuidad-Real. Par Don Francisco Quiroga. (Madrid, 1880.)

In this memoir the author gives an account of the microscopic characters exhibited by the basalts of the volcanic district of the Campos de Calatrava, which basalts he shows to have been erupted in Tertiary times. These rocks appear to belong to Dr. Boricky's classes of the Nepheline-basalts and the Nephelinitoid-basalts, in the former of which the nepheline is fully crystallised, while in the latter it exists as a glassy base in which crystals are beginning to make their appearance. The primary minerals of these rocks are nepheline, augite, magnetite, and olivine, which may be regarded as their essential constituents, and apatite and hornblende, which the author regards as accessory or accidental constituents. The secondary or derivative minerals are kaholite, hinsuite, and hematite, magnetite, serpentine, and aragonite. The memoir is illustrated by a coloured plate of rock-sections.

Il Binomio di Newton. Per Ignazio Cameletti. 7 pp. (Genova, 1880.)

By performing the successive multiplications and writing, after the following fashion—

$$\begin{array}{rcll} (1+x)^m & = & 1 + x & (m = 1 \\ & & \overline{x + x^2} & m = 2 \\ & & \overline{\begin{array}{r} x + x^2 \\ x^2 + x^3 \end{array}} & m = 3, \\ & & \overline{} & \end{array}$$

and so on, the author succeeds in an ingenious manner, by summation of simple series, in getting the successive coefficients of the general expansion, and so proves his theorem, which is—

$$(a+b)^m = a^m + \Sigma_{p=1}^{p=m} \frac{m(m-1)\ldots(m-p+1)}{1 \, . \, 2 \, . \, . \, . \, . \, p} a^{m-p} b^p$$

or the Binomial Theorem of Newton without having recourse to the doctrine of combinations.

LETTERS TO THE EDITOR

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

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

Photograph of the Nebula in Orion

DURING the night of September 30 I succeeded in photographing the bright part of the nebula in Orion in the vicinity of the trapezium. The photographs show the mottled appearance of this region distinctly. I intend shortly to publish a detailed description of the negatives. They were taken by the aid of a triple objective of eleven inches aperture made by Alvan Clark and Sons, and corrected especially for the photographic rays. The equatorial stand and driving-clock I constructed myself. The exposure was fifty minutes. HENRY DRAPER

New York, October 2

An Annelidan Entozoon

WHILE examining the intestinal tract of *Megaderma frons* from the Gold Coast, I found coiled up spirally and adhering to the wall of the lower part of the ileum a small parasite about half an inch in length. On placing this under the microscope I was much surprised to find that it belonged to a class of worms (*Annelida*), none of the species of which have hitherto been known as Entozoa, and further that I was unable to refer it to any of the orders of that class.

On showing it to Dr. J. D. Macdonald, F.R.S., he quite agreed with my opinion that it represents a new order of Annelids, and is moreover disposed to consider it as a connecting-link, hitherto wanting, between the *Chætopoda* and the true leeches.

The specimen in question is about half an inch in length without distinct segmentation, except what is indicated by the perfectly regular disposition of the cephalo-somatic appendages—seventy-three pairs, extending from the anterior almost to the posterior extremity of the body—whereof those occupying the anterior attenuated fourth of the body are fin-like lamellæ, apparently branchial, with a single unarmed mouth not provided with a proboscis, with the intestine spirally coiled round the ovarian tube and terminating inferiorly at the posterior extremity of the body.

Megaderma frons, the host of this remarkable annelid, is a species of bat of very peculiar aspect, which is apparently widely distributed throughout and restricted to the tropical parts of the Ethiopian region. It belongs to a genus whereof one of the species at least is known to suck the blood of smaller bats, which it captures on the wing (see my "Monograph of the Asiatic Chiroptera," p. 77), and as all the species closely resemble one another in structure, it is exceedingly probable that they have all much the same habits.

Although I found remains of insects in the intestinal canal of the specimen from which the above-noticed parasite was taken, yet there was also mixed up with them a large quantity of hair, not from its own body, but evidently (judging from its microscopic structure) that of some other bat on which very likely it had been feeding. It is also worthy of notice that the intestine of the parasite is filled with a reddish matter like the remains of blood.

I have handed over this very interesting specimen to Dr. Macdonald, who will shortly publish a full description of it with figures. G. E. DOBSON

Royal Victoria Hospital, Netley, October 7

Sounds made by Ants

FROM the very interesting remarks lately made by Sir John Lubbock regarding the habits and capabilities of ants, I gather that he seems to consider them as a silent group. The modes of producing sounds among insects are as various as beautiful, whether by internal or external agency. As a rule the larger animals produce sound by internal means, *i.e.* voice, and insects by some external means.

Among ants I know of two varieties or distinct kinds, a black and brown, that make a concerted noise loud enough to be heard by a human being at twenty or thirty feet distance, and which sound is produced by each ant scraping the horny apex of the abdomen three times in rapid succession on the dry crisp leaves of which the nest is usually composed.

The noise made by a single ant is sufficiently loud to be heard on a very dry leaf if attention is directed to it, and no doubt by this means of a vibrating medium they can without special auditory organs communicate with each other. I had the honour of first discovering that the great *Mygale stridulans* made a noise; the apparatus by which it was produced was discovered and fully described by Mr. J. Wood Mason of the Indian Museum, and I should be glad if I am the means of making a similar discovery regarding ants. White ants (so-called) make a noise which is audible—if put on crisp paper—by suddenly shaking the whole body, and seem to warn each other by this means.

Sapakati, Sibsagor, Asam, August 20 S. E. PEAL

Faraday Exhibiting Ghosts

MR. J. INNES ROGERS' communication on a "Spectre of the Brocken at home" reminds me of a passage in Dr. Bence Jones's "Memoir of Faraday," vol. i. p. 422.

Faraday's niece, Miss Reid, thus writes: "One evening a thick white mist rose and completely hid everything before us. About ten o'clock my uncle called me into his room to see a spectre. He placed the candle behind us as we stood at the window, and there, opposite to us, appeared two gigantic shadowy beings, who imitated every movement that we made."

Ardchapel, N.B., October 16 W. S.

Ice under Pressure

IN reply to C. A. M.'s letter of last week I would make the following remarks:—Ice is not an exceptional substance, for mercuric chloride has also given experimentally the same results, and though I have not yet had the opportunity of submitting other substances to the same conditions, yet I conclude from other experiments that all the bodies which I have so far investigated, and which are of the most varied description, will also exhibit the same phenomenon. As I have not yet published my detailed results, I do not wish at present to enter more fully into the subject, but I may say that the influence of pressure in the present case is not of the same kind as that referred to by C. A. M. as occurring in the text-book named, for the following amongst other reasons. From Prof. Thompson's prediction and Sir Wm. Thomson's experiments it resulted that the melting-point of ice is lowered by pressure, and lowered in proportion to the pressure, whereas in my experiments, at any rate so far as I have at present seen, we do not *vary* the melting-point by diminishing the pressure, but we prevent the substance from melting at all. If the pressure be increased even but slightly above the critical pressure, the ice melts at its ordinary melting-point. The influence of pressure in this case is not one of degree varying with the amount by which the pressure is reduced. The two cases are, I consider, entirely different, and are not contradictions. Similar remarks would probably apply to paraffin and spermaceti, though these are bodies which have not come within the range of my experiments.

Firth College, Sheffield, October 6 THOS. CARNELLEY

A Peat Bed in the Drift at Oldham

IN NATURE, vol. xxii. p. 460, there is a letter by Mr. Jas. Nield, giving an interesting description of unique, or nearly unique, appearances in the boulder clay near Oldham. It appears that this glacial deposit has one or more beds of peat, or fragments of peat, intercalated along with it at various depths, leading to the inference that the clay had been stirred up and the fragments of peat had in some manner been mixed with it. That peat bogs, or surface black peaty mould, had existed at no great distance is a conclusion forced upon us, and that the action of ice and snow, probably during a submergence, had mashed up the clay and distributed the peat amongst it. The boulder clay, and the scratched mountain sides, and the travelled fragments of rock, do not extend over the whole of England. It used to be said by geologists that the effects of a severe Arctic climate could not be detected south of a line drawn across the country from London to Bristol; by which it was inferred that all the land north of that line had been under water, subject to the influences of snow and floating icebergs, and all the country south of it above water and clear of those influences. Since then the large granite boulder on the shore of Barnstaple Bay, estimated to weigh ten tons, has been brought more prominently under our notice by Mr. W. Pengelly (*Trans.* Dev. Assoc. vi. 211), and several others by Mr. T. M. Hall (*Id.* xi. 429), discovered by excavation. All these are travelled blocks, and probably ice-borne. Many attempts have been made by ardent and intelligent students of late years to detect proofs of glacial action further south, and even to the shores of the British Channel, but hitherto with doubtful success. There lies on the greensand of Haldon, near Exeter, and on the Blackdown Hills, stretching away towards the south-east corner of the county of Devon, a stratum of tough yellow clay full of white flints, mostly angular. About Haldon and eastward over Pitminster and Churchstanton, many white quartz rounded pebbles, foreign to the accompanying beds, are met with. Farther south, between Honiton and the sea, this stratum of flints and clay in some places is seen to be from forty to fifty feet thick, and the best section of it is in the gravel pits near the cliff on Peak Hill, on the west of Sidmouth. By some persons this deposit has been regarded as the thinned-out edge of the plastic clay formation, containing the remaining flints of the washed-out chalk, still found more perfect at Beer Head, a few miles east. Whether it was this, or whether it was a boulder clay, so called, it is well to remark that, though thickest on the flat tops of the hills, it seems to lap down over their sides, as if it had been deposited after the valleys and the elevations had come to their present conformation; and at two places at least to be visible in the valley of Sidmouth—one under the great blocks of breccia in the orchard near the brook on the Boomer or Boughmoor Estate, and the other on a subordinate hill in a grass field, at about 200 yards from Jenny Pine's Corner, walking down the new road towards Cotmaton, and on the right-hand side. Most of this latter patch of clay and flints was dug away two or three years ago to assist in forming the new road.

When engaged in making certain trenches and excavations on the top of Salcombe Hill in 1879 for archæological purposes (see *Proceedings* Soc. Antiq. Lon. viii. 209) it appeared that the yellow clay, to the depth of two or three feet, was not so much encumbered with flints as deeper down. But whilst thus engaged, what struck me as rather strange was that numerous fragments of black peat were more or less generally but irregularly distributed through the upper two feet; and bearing in mind Mr. Nield's letter, I have in my foregoing remarks been trying to lead up to this point. The cases may not be similar, but they are worth comparing. The land on the top of the hill at this place still bears its wild growth of heath and furze, and has never been subjected to the plough or to cultivation of any sort; so that the clay has not been disturbed by the hand of man. It is too soon to say that this capping of clay and flints is of glacial origin; but some of the indications that have suggested the idea may be observed in the section in the gravel pits on Peak Hill, especially when fresh dug down. They are: (1) that no horizontal bedding is visible, as there would be if the deposit had been made in a large body of undisturbed water; (2) That, on the contrary, waving and distorted lines are sometimes very plain, one instance of which I carefully sketched and coloured in January, 1875; (3) and that the long axes of the embedded flints do not as a rule lie horizontally, as they would necessarily do if they had settled at the bottom of a sea or pond, just as an egg will lie on its side, and not on its point, but they are distributed through the soft mass at all angles, as raisins lie in a pudding that has been kneaded up together.

My object in this communication has been merely to compare the case of the peat mixed with the clay on Salcombe Hill with the somewhat similar case occurring near Oldham.

P. O. HUTCHINSON

Old Chancel, Sidmouth, Devon, October 4

IN NATURE, vol. xxii. p. 511, I find a letter from Mr. G. H. Morton, in which he expresses an opinion contrary to that expressed by me (vol. xxii. p. 460), as to the age of the "peat bed in the drift of Oldham." The section therein alluded to is fairly described by him, but I am surprised that he should for an instant entertain the belief that the clay "has simply slipped down off the sand on to the surface of the peat at a lower level." Had the clay slipped down we ought to have been able to see some indications of the conjectured displacement. Let me say, however, that during my repeated visits to the place and my examinations of the section I have utterly failed to perceive any trace of such indications, and, moreover, I do not remember that one person out of some scores who have in presence of the section pointed out to me the slightest appearance of disturbance. There is not a broken or crumpled line in the whole section.

The peat bed, and indeed the whole of the section, is now, I am sorry to say, covered up; but in and about Oldham we have a large area covered by what I believe to be typical beds of the "Middle" and the bottom of the Upper Drift—alternations of gravel, pebbles, fine and coarse sand, the latter showing lines of "current bedding," and occasionally clay with boulders—in which many similar sections, but wanting in the peat, of course, may be seen, and in which the position and surroundings of the beds quite forbid the possibility of "slipping." The idea of the upper clay "having been excavated and thrown down" is, I think, too improbable to be seriously entertained, seeing that the surface-soil and subsoil on the top of it are of the usual thickness common to the neighbourhood.

The "blue silt" alluded to by Mr. Morton as giving strength to his suspicions, I can assure him is one of the supports upon which I rest my opinion that there has been no disturbance. Do I understand him to mean that the silt is the result of the washings of some passing stream? If so, let me recommend him to visit the railway cutting across the large peat bog a few miles from here, and known as the "Ashton Moss," where he will find, at the bottom of a bed of recent peat, of from two to three yards in thickness, a thicker, but in every other respect a similar band of blue silt, upon which the peat rests throughout the length of the whole cutting. This silt seems to have its equivalent in the "floor clay" which accompanies our seams of coal. I believe that the removal of so much of the peat bed and drift deposits from the face of the excavation as has already taken place has served all the purposes of the "few hours digging at a right angle to the present exposure," suggested by Mr. Morton.

Perhaps a more complete acquaintance with the Oldham drift beds would bring Mr. Morton nearer to my way of thinking. I shall be glad to see him here again, and to assist him in making a wider, and more thorough examination of them.

29, Radclyffe Street, Oldham, October 7 JAMES NIELD

Temperature of the Breath

MR. MCNALLY has, it appears to me, missed the point of my observations on this subject.

His own experiments, though they show a temperature obtained by breathing on a thermometer through silk, wool, and linen, considerably above the accepted temperature of the breath, are by no means an exact repetition of mine. He only breathed through four folds of the material for three minutes. I breathed through a much greater amount of material and for a longer time, viz., twenty to thirty folds tightly encircling the thermometer bulb for five minutes.

The temperatures I obtained were very much higher than those observed by your correspondent. Thus on a warm summer day the temperature obtained on rising in the morning before dressing and before eating was 106°. In the afternoon, after playing a game of golf, when returning home by rail with all the windows open, the temperature observed was 107°. The same day, after dinner (without alcoholic stimulants), the thermometer rose to 108° when breathed on in the way described. The temperature of the air that day averaged 70°. Since then I have not obtained a higher temperature than 107°·5.

These temperatures were obtained by breathing through a silk pocket-handkerchief tightly rolled round the thermometer, but I have obtained temperatures nearly as high when the thermometer was wrapped up in cotton or woollen stuff.

Mr. McNally asserts that the explanation suggested by my friend that the high temperature thus obtained was owing to the heat evolved by the condensation of the aqueous vapour contained in the breath is "undoubtedly correct," but he gives no answer to the obvious objection to this explanation, viz., that if the real temperature of the breath be, as stated in physiological works, 95° to 97°, condensation of the aqueous vapour in it would only take place as long as the material through which it is propelled was of lower temperature than the breath. When the material attained a higher temperature than 97° the aqueous vapour, in place of being condensed, and thus evolving heat, would be still further evaporated, and hence be a cause of reduction of temperature.

The fact that woollen clothing prevents chill after exercise has no bearing on the subject of the high temperatures obtained by breathing through woven material on the bulb of a thermometer, for no one has yet observed that woollen clothing will develop a heat greater than that of the body it covers, viz., 98°·5.

The hygroscopic properties of different materials afford no explanation of the phenomena, for the power of materials to imbibe moisture will not account for an increase of their temperature by breathing through them.

My speculations may be right or wrong; Mr. McNally has not shown them to be either. My facts are not the less true from being incompatible with "ascertained physiological truths," for ascertained physiological truths are only true so long as they are not controverted by other ascertained physiological truths.

My experiments show that the temperature obtained by breathing on the thermometer in the manner described is higher when less caloric is abstracted from the surface of the body, lower when the surface of the body is losing more caloric. Thus on a warm summer day my breath raised the thermometer to 108°, whereas to-day (a cold wet day) it only raised the thermometer up to 103°. Does not this seem to show that respiration is a means of getting rid of the superfluous caloric generated in the body, and that when this excess of caloric cannot be got rid of by the skin it passes off by the breath? R. E. DUDGEON

October 9

Selenium

As the only chance of being able to transmit images of reflection through a conducting wire, in the way sound is repeated to a distance by telephone, appears to lie in the preparation of a fairly transparent sheet of metallic selenium; it may tend to advance the subject if the difficulties experienced in dealing with this substance are mentioned.

Selenium in its vitreous condition melts about 220° Fahrenheit, and can be drawn out between mica plates over a lamp, to a thin transparent red film. But heated for some time it turns black and granular, apparently absorbing hydrogen, then melts only at 423° F., and is brittle and intractable. Unfortunately it is only in this crystalline state that its power of conducting electricity appears, and varies with the light under which the selenium is placed.

Prepared in the mass, electrically conducting selenium is as compact as the hardest gas carbon, with the shiny appearance and surface of graphite. How to reduce such a substance to any degree of transparency is perplexing. By reducing it to fine powder, and subjecting the black selenium to severe hydraulic pressure between hot polished steel plates, the desired effect might be produced. Selenium also dissolves freely in chloride of selenium, Se_2Cl_2, and precipitates slowly in a botyroidal mass of black selenium. It also separates in the crystalline form from concentrated solutions of selenide of potassium or sodium.

There is some uncertainty as to whether a transparent sheet could be more easily obtained by the method of precipitation, than by mere mechanical treatment. But the investigation is one that requires to be carried out with the aid of a fully equipped laboratory, and is beyond the power of an ordinary experimentalist.

To devise a successful mode of making a black substance like graphite at all translucent, requires a distinct understanding of the reason why bodies are opaque. Something more than an explanation in general terms is needed before camera pictures can be resolved into electric currents, and again integrated upon a receiving plate.

Perhaps some of the readers of NATURE may be able to suggest a method of dealing with selenium that will produce thin transparent sheets capable of conducting electricity.

London, October 16 A. T. F.

Dynastes Hercules

THE reviewer of Ober's "Camps in the Caribbees" (NATURE, vol. xxii. p. 216) appears to doubt the story of the habits of the large Hercules beetle, *Dynastes hercules*, given by Ober on the authority of his guide. It is nevertheless perfectly true, and I have myself witnessed the occurrence twice in this neighbourhood, where the beetle is not uncommon. In the first instance I noticed it on a branch of *Ochroma lagopus*, and the second time on a species of *Bombax*, both very soft-wooded trees. The branches in each case were about three-quarters of an inch in diameter, half an inch being formed by the wood. In both cases I saw the performance of the animal most distinctly, just as described by Ober's guide, and I took not only a piece of the severed branch with me, but secured also the second animal. The noise is not so much produced by the cutting of the branch as by the open wings passing rapidly through the air during the rotation of the beetle. I do not believe there is anything of a sexual call in the manœuvre. The beetle wants to get at the abundant juice of the young branches. It is called in this country *aserrador, i.e. sawyer*. *Golofa porteri*, an allied insect of the same family as Lamellicornes, behaves in a similar way, but chooses of course thinner branches. A. ERNST

Carácas September 9

What is Alrese?

IN the large *Encyclopédie* published by Diderot and d'Alembert, vol. xii. p. 224 (edit. in folio) there is mentioned amongst the substances used for poisoning water to catch the fish, *l'herbe qu'on appelle l'*ALRESE. Littré has no such word, nor anything like it, nor indeed any other lexicographer I am able to consult here. I should be much obliged for any information on this name, or the plant referred to. A. ERNST

Carácas, September 9

Rainfall of Sierra Leone

As I believe there is little account taken of this climate at home, and as perhaps it might interest you, I send you an account of one day's rainfall this month, which is an excessive amount even for Freetown, and equal to one-third the whole year's rainfall for Dublin, I believe:—

Rainfall registered in the Colonial Hospital, Freetown, 50 feet above Sea-level

	Inches.
From 6 a.m. to 4 p.m. September 11	6·35
From 4 p.m. to 6 a.m. September 12	4·05
Total in 24 hours	10·4

Garrison House, Freetown, September 16 W. HUME HART, Colonial Surgeon

An Octopus

I INCLOSE an account of an enormous octopus which was thrown on the shore at Kilkee, Co. Clare, in the last great storm. As strangers find my uncle's hand very hard to read, I have copied his letter.

Ardanoir Foynes C. G. O'BRIEN

"*Saturday, October* 9, 1880

"I am sorry you were not at Kilkee when a great octopus was stranded on the side of the Duggerna reef on Thursday last. Its arms had been partially broken: there were eight of them, each as thick as a strong man's upper arm, and beneath each were two rows of suckers like cupping-glasses, more than a shilling size in circuit. When perfect, each of these arms must have been from twelve to fifteen feet long, and from the point of one arm to that of its opposite was a length of nearly thirty feet. The animal's length from the insertion of its suckers to the end of its body must have been nearly twenty feet, perhaps more. Its mouth, like a parrot's beak, was as large as two joined hands of a large man with the fingers outstretched. It weighed about 4 cwt. Its head was 1½ inch in diameter, about three feet long; its eyes of the size of the inner circuit of a breakfast-plate. A monster. The under colour that of the under side of a turbot." —(*From a letter of the* Rev. R. J. GABBETT.)

SYNTHESIS OF CITRIC ACID

AS we intimated last week, another brilliant synthesis has recently been accomplished in the domain of organic chemistry. Messrs. Grimaux and Adam have succeeded in building up the characteristic acid of lemons from glycerin. Glycerin may be regarded as trihydroxypropane, $C_3H_5(OH)_3$, and citric acid as hydroxypropanetricarboxyllic acid, $C_3H_4(OH)(CO_2H)_3$. To convert glycerin into citric acid it was therefore necessary to replace two hydroxyl groups, and one hydrogen atom, by the group CO_2H (carboxyl). This was done as follows:—By the action of hydrochloric acid on glycerin, dichlorhydrin,

$$CH_2Cl-CH(OH)-CH_2Cl$$

was produced; this was oxidised by potassium dichromate and sulphuric acid, to dichloracetone,

$$CH_2Cl-CO-CH_2Cl,$$

which, when acted on by concentrated hydrocyanic acid, yielded dichloracetone cyanhydrin,

$$CH_2Cl-\underset{OH}{\underset{|}{C}}\left\langle\begin{matrix}CN\\CH_2Cl\end{matrix}\right.$$

The acid corresponding to this cyanhydrin having been produced by saponifying with hydrochloric acid, the sodium salt of this acid, viz.,

$$CH_2Cl-\underset{OH}{\underset{|}{C}}\left\langle\begin{matrix}CO_2H\\CH_2Cl\end{matrix}\right.,$$

was treated with potassium cyanide, whereby a dicyanide,

$$CH_2CN-\underset{OH}{\underset{|}{C}}\left\langle\begin{matrix}CO_2H\\CH_2.CN\end{matrix}\right.$$

was produced. When decomposed by hydrochloric acid, this dicyanide yielded citric acid, in all respects identical with that obtained from the lemon and other fruits. The generally accepted structural formula for citric acid, viz.,

$$CH_2.CO_2H-\underset{OH}{\underset{|}{C}}\left\langle\begin{matrix}CO_2H\\CH_2.CO_2H\end{matrix}\right.$$

is confirmed by the synthesis of Grimaux and Adam. Glycerin may be prepared from trichlorhydrin,

$$CH_2Cl-CHCl-CH_2Cl,$$

which is itself obtained by the action of chlorine in daylight on propylenic chloride,

$$CH_3-CHCl-CH_2Cl,$$

one of the products of the chlorination of propylene, C_3H_6. Finally this hydrocarbon, propylene, may be produced by passing a mixture of carbon monoxide and marsh gas through a red-hot tube. Inasmuch as carbon monoxide and marsh gas are easily built up from carbon, hydrogen, and oxygen, the synthesis of citric acid from these three elements is now an accomplished fact.

In connection with this synthesis, it is worthy of remark that in the last number of the Berlin *Berichte*, Kekulé announces that he has been working at the same subject, but by a totally different method. Kekulé's work is not sufficiently advanced for him to say positively that his method of synthesis is successful, but he feels justified in saying that very probably the process adopted by him has resulted in the formation of citric acid.

M. M. P. M.

PLANTS FROM LAKE NYASSA AND LAKE TANGANYIKA

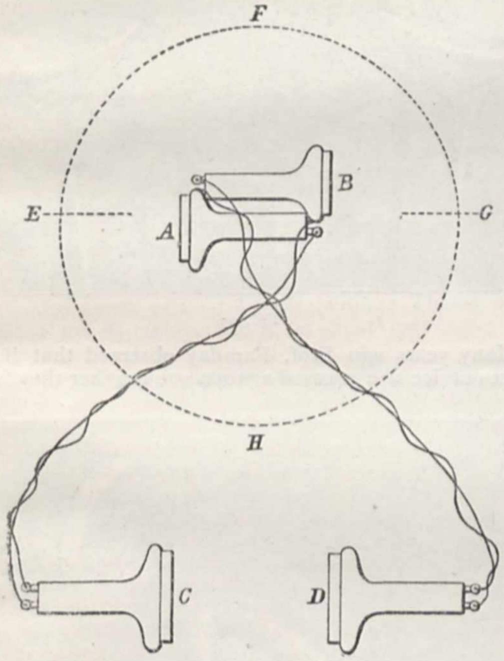
MR. THOMSON, who has recently returned from the expedition of the Royal Geographical Society to Central Africa, has brought to Kew a considerable collection of plants from the plateaux round Lake Nyassa and Lake Tanganyika. The plants from an elevation of 6,000 to 8,000 feet above sea-level contain a large proportion of Cape and characteristically temperate types. Amongst the former are the well-known *Dierama* (*Sparaxis*) *pendula*, *Scilla rigidifolia*, *Buphane toxicaria* (the great poison bulb of Natal and the Transvaal), a fine *Moræa* with a long tube and bright purple flowers as large as those of *Iris fœtidissima*, a *Gladiolus*, a *Pelargonium*, more than one species of *Gnidia* and *Helichrysum*, and a proteaceous shrub (probably *Faurea*, which extends to Abyssynia) with large heads of flowers. Of characteristically temperate types there are species of *Geranium*, *Rumex*, *Cerastium*, *Coalamintha*, and a *Scabiosa*, perhaps identical with our European and English *S. Columbariæ*. Upon the plateaux below 6,000 feet the vegetation assumes a sub-tropical character. Here he met with a tree-fern of the genus *Cyathea*, *Agauria salicifolia*, Hook, fil, an ericaceous shrub common to Bourbon, Madagascar, and the Cameroons, representatives of *Mimulopsis*, *Hibiscus*, *Clematis*, *Phyllanthus*, *Gerbera*, *Smithia*, *Acalypha*, *Pentas*, *Thunbergia*, *Buchnera*, *Striga*, a shrubby *Spermacoce*, a curious *Loranthus* with broad leaves and tubular flowers densely clothed with yellow hairs, *Hypoxis Villosa*, several fine Dombeyas, Vernonias, and Combretums, a genus of *Hedysareæ* with flowers in heads like those of the hop, and a curious broad-leaved *Euphorbia*, with very large hand-like glands to the involucre. The specimens are well selected and excellently dried. It is probable that nearly all of them are in a condition in which their botanical position can be settled, and that although upon a hasty glance there do not seem to be any strongly-marked new generic types, a good many of the species will prove new to science. The marked northern extension of the Cape flora at comparatively high elevations in Central Africa is a fact of importance. It quite supports the theory that that flora is of great antiquity, and that what exists of it at the Cape is only a survival from a period when it was probably far more extensively diffused, though perhaps less highly specialised. It is much to be desired that travellers in Central Africa would do all in their power to collect dried specimens of the vegetation of elevations above 6,000 feet.

GRAHAM BELL'S EXPERIMENTS IN BINAURAL AUDITION

PROF. GRAHAM BELL has published in the *American* (quarterly) *Journal of Otology* a memoir on some experiments relating to binaural audition, read by him last autumn at the session of the American Association for the Advancement of Science. Some of his observations confirm the work of previous observers, but are of additional value in affording a more systematic examination of some of the phenomena than has hitherto been attempted. The following summary of the results obtained by him will therefore be of some interest.

When we close one ear and listen to sounds through the other only, there seems to be a onesidedness about them, as there is about objects perceived by one eye. When both ears are employed simultaneously a sort of stereoscopic effect of audition is perceived. Sounds assume a "solidity" which was not perceptible so long as one ear alone was employed. The difference between *monaural* and *binaural* audition is especially well marked when we attempt to decide by ear the *locality* of a particular sound. Whatever power a single ear may possess of determining the direction of a source of sound, both ears are certainly much more effective for this purpose.

The following experiment, designed to produce artificially the stereophonic phenomena of binaural audition, was therefore devised by Prof. Bell while in this country in 1878. Four telephones were arranged, as in the figure. The telephones A and B in one room; C and D in another. The mouthpieces of A and B were turned away from one another like the auricles of a person's ears, and the diaphragms were about as far apart as the tympana of the two ears. The expectation was that a person holding C and D to his ears should not simply hear speech when any one was talking near A and B, but that he should be able to perceive the *direction* of the speaker's voice relatively to A and B. In fact, the listener's ears were, as it were, electrically prolonged to A and B respectively. The sensations produced were decidedly novel; but not exactly such as had been expected. Using various sources of sound—speaking, ringing a loud dinner-bell in various parts of the room, &c.—it was found that the location of the sound could be determined to a limited extent. The general result was as follows: imagine a globe, E, F, G, H, in the interior of which are the telephones A and B; let E and G be the two poles, and imagine the usual meridian lines and parallels of latitude. It was found as the result of the experiments that the observer at C, D could determine with tolerable accuracy the *latitude* of a sound made near A, B, but that *he had no idea whatever of its longitude.* In a later experiment two Blake transmitters were employed. They were placed back to back at about five feet from the ground in the open air. The receiving telephones were indoors, whence the speaker could be observed. The results of observation coincided with those already described. In order more closely to imitate the natural arrangement of the ears the transmitters were then set so that the diaphragms were at 45° to each other. A sound made at H here produced a feebler effect than one made at F; and *after a few experiments* the ear seemed to be able to distinguish whether the speaker were in front of, or behind the transmitters. Unfortunately the two transmitters were not equally sensitive, and the ear had to get accustomed to the slight inequality in the intensity



of the transmitted sounds. Prof. Bell suggests that the sensations experienced by deaf persons might be studied by persons possessed of normal hearing powers by purposely using transmitters of unequal power, or by introducing artificial resistances into the circuits.

It also occurred to Prof. Bell that the telephone might afford a means of ascertaining to what degree the human ear normally has the power of appreciating the *direction* of sound. For this purpose a number of telephones were hung up in different parts of a summer-house, and were connected with a switch-board so that an interrupted current from a rheotome in a distant place could be sent through any one at will. A person stationed at the middle of the summer-house, with his eyes closed, and holding his head perfectly still, was required to indicate the point from which the sound seemed to emanate. The indicated direction usually differed considerably from the true direction, and it was found that the observer soon came to recognise each individual telephone by its particular timbre. To obviate this a single telephone was hung up in different parts of the summer-house during the absence of the observer. This was very laborious; nevertheless a long series of experiments were carried out, and their results carefully set down in a series of eight tables. Five young men were employed as observers, the power of each of their ears being previously ascertained by an independent test. The experiments thus carefully made and tabulated are still too few, and in Prof. Bell's opinion too imperfect in several respects, to admit of accurate generalisation; but some deductions are unmistakable. The tables establish beyond dispute (*a*) that the perception of the direction of a source of sound is less perfect by a single ear than by both ears; (*b*) they disprove the idea that direction cannot be appreciated by monaural observation; (*c*) they show that the direction of sound is more accurately defined as it approximates to the axial line of the ears [this entirely negatives Steinhäuser's theory of binaural audition]; (*d*) that the indications are proportionately at fault as the true source is in any other direction, the angular error sometimes amounting to 180° when the source is 90° from the axial line! (*e*) the perception of direction is absolutely unreliable when the source of sound is at the nadir with respect to the observer. It should however be remembered that in experiments thus made in an apartment reflexion of the sound comes into play, and partially vitiates any general deductions by introducing slight though unknown complications.

The method adopted by Prof. Bell to measure the relative hearing power of the separate ears was as follows:—Two flat coils of wire were placed upon a long wooden rod which passed through their centres. One of these coils, the "primary," was a fixture, and was put in circuit with a battery and a vibrating interrupter in a distant room. The other coil, the "secondary," was joined up to a telephone. When placed close to the primary the induced current produced loud sounds; the observer, holding the telephone to his ear, was then directed to slide the secondary coil away from the primary until he ceased to hear anything. The distance between the two coils was then measured. It will be seen that this arrangement anticipated to some extent the sonometer of Prof. Hughes.

We venture to hope that Prof. Bell will continue these interesting researches in this promising, and hitherto almost unexplored field.

S. P. T.

THE GEOLOGY OF THE LIBYAN DESERT[1]

IN his very interesting anniversary address before the Academy of Sciences in Munich Dr. Zittel has brought together all the known facts concerning the geology of the northern districts of Africa, in a manner which is calculated to render the greatest service to his fellow-workers in science. The address, with its accompanying map and numerous explanatory notes, constitutes indeed by far the best monograph on North African geology which has yet appeared. The author not only reviews the works of the various travellers who have furnished materials bearing upon the question, from Browne and Hornemann to Fraas, Rohlfs, and Schweinfurth, but what is of far more importance, gives the results of his own accurate study of the rocks and fossils collected and brought home by recent investigators. The general results arrived at by Dr. Zittel are as follows.

To the east of the Nile rises a mountain range composed of highly crystalline rocks—granite, diorite, and hornblendic gneiss. The peaks of this range rise to heights varying from 5,000 to 8,000 feet.

The oldest stratified rocks of the district appear to be of Cretaceous age. Lying upon the axis of crystalline rocks, and also covering wide tracts of country to the south of the Great Desert, is found the Nubian sandstone

[1] "Ueber den geologischen Bau der libyschen Wüste. (Festrede gehalten in der öffentlichen Sitzung der k. b. Akademie der Wissenschaften zu München zur Feier ihres einhundert und einundzwanzigsten Stiftungstages.) Von Dr. Karl A. Zittel.

formation. Concerning the age of these sandstone rocks a considerable amount of controversy has taken place in recent years, and they have been referred by different authors to the Triassic, the Jurassic, and the Neocomian systems. The fossils found by Overweg and others, however, seem to leave no room for doubt that the real age of the Nubian sandstone is the Cenomanian, or lower portion of the Upper Cretaceous.

Lying upon these sandstones are found great deposits over 600 feet in thickness, consisting of dark green and grey, finely-laminated marls in their lower, and of white, earthy limestones in their upper part. These rocks contain many characteristic Upper Cretaceous fossils, such as *Ananchytes ovatus*, *Ventriculites*, and *Rudistes*. These Upper Cretaceous rocks have been found not only forming the whole southern margin of the Desert, but also rising above the sandy wastes in the hilly masses which form the oases.

The deposits which underlie the greater part of the Sahara appear to be of Tertiary age and referable to the Nummulitic and Miocene periods. There would seem to be no sharp line of demarcation between the Cretaceous and the Tertiary deposits in this area, and in this, as in many other particulars, which are pointed out by Prof. Zittel, the North African formations of these periods remind us of those of the Rocky-Mountain regions of North America.

The older Tertiary deposits of Northern Africa are divided by Dr. Zittel into two members, which he designates the "Lybysche Stufe" and the "Mokattam Stufe." In the lowest of these (the Libysche Stufe) a widely-spread and very characteristic fossil is the Belemnite-like *Graphularia desertorum*, Zitt.; many nummulites and other well-marked Eocene fossils also occur.

There appears to be still some doubt as to whether the "Mokattam Stufe" of Dr. Zittel should be classed as Eocene or Oligocene.

In the northern part of the area various freshwater and marine deposits are found which are now referred to the Miocene. No less than sixty-eight forms of marine mollusca have been determined by Dr. Theodor Fuchs as occurring in these beds, and he is led to regard them as indicating a horizon not far removed from that of the Leitha-kalke of the Vienna basin.

The several formations described succeed one another from south to north, this being the direction of the dip of the beds; their relations to one another are well illustrated in the map and sections which accompany the work.

In the midst of the Beharieh oasis a mass of igneous rock is found rising through the midst of the Upper Cretaceous limestones. This rock has been studied by Prof. Zirkel of Leipzic, who pronounces it to be an ordinary plagioclase basalt, very similar in character to that of the Giant's Causeway in Ireland.

Over the whole of these formations the great mass of sands of the Desert is spread, and rises in places into hills several hundreds of feet in height.

In reading this address we cannot but feel that Dr. Zirkel has made admirable use of the collections which Dr. Schweinfurth and others have placed in the museum at Munich; and that by their careful study he has been enabled to clear up many of the difficulties which every one must have felt who has endeavoured to understand the geological structure of the great African continent.

PHYSICS WITHOUT APPARATUS[1]

VIII.

In the preceding articles of this series we have shown how in every department of physics a large number of instructive experiments may be performed without the aid of any more formal apparatus than the usual domestic appliances of an ordinary household. There remain to be described a few miscellaneous experiments before concluding the subject.

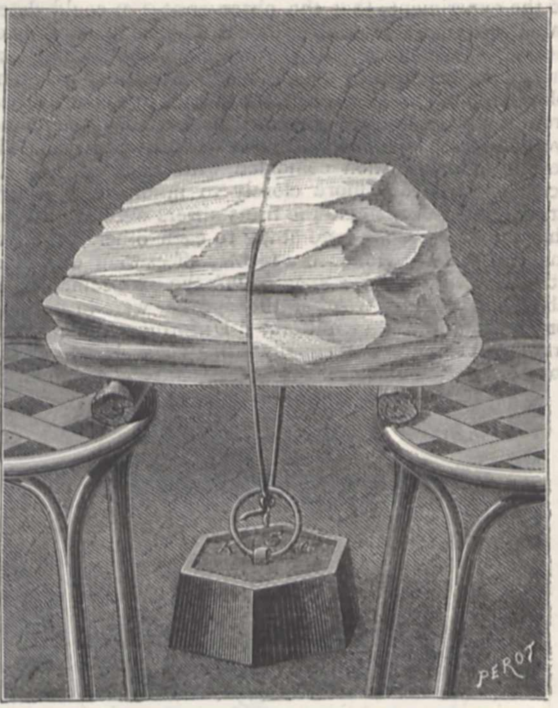


FIG. 25.

Many years ago Prof. Faraday observed that if two pieces of ice are pressed against one another they freeze

FIG. 26.

firmly together at the point of contact, even though they may themselves be thawing at the surface. To this

[1] Continued from p. 538.

peculiar property of ice he gave the name of *regelation*. The true explanation of this property was not at once arrived at. From theoretical considerations Prof. James Thomson was led to predict that the application of pressure to ice would lower the temperature of its melting-

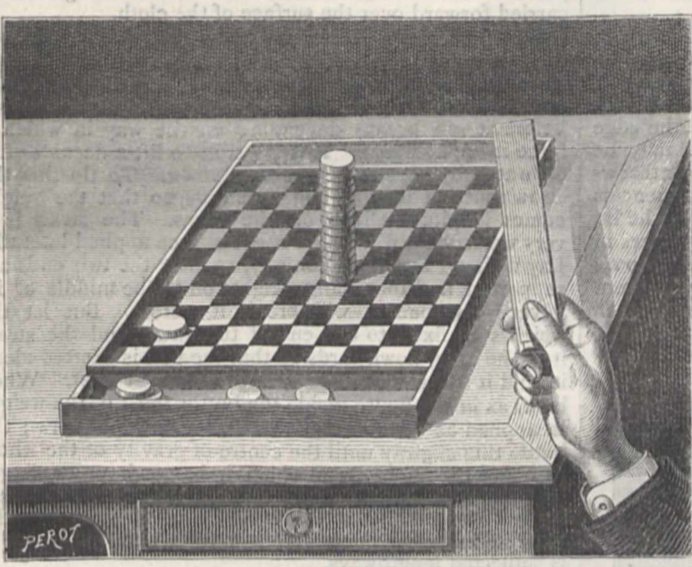


FIG. 27.

point, and cause it to melt even though as cold as, or colder than, the usual "freezing-point." This prediction was afterwards verified by Sir William Thomson, who melted ice by subjecting it to great pressure. More

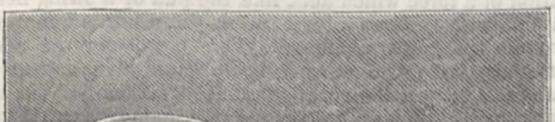


FIG. 28.

recently Mr. James Bottomley has devised a very beautiful experiment on regelation which requires no special apparatus for its performance. A block of ice (Fig. 25) is placed upon a suitable support, and over it is hung by a copper wire a heavy weight. It is found that in the course of a few hours the weight will have dragged the wire through the ice, as if it were no harder than a piece of cheese, yet that the ice has healed up as fast as the wire cut into it, and that it is still one solid block. This extraordinary fact can be accounted for in the following way. In the neighbourhood of the wire where it passes through the ice the pressures are not uniform, for just below the wire the portions of the ice are under pressure, owing to the pull of the heavy weight, while immediately above the wire the ice is subjected to a stress tending to draw the particles asunder, or, in other words, it is subjected to a *pull* or "negative pressure." The pressure on the ice under the wire lowers its melting-point, and causes very small quantities of it to melt; these liquid portions immediately are squeezed out, and find their way round the wire to the space above it, where, the pressure being reduced, they again freeze hard.

Our next picture (Fig. 26) is a simple illustration of the principle of the diving-bell. A wine-glass is turned mouth downwards and plunged into a jar of water. The water rises up only a very little way into the mouth of the wine-glass, owing to the air which it contains. The deeper the wine-glass is plunged the more is the air compressed and the higher does the water rise in the miniature bell. To compress the contained air into one-half of its original volume it would be necessary to plunge the wine-glass about thirty-four feet deep into water; for to halve the volume of the air inside we must double the external pressure. The pressure of the air is already

FIG. 29.

about fifteen pounds on every square inch, and to double that pressure requires the additional weight of thirty-four feet of superincumbent water, for that is the depth at which the water itself presses with a force of fifteen pounds on each square inch of surface. M. Tissandier, in describing this simple experiment in the pages of *La Nature*, has suggested that a few imprisoned flies or other insects may without any cruelty or hurt do duty as divers within the miniature diving-bell, and afford proof that life can go on in the inclosed air even though below the surface of water.

In speaking in a former article of the subject of *inertia* we mentioned the following familiar trick: a number of the round wooden "men" used in playing the game of draughts are piled up in a column one upon another. If the lowest one of the pile is dextrously hit with the edge of a paper-knife or other suitable article it may be knocked away from under the others without overthrowing the others. Fig. 27 shows how the experiment is arranged, the narrow slip of wood which serves as the lid of the box being here used as the weapon. Beginners in science must not mistake the meaning of the term *inertia* as applied to matter. Matter is not in itself lazy or inert. But it possesses the property of *mass*, and to set mass in motion requires the expenditure of *energy*. If we skilfully

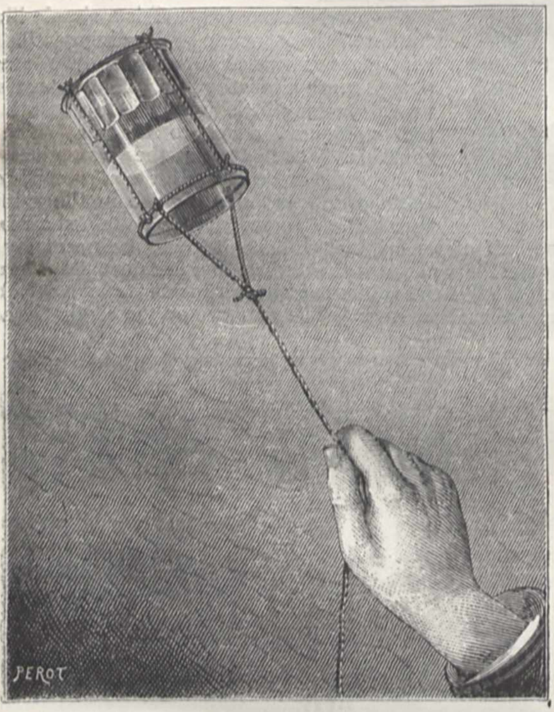


FIG. 30.

spend the energy of the rapid blow upon the one draughtsman, it is knocked away before there is time for any considerable part of the energy to be imparted to the others that are piled upon it.

Another simple experiment, depending partly upon the inertia of matter and partly upon elasticity, is often shown as an after-dinner trick. Upon a linen tablecloth is placed a threepenny-piece between two pennies or other larger and thicker coins. Over this an empty wine-glass is placed, and the puzzle is how to get out the smaller coin without touching the glass. The very simple operation of scratching with the finger-nail upon the cloth, as shown in Fig. 28, suffices to accomplish the trick, for the little coin is seen to advance gently towards the finger until it has moved completely away from under the glass. The fibres of the linen cloth are elastic; when you scratch with your finger-nail they are drawn gently forward until the force of their elasticity becomes too great and they fly back, to be once more drawn forward, again to slip back, and so on. While the fibres are drawn forward slowly, they drag the coin with them to a minute distance. But when the slip occurs and they fly backward, they do so very rapidly, and slip back under the coin before there is time for the energy of their movement to be imparted to the coin to set it in motion. So the coin is gradually carried forward over the surface of the cloth.

We will next give a simple experiment which illustrates the principle that a substance which is very weak in one direction may be very strong in another, the "strength" of the material (that is to say, the resistance it offers before it will break) depending on the way in which a force is applied to it. It is possible to lift a decanter full of water by means of a single straw. To do this the straw must be bent as Fig. 29 shows, so that the weight comes longitudinally upon the straw. The straw is a very weak thing if it has to resist a force applied laterally. Lay a single straw horizontally, so that the two ends are supported, and then hang weights on to the middle of it: a very few ounces will break it across. But let the weights be fixed to one end of the straw, and the straw itself be hung downwards so that the pull is exerted along it, and it will support one or two pounds at least. When bent, as in the figure inside the bottle, most of the weight is applied as a thrust against the end of the straw; the bottle tilts slightly until the centre of gravity of the whole is below the point from which it hangs between finger and thumb; but in this position the sideway thrust against the middle of the straw is very small, and the material is strong enough to stand the strain to which it is subjected lengthways.

Lastly we offer an illustration (Fig. 30) of an experiment known to every schoolboy. A can or jar containing water may be whirled round the head without spilling a single drop, provided the motion be sufficiently rapid. When a moving body is subjected to the constraining action of a force which acts, like the pull of a string held in the hand, towards a fixed centre, the result is a motion around the centre of force. Were it not for the constraining force the moving body would fly away at a tangent; and to the reaction exerted successively in all directions away from the centre the name "centrifugal force" was formerly given. The water in the can, being heavy, is also subjected to this so-called centrifugal force as it moves around the fixed centre, and hence it does not fall out of the can while passing through the inverted position in the air if its speed be sufficiently accelerated.

THE GERMINATION OF WELWITSCHIA MIRABILIS

HAVING been supplied, through the kindness of the Director of Kew Gardens, with young seedlings of *Welwitschia mirabilis*, I have been enabled to draw some fresh conclusions as to the homology of the large leaf structures, which have hitherto been described as persistent cotyledons. It is true this description has been confessedly provisional, since the process of germination has not hitherto been traced.

The seeds germinate in a manner corresponding in the main with that described by Strasburger for *Ephedra campylopoda* ("Conif. und Gnet.," p. 320). The radicle first breaks through the testa, the point of perforation depending apparently upon the position of the seed during germination. The cotyledons also break through the testa, but at a different point from the radicle. The cotyledons are two in number; in one case I observed three, one being smaller than the others. They free themselves entirely from the seed, and expand to a length of 1 inch to 1½ inch, with a breadth of ⅛ inch, or rather more; it is possible, however, that they may by growth attain a larger size. The cotyledons when expanded are green, though while still in the seed they are yellow.

Their form is linear, margin entire, glabrous. Each has two main fibro-vascular bundles parallel to one another, and two or more lateral ones, also parallel to these; they all give off lateral bundles which anastomose freely. The hypocotyledonary portion of the stem extends to a length of about one to two inches; it is compressed in a plane parallel to that of the cotyledons, and is slightly swollen immediately below the point of junction with them.

Though the cotyledons are completely withdrawn from the seed at an early stage, a physiological connection is kept up between the seedling and the endosperm by a peculiar structure, produced apparently by a lateral swelling of the hypocotyledonary portion of the stem. The time and manner of its development I have not yet been able to ascertain, but in one seedling of twelve days it was found lying parallel to the cotyledons, these being still inclosed in the endosperm, whereas in the mature seeds I have not been able as yet to see any trace of it.

This structure remains in close connection with the endosperm, and is probably useful in transferring the nutritive substances from it to the embryo after the cotyledons have been withdrawn. As far as I can see at present, this lateral structure is produced merely by a process of lateral extension of tissues. The fibro-vascular bundles curve slightly into the protrusion, but I have observed no special modification of the tissues further than a lateral extension. If this be the case, it may be considered morphologically as an emergence.

It has been already observed by Strasburger ("Angiospermen und Gymnospermen," p. 155, Plate xxii., Figs. 90, 91, 93) that in the ripe embryo of Welwitschia an apical papilla is to be seen between the cotyledons; but his observations were conducted only on embryos in mature but ungerminated seeds; and here, as in other members of the group, the plumule does not develop beyond this condition of a mere papilla till germination begins. In the young seedlings (about six weeks old) which I have had the opportunity of observing, the *plumule consists of two leaves*, decussating with the cotyledons, and between these there is an apical papilla. In the most advanced specimens now growing at Kew these leaves of the plumule are about one-sixteenth of an inch in length, but no further development of leaves is at present to be seen.

These observations suggested a comparison with the youngest specimens preserved in the Kew collections: the result is the discovery of evident traces of the bases of leaf-structures below the well-known pair of large leaves, in the form of ragged ends of fibro-vascular bundles, which run directly into the tissues of the stem. These earlier leaves appear to have been at right angles to those of the existing leaves of the plant, and we may with good reason conjecture that they were the cotyledons. Full proof of this will be afforded if the plants at present growing at Kew remain healthy. If this conjecture be true the pair of large perennial leaves are *the first and only pair of leaves developed from the plumule*, and not cotyledons, as they have been hitherto assumed to be.

Other interesting points in the germination of this plant, together with a description of its minute histology, must be deferred till a later notice. This I hope to be able to publish with illustrations in an early number of the *Quarterly Journal of Microscopical Science*.

F. ORPEN BOWER

The Jodrell Laboratory, Royal Gardens, Kew, October 9

NOTES

IN the second of a series of articles in the *Pall Mall Gazette* "On Vain Discourse," in the quaint and leisurely style of our remote forefathers, the writer speaks of "the talker who thinketh he hath a vocation to popularise science, not as some of our masters come forth to stir up interest in these matters, but from folly and emptiness." He then proceeds to define him:—"He is a great breeder of vain discourses, for he deemeth that the strong meat of knowledge will sit ill on dainty stomachs, and so sets himself to save them the digesting. He watereth first to the consistency of a small fact to the page, and sweeteneth with many a line of poetry; and if there be a tough morsel of reasoning or a sharp fragment of logical defining, that he carefully throweth aside, 'et pondera rerum minutissimis verbis frangit.' For seasoning there are divers sorts of lights or colours or smells to wonder at, and pictures and tales, and praise of the wonderful nineteenth century, and of science and of such as study it. And so there is made a thin and limpid pabulum, or *extractum scientiæ dilutum*, which will not harm the delicatest, nor indeed do them any good, though it be sweet to the taste and pleasant to the eyes, and have the savour of wisdom. For knowledge that is worthy of being attained needeth faithful striving and endeavour, and skill cometh not but by assiduity in act and exercise—χαλεπὰ τὰ καλά." The lecture season is now beginning, and it would be well that those who attend science lectures should learn to distinguish between the true and the false, and this they can easily do by applying the test given by the *Pall Mall*. The spread of efficient education in science will either extinguish the popular lecture or greatly alter its character. We are glad to see the growth of outside opinion on the subject, as may be inferred from the article alluded to.

WE regret to record the death of Dr. E. J. Sparks, F.R.C.P., of Mentone, which occurred at Crewkerne on the 11th instant. Dr. Sparks has been in failing health for several years, but he is one of those striking instances of what work can be done by an active mind in spite of physical weakness. He was well known as a constant contributor to the *Medical Times*, in which appeared the series of letters on the climate of the Riviera, which were afterwards developed into his excellent book on the Health-Resorts of the Riviera. The preparation of this work occupied the best portion of Dr. Sparks' later years, and it is only three months since he revisited several of the less frequented places on the Eastern Riviera for the sake of a second edition. The book is a truly scientific work. Statistics relating to climate and the various diseases for which the Riviera has been recommended have been collected and tabulated with the greatest diligence and care; and the experience of observers, both lay and medical, as to the beneficial influence of the climate is given with the greatest candour. Besides this work, Dr. Sparks published a few years ago a translation of Dr. King's "Therapeutics," the value of which was greatly enhanced by the introduction of a quantity of new matter carefully collected together from medical periodicals. It was a work of no small labour, necessitating as it did the transformation of all quantitative relations from the German into those employed in the English and American Pharmacopœias. It received on the other side of the Atlantic prompt appreciation in a manner both hurtful and complimentary. Before it could be reprinted from the stereotype plates sent over for the purpose, a pirated fac-simile edition was produced by a publisher who has hitherto forgotten to send a cheque. He brought to his medical practice an unusually thorough knowledge of the science of his profession, and a high-minded devotion to the welfare of his patients which quickly secured the confidence of all who consulted him. In friendship he was staunch, loyal, and self-sacrificing, and his loss will be long felt by a wide circle of friends.

THE following are among the scientific and geographical publications announced for the present season:—By Mr. Murray: "Japan; its History, Traditions, and Religions, with the

Narrative of a Visit in 1872," by Sir E. J. Reed, K.C.B., M.P.; "Unbeaten Tracks in Japan," by Isabella Bird (these works are just published); "Personal Life of David Livingstone," by Dr. W. G. Blackie; "A Pilgrimage to Nejd," by Lady Anne Blunt; "The Power of Movement in Plants," by Charles Darwin, assisted by Francis Darwin; "The Cat; an Introduction to the Study of Back-boned Animals," by St. George Mivart; "Siberia in Europe, a Naturalist's Visit to the Valley of the Petchora," by Henry Seebohm; "The Gardens of the Sun: a Naturalist's Journal on the Mountains and in the Forests and Swamps of Borneo and the Sulu Archipelago," by F. W. Burbidge. Messrs. Allen and Co. announce: "The Expiring Continent; a Narrative of Travel in Senegambia," by A. W. Mitchelson; "A Dictionary of Ethnological and Philological Geography," by Dr. R. G. Latham; "Incidents of a Journey through Nubia to Darfur," by Sydney Ensor, C.E. Among Messrs. Crosby, Lockwood, and Co.'s announcements are: "The Fields of Great Britain; a Text-Book of Agriculture," by Hugh Clements; "A Rudimentary Treatise on Coal and Coal-Mining," by Warington W. Smyth, F.R.S. Messrs. Sampson Low and Co. announce: "New Guinea," by L. M. D'Albertis; "Seven Years in South Africa," by Dr. Holub. Messrs. Longmans promise the second series of Helmholtz's "Popular Lectures on Scientific Subjects," translated by Dr. E. Atkinson. Messrs. Chatto and Windus: "A Simple Treatise on Heat," by W. M. Williams. Macmillan and Co.: "Island Life," by A. R. Wallace; "A Visit to Wazan," by L. S. Watson; "Voyage of the *Vega*," by A. E. Nordenskjöld; "Text-Book of Geology," by Prof. Geikie; "Ideal Chemistry," by Sir Benjamin Brodie, Bart.; "A Treatise on Organic Chemistry," by Professors Roscoe and Schorlemmer; vol. ii. of Mr. F. M. Balfour's "Treatise on Comparative Embryology;" "Anthropology," by Dr. E. B. Tylor; "Mathematical Papers," by the late Prof. Clifford; "History of the Steam Engine," by R. L. Galloway.

THE inauguration of the Paris Popular Observatory took place at the Trocadéro Palace on October 11, on the second terrace of the Eastern Tower. Four telescopes—three reflectors and a refractor, have been placed at the disposal of the public. No fee is taken from the visitors, who have only to make application to the Popular Observatory Office, Trocadéro, and register their names. A series of lectures on practical observations will soon begin. A room is also reserved for microscopical observations, which will be opened during the daytime.

THE Sheffield Public Museum boasts of an equatorially mounted telescope which the public are permitted to use under certain restrictions and under the direction of Mr. E. Howarth, the curator.

M. HERVÉ-MANGON, the new director of the Conservatoire des Arts et Métiers, gave yesterday a great dinner in honour of Mr. Graham Bell, the inventor of the photophone, which was exhibited and tried in that establishment.

THE Calisaya bark plants cultivated in Jamaica appear to have been replaced by an inferior hybrid between true *Cinchona Calisaya* and *C. succirubra*. In order to remedy this state of things Mr. J. E. Howard, F.R.S., the well-known quinologist, liberally placed cuttings from his authentic plant of *Cinchona Ledgeriana* at the disposal of the Royal Gardens, Kew. Three healthy plants raised from this source have lately reached Jamaica, besides others which have been sent to Ceylon.

Camoensia maxima, the most striking leguminous plant known, has flowered for the first time in cultivation in the Botanic Garden, Trinidad, to which it was sent two years ago from Kew. Welwitsch found it abundantly in the forests of Angola. The flowers are nearly a foot long, with a reddish calyx and cream-coloured petals with a golden border. The standard is 3 4 in. broad, which gives some idea of the scale of the other parts. There are living plants also at Kew, but at present it has shown no indication of flowering under glass.

A CORRESPONDENT states that when he was a schoolboy at Hamburg, male crickets (species not indicated) were sold there in cages made of four playing-cards, and at the rate of a penny a-piece.

ANOTHER correspondent states that the electric lamps illuminating a large concert-room in the Champs Elysées at Paris, a year or two ago, were extremely attractive to insects of various orders. Who knows that the Thames Embankment may not become the nightly resort of members of the Entomological Society?

THE Committee of the Topographical Society of London, which has been formed for the purpose of collecting and publishing maps, views, and other materials for the history of London, have made arrangements for the holding of the inaugural meeting of the Society on Thursday, the 28th inst., at 4 o'clock. The Lord Mayor has granted the use of the Long Parlour at the Mansion House, and will preside on the occasion. Cards for the meeting may be obtained from Mr. Henry B. Wheatley, F.S.A., 18, John Street, Adelphi, W.C.

WE are glad to see a new edition of the late Sir J. W. Lubbock's Star Maps, under the title of "The Stars in Six Maps on the Gnomonic Projection," with explanatory notes by Mr. James Glaisher, F.R.S. Letts, Son, and Co. are the publishers.

IT is proposed that an International balloon race should take place at Paris on October 31. Active steps are being taken, and the necessary authorisation will be procured without difficulty from the public authorities, but an obstacle of a quite unexpected nature remains to be solved. For motives, which it is very difficult to determine, the Parisian Company who monopolise the gas, and sell it at the enormous price of threepence per cubic metre, refuse to dispose of the commodity to aëronauts. As no provision in the charter has been made for the right of inflating balloons, it remains to be seen whether or not the gas monopolists will persist in their refusal.

M. SADI CARNOT, the French Minister of Public Works, has appointed a Commission to explore the antiquities of the Regency of Tunis, and determine what works could be executed with advantage in a country of which the welfare is of such importance for the good of the largest French dependency.

THE *Pester Lloyd* gives a detailed account of the earthquake which seems to have been felt generally all over Transylvania on the night between the 3rd and 4th inst. From about 7 o'clock in the evening rumbling noises were heard throughout the night, especially in the hilly districts. About 6.15 a.m. a shock was felt which lasted a couple of seconds, and the shock was repeated, in some places twice, in others as often as ten times. Doors were opened and shut, windows rattled, bells were rung. In several places a movement of the ground was felt, in a direction from north-west to south-east; in some places this movement lasted as long as ten seconds. In the neighbourhood of Tövis a small railway-station building was overthrown. At Felvinez the shocks were very severe, lasting fully two minutes. Several public buildings had rents in the walls, and nearly the whole of the ceiling of the Reformed Church fell. At Bistritz the people were so alarmed that they rushed from their beds into the streets and open places. In general the disturbance was greater in the western portion of the province.

AN interesting "Note on the Distribution of some of the more important Trees of British Columbia" has been contributed by Mr. George M. Dawson to a recent number of the *Canadian*

Naturalist. In a brief review of the general characters of the vegetation of the country the peculiarities in distribution are pointed out. The arrangement of the trees referred to is not based on any scientific principle, the Coniferæ being "placed first, as having the greatest importance both from an economic point of view and from the vast extent of country which they cover almost to the exclusion of other trees." Considering the variety of well-known timber trees to be found in British Columbia one is scarcely prepared to find it stated, with regard to the Douglas Fir (*Pseudotsuga Douglasii* or *Abies Douglasii*), that it is the "most important timber tree of British Columbia, and the only one of which the wood has yet become an article of export on a large scale." The best grown specimens of this noble tree are stated to be found near the coast in proximity to the waters of the many bays and inlets which indent it. In these situations the tree frequently exceeds eight feet in diameter at some considerable height from the ground, the height of the tree itself ranging from 200 to over 300 feet. "The wood varies considerably in appearance and strength according to its locality of growth and other circumstances. It is admirably adapted for all ordinary purposes of construction, and of late has obtained favourable notice in shipbuilding, remaining sound in water for a long time. For spars and masts it is unsurpassed, both as to strength, straightness, and length. Masts for export are usually hewn to octagonal shape from 20 to 32 inches in diameter by 120 feet long. Yards are generally hewn out from 12 to 24 inches in diameter and 50 to 102 feet long. Masts and spars are generally sent to Great Britain; other forms of timber to South America, Australia, India, China, and the Sandwich Islands. Of the *Thuja gigantea*, which in favourable situations on the coast reaches a height of 100 to 150 feet, the pale yellowish or reddish wood is stated to be very durable, though not extensively used except for shingles. The large and elegant canoes of the Indians are made of the hollowed trunks, and the fibre of the inner bark is used for ropes and cordage, as well as for paper-making and other purposes. One of the most remarkable uses for a wood is referred to under *Pinus contorta*, where it is said that the cambium layer contains much sugar, and for that reason it is eaten by the natives in the spring of the year, and in some instances large quantities of it are collected and dried for winter use.

THE *Boston Herald* gives the following account of an American experiment made on September 2:—"A novel exhibition of powerful electric lights was made last evening in the vicinity of the Sea Foam-house, Nantucket Beach, and the display was witnessed by quite a crowd of interested spectators. The Northern Electric Light Company have erected three wooden towers, each 100 feet high, and mounted upon each of these a circular row of twelve electric lights of the Weston patent, each light being estimated at 2,500-candle power. As these towers are but 500 feet apart and in a triangle, it will be seen that the light of 90,000 candles was concentrated within a limited territory. The design of the exhibition was to afford a model of the plan contemplated for lighting cities from overhead in vast areas, the estimate being that four towers to a square mile of area, each mounting lights aggregating 90,000-candle power, will suffice to flood the territory about with a light almost equal to midday. Last evening a motive power of thirty-six horses was used in generating the electricity from three Western machines, and the lights, with one single slight flicker, burned steadily and brilliantly all the evening. It is difficult to say whether the experiment proved anything or not. The claim put forward by the company is for an original plan of lighting cities and towns by grouping and elevating electric lights of any kind."

WE have received Part 1 of the *Transactions* of the Epping Forest and Essex Field Club, containing Mr. Henry Walker's interesting lecture on "A Day's Elephant Hunting in Essex."

AT the Leeds Philosophical and Literary Society the following are among the lectures to be given this winter:—October 20, Prof. Silvanus P. Thompson, D.Sc., "Waves of Sound and the Photophone"; November 16, H. Clifton Sorby, LL.D., F.R.S., "The Structure and Origin of Meteorites and Meteoric Iron"; December 7, Dr. Sydney H. Vines, "The Nutrition of Plants"; December 21, Prof. E. Ray Lankester, F.R.S., "Degeneration"; February 15, 1881, Prof. T. E. Thorpe, Ph.D., F.R.S., "The Azores"; March 1, J. W. Swan, "The Electric Light, with Demonstrations."

OUR ASTRONOMICAL COLUMN

THE BINARY STAR δ EQUULEI.—Mr. Burnham publishes a new epoch for this star, which there is now good reason to conclude will prove to be the most rapid revolver amongst the binary systems; on this account it well deserves the attention which Mr. Burnham claims for it at the hands of those observers who are in possession of instruments competent to cope with so close a double-star. The duplicity was detected by M. Otto Struve on August 19, 1852, with the Pulkowa refractor, when definition was unusually good, and the components almost equal in magnitude were "à peine séparées par une ligne noire." In 1853 and 1854 it appeared single in the same instrument. The object was elongated in the summer of 1857, and at the date 1858·59 M. Struve saw the stars separated at moments, and they were again divided in the autumn of 1874. As is pointed out in the Pulkowa Observations, vol. ix., the case is evidently a similar one to that of 42 Comæ Beren., the visual ray coinciding very nearly with the plane of the orbit, so that the companion appears to oscillate backwards and forwards almost in a right line, and that of very small extent. M. Struve has established the period of revolution of 42 Comæ to be only about twenty-five years, but δ Equulei appears to indicate a period of only thirteen or fourteen years. Mr. Burnham finds from five nights' measures with the 18½-inch Chicago refractor,

1880·60, Position 29°·1, Distance 0″·35.

In September, 1870, Dunér remarked of this star: "Oblongue, j'en suis bien sur. Les diamètres sont comme 3 : 5," and the angle was estimated 8°. The only measures except Mr. Burnham's are those of M. Otto Struve. The magnitudes of the components are so nearly equal (the American observer considered there was a difference of only about two or three tenths of a magnitude), that care will be necessary to place the smaller star in its proper quadrant. Mr. Burnham adds: "It seems certain that it is measurable with any good instrument of ten inches aperture and upwards at least one year in every six years," and he believes that it is now near its maximum distance.

FAYE'S COMET.—The following positions are extracted from Dr. Axel-Möller's ephemeris for Berlin midnight:—

	R.A. h. m. s.	N.P.D. ° ′	Log. distance from Earth.	Log. distance from Sun.
Oct. 22	22 48 22	88 50·8	0·0506	0·2892
24	— 48 58	89 9·8	0·0532	
26	— 49 43	89 27·8	0·0561	0·2855
28	— 50 37	89 45·0	0·0591	
30	— 51 39	90 1·2	0·0623	0·2819
Nov. 1	— 52 50	90 16·5	0·0656	
3	— 54 9	90 30·7	0·0691	0·2785
5	— 55 37	90 43·8	0·0727	
7	22 57 2	90 55·9	0·0764	0·2751

The comet remains sensibly at the same intensity of light (not far from the maximum of the present appearance) during this period. On October 26 it will be within 20′ from 1 Piscium (B.A.C. 7985), and on November 3 very close to 3 Piscium (B.A.C. 8012), stars of the sixth magnitude.

HARTWIG'S COMET.—The subjoined places of this comet are from the calculations of Dr. Oppenheim, and are also for Berlin midnight:—

	R.A. h. m. s.	N.P.D. ° ′	Log. distance from Earth.	Log. distance from Sun.
Oct. 22	17 52 1	76 23·8	0·0582	0·0610
24	17 58 30	77 13·0	0·0826	
26	18 4 22	77 57·3	0·1057	0·0883
28	18 9 43	78 37·2	0·1276	
30	18 14 39	79 13·2	0·1483	0·1136
Nov. 1	18 19 13	79 45·7	0·1680	
3	18 23 26	80 15·1	0·1868	0·1370

COMETS 1880, *d* AND *e*.—M. Bigourdan has continued his ephemeris of the comet discovered by Schäberle on April 6, but states from observations made at Paris that the intensity of light has diminished much more rapidly than is due to change of distance from the earth and sun; on September 30 he estimated the comet to be of the same brightness as on May 18; it is still in a favourable position for observation, as will be seen from the following extract from M. Bigourdan's ephemeris for Paris midnight:—

	R.A. h. m. s.	N.P.D. ° ′		R.A. h. m. s.	N.P.D. ° ′
Oct. 22	5 56 3	89 49	Oct. 30	5 34 22	94 55
24	– 50 57	91 4	Nov. 1	5 28 27	96 12
26	– 45 38	92 21	3	5 22 21	97 28
28	– 40 6	93 38	5	5 16 6	98 44

The Astronomer-Royal has notified the discovery of another comet by Mr. Lewis Swift of Rochester, N.Y., on the night of October 11, in R.A. 21h. 30m. and Decl. + 18°.

METEOROLOGICAL NOTES

PROF. LOOMIS, in his thirteenth contribution to meteorology, investigates the question of the great and sudden changes of temperature which are so marked a feature in the climates of a large portion of the United States. Six years' observations of the Signal Service stations have been examined, with the result that there are 118 stations at which there has occurred at least one case of a daily range not less than 40°·0. Limiting the inquiry, however, to stations at which the average number of cases amounted to six annually, it is seen that there are thirty-six such stations. The stations where the great fluctuations of temperature occur most frequently are situated south of lat. 35°, in which region the fluctuations of pressure attending the progress of storms are but little felt; and it is to be noted that these great fluctuations of temperature occur most frequently in the summer months. Thus at Wickenburg (lat. 34·0, long. 112°·7), which is situated in a desert sandy region, with an annual rainfall of only 4·99 inches, on ten of the nineteen days ending with August 14, 1877, the temperature showed a daily range of at least 62°·0, reaching in one case to 76°·0. These enormous temperature changes are due to the extreme dryness of the air, by which the sand becomes intensely heated by the sun during the day, whereas by night the loss of heat by radiation is as great as perhaps anywhere on the globe. The general result of the inquiry is that the most remarkable cases are merely examples of the ordinary diurnal change of temperature, unaffected by the passage of storms, whilst the remaining cases, which occur in the higher latitudes of the States, are to be ascribed to the influence of storms along with the ordinary diurnal change of temperature. It also appears from a careful investigation that dry air, even when greatly heated, has but little ascensional force, and that the violent uprising of heated air, so frequently witnessed in moist climates, particularly during thunderstorms, is mainly due to the large amount of aqueous vapour with which it is charged. As regards great fluctuations of temperature in winter, Prof. Loomis points out that while, for example, a temperature of – 20°·0 occurs at Denver on the east side of the Rocky Mountains, an average temperature of 30°·0 prevails in the Salt Lake Basin, and remarks that by the movements of the atmosphere attending the progress of a great storm these contiguous masses of air with temperatures so different from each other are brought successively over the same station, and thus bring about a change of temperature amounting on occasions to 50°·0 in a single hour.

PROF. LOOMIS also carefully investigates the storms, with their characteristic low barometers, which cross the Rocky Mountains, and shows that no great barometric disturbances originate in the Salt Lake Basin; that nearly all the great barometric disturbances experienced in the Salt Lake Basin come from the Pacific, and generally from the north-west; and that nearly all these disturbances can be followed to the Atlantic, meeting it near lat. 47°·0, and occupying from two to six days in the passage, or an average of three and a half days, corresponding to an onward movement of about 700 English miles a day. As has been shown to obtain in other regions of the globe, the isobars which define storms are often not so symmetrical over a mountainous region as over a level country. In not a few cases however the isobars show considerable symmetry over the Rocky Mountains, and this feature becomes the more noticeable in very violent storms. From the observations made at Pike's Peak, 14,200 feet high, as well as at Mount Washington, 6,285 feet, it appears that the winds at great elevations circulate about a low barometer, just as they do near the level of the sea; but the position of this centre at great heights sometimes differs considerably from the low centre prevailing at the surface of the earth, and when such deviation does occur it is generally toward the north-west. Of the thirty-six cases examined, the low centre at great elevation was, in twenty-seven cases, vertical over the low centre at lower levels, in five cases to north-west, in one case to north, in another case to west, and in two cases to east. It must however not be lost sight of that this important point in the phenomena of storms cannot be exactly determined but by a multiplication of high-level stations.

DISPLAYS of auroras appear to have been remarkably frequent in America during August last. In Mr. Carpmael's Weather Report of the month for Canada it is stated that the aurora of the 12th was very brilliant, and was seen at nearly every station from Manitoba to the Atlantic. From the United States Monthly Weather Report we learn that auroras were frequent during the month, occurring on no fewer than twenty-one nights, the auroras of the 12th and 13th being of remarkable brilliancy, as well as widespread. On these nights the aurora was seen at about 100 stations from Maine westward, as far as clear skies allowed its being seen. The more prominent features of these auroras as detailed in the Report are of such interest as to suggest that a more detailed account of them, as seen in the northern hemisphere during the night of August 12 and 13, could not fail to contribute data of the greatest importance in this little-understood branch of physics.

IN the *Journal* of the Scottish Meteorological Society, recently published, there is a paper of some interest, by Mr. Buchan, on the diurnal periods of thunderstorms in Scotland. There are two well-marked types of thunderstorms, the one occurring in the summer months, and having its daily maximum frequency from 1 p.m. to 6 p.m., and the other occurring in the winter months, with its maximum from 9 p.m. to 3 a.m. Stations in the eastern division of the country where the annual rainfall is small, or only of moderate amount, have all, or nearly all, their thunderstorms during the summer months; whereas in the west, or where the climate is wet and the rainfall heavy, a very considerable proportion of the thunderstorms occur during the winter months, and these are nearly always of short duration, and are the accompaniments of the winter cyclones of North-Western Europe. In this connection it is interesting to note that the thunderstorms of Stykhisholm in Iceland are phenomena of the winter months and of the nights, only three being recorded as having happened at a time of the day when the sun was above the horizon. The maximum daily period of the summer thunderstorm coincides with the hours when the ascending columns of heated air from the earth's surface are in full activity, and the result is no doubt largely due to the circumstance that these ascending masses of heated air develop a charge of electricity as their moisture condenses into cloud. The period of maximum frequency of the winter thunderstorm occurs some hours before and after midnight, or during those hours of the day when the land surface presented to the vapour-laden winds of the Atlantic approaches to and reaches its diurnal minimum temperature, and when consequently the condensation of the vapour may be expected to reach its daily maximum. On the other hand, the minimum period in summer occurs during the early morning, the absolute minimum being at the hour just before the ascending columns of heated air are set in motion, and the number remains few till about 11 a.m., or till the tops of the heated columns have risen to some height in the atmospheres.

IN the *Journal* of the Meteorological Society for April and July last are given the results of observations made during the first six months of 1880 at about forty "climatological stations" recently established by the society. At these stations observations are taken only once a day, viz., at 9 a.m., and are restricted to temperature, cloud, and rain. An extension of these stations which would include the whole of the English sanataria, and which doubtless will gradually be effected, would furnish data for a correct presentation of the comparative climatologies of the health resorts of England.

BIOLOGICAL NOTES

NEST-BUILDING AMPHIPODS.—Mr. S. J. Smith, in a memoir on some amphipods described by Thomas Say (*Trans.*, Connecticut Acad., July, 1880), states that the tubes which certain species make to live in are to a great extent formed of pellets of their excreta. In 1874 he watched carefully the process of constructing the tubes in several species of Amphipoda. *Microdeutopus grandimanus* (*M. minax*, Smith) was a particularly favourable subject for observation. When captured and placed in a small zoophyte trough with small branching algæ, the individuals almost always proceeded at once to construct a tube, and could very readily be observed under the microscope. A few slender branches of the alga were pulled toward each other by means of the antennæ and gnathopods, and fastened by threads of cement spun from branch to branch by the first and second pairs of peræopods. The branches were not usually at once brought near enough together to serve as the framework of the tube, but were gradually brought together by pulling them in and fastening them a little at a time, until they were brought into the proper position, where they were firmly held by means of a thick network of fine threads of cement spun from branch to branch. After the tube had assumed very nearly its completed form, it was still usually nothing but a transparent network of cement threads woven among the branches of the alga, though occasionally a branch of the alga was bitten off and added to the framework: but very soon the animal began to work bits of excrement and bits of alga into the net. In this case the pellets of excrement, as passed, were taken in the gnathopods and maxillipeds, and apparently also by the maxillæ and mandibles, and broken into minute fragments and worked through the web, upon the outside of which they seemed to adhere, partially by the viscosity of the cement threads, and partially by the tangle of threads over them. Excrement and bits of alga were thus worked into the wall of the tube until the whole animal was protected from view, while, during the whole process, the spinning of cement over the inside of the tube was kept up. When spinning the cement threads within the tube the animal was held in place on the ventral side by the second pair of gnathopods and the caudal appendages, the latter being curved beneath the anterior portion of the pleon, and on the dorsal side by the third, fourth, and fifth pairs of peræopods extended and turned up over the back, with the dactyli turned outward into the web. The spinning was done wholly with the first and second peræopods, the tips of which were touched from point to point over the inside of the skeleton tube in a way that recalled strongly the movements of the hands in playing upon a piano. The cement adhered at once at the points touched and spun out between them in uniform delicate threads. The threads seemed to harden very quickly after they were spun, and did not seem even from the first to adhere to the animal itself.

Death by Hanging.—Recent experiments regarding the nature of death by hanging or strangulation induce Prof. Tammasia to reject the view that the chief cause of such death is compression of the pneumogastric, causing paralysis of the heart (*Reale Ist. Lomb.*, fasc. xiii.). In the great majority of cases, he says, the proximate cause of death is the occlusion of the respiratory passages. The greater or lesser rapidity of the death depends on the degree of such occlusion. Compression of the pneumogastric and of the vessels of the neck may strengthen the efficacy of that direct cause, but, in the absence of the latter, it is insufficient to cause any instantaneous lethal phenomenon, as some have supposed.

Hæmoglobin in Echinoderms.—The presence of hæmoglobin in the aquiferous system of an Echinoderm (*Ophiactis urens*, one of the Ophiurida) has lately been demonstrated by M. Foettinger (Belgian Acad. *Bull.*, No. 5). The only branches of the metazoa in which it had not before been found were echinoderms and zoophytes. Simroth observed certain globules in the ambulacral canals of the former, but not observing live individuals, he missed the hæmoglobin, which may be observed if one of the arms of the living animal be broken; a drop of red colour appearing presently at the extremity. With the spectroscope the identity of the colouring matter with that of the blood of vertebrates can be easily proved. The hæmoglobin is connected with globules, of varying form and size. Most have a nucleus and are true cells. Along with these are free nuclei and small unnucleated corpuscles charged with hæmoglobin.

An Optical Property of the Cornea.—Prof. Fleischl of Vienna has recently examined fresh corneas in polarised light, and found that the corneal fibres became, under tension, doubly refractive, and then occasionally give phenomena similar to those occurring in starch granules (the theory of which has been examined by von Lang). With this condition also is connected the opacity of the cornea on rise of intraocular pressure.

Phosphoric Acid in the Urine of Cows.—It is generally supposed that the urine of herbivora does not contain phosphoric acid. M. Chevron, however, lately had occasion (*Bull. de l'Acad. Roy. de Belg.*, No. 8) to observe phosphates (a combination of potassico-magnesian phosphate with bimagnesic phosphate) in the urine of cows which had been receiving linseed oil-cake (1½ kil. per head daily), bran (1½ kil.), beet (25 kil.), and straw (7½ kil.), a diet which is rich in phosphoric acid (oil-cake and bran) and in potash (beet). The phosphoric acid diminished and disappeared when green clover or lucern was substituted for the beet. It appears from experiments made by Herr Bertram in Leipzig, in 1878, that lime has the property of eliminating phosphoric acid from the urine of herbivora, and M. Chevron points out that the green fodder specified undoubtedly imparted more lime than the beet did. He proposes further experiment, however, to determine exactly the cause of elimination of the acid

Rudimentary Coma in Godetia.—While investigating the development of the embryo sac in the different genera of Onagraceæ, writes Mr. John M. Coulter, editor of the *Botanical Gazette*, Indiana (vol. v. Nos. 8 and 9, p. 75), my attention was attracted to certain hair-like projections which appeared upon the forming ovule of Godetia (probably *G. grandiflora*). A careful examination showed them to be identical in structure with the forming hairs in the coma of Epilobium. They occurred almost exclusively at the chalazal end, one or two scattered ones being detected farther down upon the raphe. A study of the development of the coma of Epilobium shows that the first indication of it is a tuberculated appearance of the chalazal end. Presently these tubercles push out into elongating nucleated cells, which eventually develop into the long hairs of the coma. Now Godetia permanently retains this tuberculated margin at the upper end, but does not usually develop its coma any further. In the cases examined, however, the forming ovules (either in reminiscence or prophecy) stretched out their tubercles into incipient hairs. Tracing these ovules in their subsequent development, it was found that these hairs gradually disappeared until, when the ovules had become anatropous, there was no indication of them. As Godetia has been merged into Œnothera, many species of the latter were examined, to see if any such thing occurred in them; but no trace of such growth was detected. This would seem to indicate that if Godetia be not entitled to generic rank, it is at least that part of Œnothera which approaches Epilobium. A discrepancy must, however, be noticed here. In Epilobium the hairs of the coma do not begin to form until the ovule has become completely anatropous; but in the Godetia observed the incipient coma had all disappeared by the time the ovule had become anatropous, beginning to form before the nucleus is half covered by the coats. These hairs appeared in greatest size and abundance when the axis of the ovule was at right angles to its anatropous position.

PHYSICAL NOTES

A beautiful illustration of the laws of polarisation of light has lately been made by M. G. Govi. To understand it requires a somewhat careful explanation. Let a parallel beam of light be passed through a polariser, then through a thin slice of quartz cut perpendicularly to the optic axis, then through an analysing Nicol prism. It is seen, as is well known, to be coloured. This coloured light when passed into a spectroscope gives a spectrum marked by one or more dark bands, corresponding to the particular rays whose relative retardations in passing through the crystal slice have produced interference. These bands are not always in one place; they are displaced right or left (according to whether the crystal is a right-handed or a left-handed specimen) if either the analyser or the polariser be rotated. A slice of quartz about 4·3 millims. thick produces a single band. One of 8·6 millims. two bands at once in the visible spectrum, the number of bands being proportional to the thickness of the crystal. Now suppose a mechanical contrivance by which both the analyser and the spectrum can be rotated at the same velocity. A direct-vision prism attached to the front of the Nicol prism realises the optical portion of this combination. There will be seen on rotation a circular spectrum, having either red or violet at the centre and either violet or red at its outer circumference. Now since the dark band spoken of is displaced by a quantity proportional to the amount of rotation, interference will take place in this circular spectrum along points which form geometrically a spiral of Archimedes. The persistence of impressions on the retina will enable this dark spiral to be seen in its entirety, provided the rotation be sufficiently rapid. If a thicker piece of quartz be used, giving two, three, or four dark bands, the rotation-spectrum will present a most beautiful appearance, being crossed by a two-branched, or three-branched, or four-branched spiral, the separate lines of which proceed from the centre to the circumference. The sense of these dark spirals will change with the sense of the impressed rotation. The effects are very striking.

SEVERAL ingenious contemporaries of ours on this side of the Atlantic have furnished the eager appetites of their readers with diagrams of Graham Bell's photophone, of which the most casual observer cannot fail to notice the utter want of resemblance to one another. More than one at least of these is *ben trovato*.

LIQUID OZONE has been obtained by MM. P. Hautefeuille and J. Chappuis, and is found to be of a beautiful blue colour. If a mixture of oxygen and ozone at a temperature of about -23° or -25° be subjected to a considerable pressure, the ozone liquefies and will remain liquid even though the pressure be reduced to 10 atmospheres. Experiments involving alterations of pressure must however be carefully made; for the ozone is liable to change into oxygen with a sudden evolution of heat, producing an increase of pressure with explosive violence. It is necessary to interpose a layer of sulphuric acid upon the top of the column of mercury by which the pressure is applied in the instrument, as ozone acts directly on the mercury.

HERR HANKEL has recently (*Wied. Ann.*, No. 8) endeavoured to prove the direct transformation of vibrations of radiant heat into electricity. He had formerly shown that rock crystal has thermoelectric polar axes in the direction of its secondary axes (the six successive poles being alternately positive and negative), and he supposes the ether within the crystal to be so arranged that under influence and with participation of the material molecules it is movable in circular paths round the secondary axes, and more easily movable in one direction than in the other. Thus all along a secondary axis the more easily occurring rotation has the same direction, but looked at from without, the direction is opposite at one end to what it is at the other, so giving the opposite modifications of electricity. When radiations from without strike along such an axis, those vibrations in them whose direction coincides with that of the easier rotation of the ether-molecule in the crystal should induce rotation of this along with the material molecule, and at the two ends of the secondary axis there should be electric tensions, with opposite electricity. Herr Hankel verified this by placing an insulated metallic ball connected with a gold-leaf electroscope in the middle of one edge of a rock crystal fixed with its principal axis vertical, while sunlight was thrown from the other side along the secondary axis terminating at the ball; then the arrangement was reversed. The electroscope indicated opposite electricities in the two cases. A gas-flame or a heated ball gave similar effects, which, moreover, were proved to be due to the dark heat rays (not to the luminous rays).

THE specific rotatory power of paraglobulin in blood serum is $47^\circ{\cdot}8$ for yellow light; that of albumen, $57^\circ{\cdot}3$. As these are the only albuminoid substances present in any considerable quantity, two determinations with the aid of the polaristrobometer suffice (as M. Fredericq has shown to the Belgian Academy) for ascertaining their relative proportions. The rotation produced by the whole liquid is first determined; then the paraglobulin is precipitated with $MgSO_4$, then redissolved in a volume of water equal to that of the original serum, and the rotation-number got from this is deducted from that got previously. Each of the numbers divided by that representing the specific rotatory power of the corresponding substance indicates the quantity of the substance in 100 cc.

IN a recent brief memoir to the *R. Accademia dei Lincei* (*Atti*, June, 1880), Dr. Bartoli describes an ingenious application of the Bunsen calorimeter to determination of the mechanical equivalent of heat. A given mass of mercury at zero temperature is subjected to a considerable pressure, exactly determined, and passed through a steel tube of so small internal diameter and such length that its velocity of outflow is virtually *nil*, and so the work equivalent to the kinetic energy of the mercury issuing from the tube becomes negligible in presence of the work consumed by friction between the mercury and the walls of the tube. This tube penetrates into a metallic cylinder situated within the reservoir of the Bunsen calorimeter. The quantity of ice melted in the calorimeter serves as measure of the heat developed by the work of efflux of mercury. It is stated that the numerical results are noteworthy for their agreement with the mean of former determinations, and still more for the narrow limits between which the extreme values arrived at are comprised.

EXPERIMENTS with regard to interpretation of the unequal reversal of magnesium lines in the green part of the solar spectrum are detailed by M. Fiévez in a recent paper to the Belgian Academy (*Bull.* No. 8). He first examined the influence of relative intensity of bright magnesium lines on their visibility by observing them separately and projecting them on the solar spectrum. Then he repeated the experiments of simplification of the spectrum by varying the intensity of the spark. Lastly, he studied the influence of greater or less dispersion and definition on the number and visibility of the lines, comparing prismatic with diffraction spectra. The experimental arrangements were mainly the same as in his recent researches on the spectra of hydrogen and nitrogen. The conclusion he arrives at is that the unequal reversal in question is due merely to a difference in the intensity of the bright lines, not to a dissociation of the metal.

M. BOUTY considers he has proved (*Journal de Phys.*, September) that in simple electrolysis the Peltier phenomenon is produced according to the same laws as at the surface of contact of two metals. It is a purely physical phenomenon without known relations with the heat of combination, or with the latent heat of solution, but connected by a precise law with the thermo-electric forces of corresponding couples. Chemical actions intervene in the production of one or other of the two inverse phenomena merely as disturbing causes, either altering the nature of the surfaces or producing a secondary liberation of heat. They may mask, more or less, the phenomenon on which they are superposed, but they do not produce it.

GEOGRAPHICAL NOTES

MR. LEIGH SMITH, during his Arctic cruise in his yacht *Eira*, has evidently done some very good work this summer. After cruising about the east coast of Greenland and in the neighbourhood of Spitzbergen, finding the ice-pack too dense and too far south to get far north without danger—although he reached 79° 40′ N. in 46° 50′ E., the farthest point yet reached in that direction—Franz-Josef Land was reached on August 14. Here much exploring work was done. Land was found stretching away west and north-west from that discovered by the Austrians. A fine harbour, called after the *Eira*, was found in 80° 5′ 25″ N., 48° 50′ E., and several excursions were made from this basis, among the numerous fjörds that pierce the mainland north and north-west. From the point named by the last Dutch expedition Barentz Hook, land was traced westwards some 110 miles, and from the extreme north-west point reached land was sighted forty miles further north-west. In the sea between were several large and small islands, all covered with glaciers and snow-fields, with bluff black headlands on the southern exposure, covered with vegetation. Several Arctic flowers were collected and brought home; a number of soundings and dredgings were made, yielding interesting results, and two bears which were caught have been sent to the Zoological Gardens. Evidently there is here a considerable archipelago, if not continuous stretch of land, giving some support to Petermann's theory that the Pole is probably surrounded by numerous islands. It is stated that Mr. Leigh Smith goes back next year; we trust he will reach Eira Harbour early, and be able to still further extend our knowledge of these new Arctic lands.

THE October number of *Petermann's Mittheilungen* contains several good papers. There is an interesting account of the progress of the Japanese trading station in Corea, which now contains about 2,000 Japanese inhabitants. Important information is given as to the results of Dr. O. Finsch's voyage in the Pacific. During a stay in the Sandwich Islands he made considerable additions to our knowledge of their natural history; thence he went to Jabut (Bonham) in the south of the Marshall Group, where his collections and observations in all directions were numerous and of great value. Thence he proceeded to the Gilbert or Kingsmill Group, and afterwards to the Carolines. Some idea of the results so far may be obtained from the fact that he has sent to Europe something like thirty boxes of collections; the materials collected in ten months embrace 70 mammals, 180 birds, 800 reptiles, 1,200 fishes, 15,000 molluscs, 800 crustaceans, 400 spiders, 1,400 insects, and about 150 other animals, besides 700 plants, and two boxes of minerals. In anthropology there are 50 skulls and 55 casts of faces, representing the peoples of 20 different islands, besides 1,500 ethnographical objects. Dr. Hann contributes "Some Results of Recent Meteorological and Hypsometric Observations in Equatorial East Africa;" Col. Mason-Bey, a detailed account of Dar-fur; and Prof. Ratzel, a paper on the Formation of Fjörds in Inland Seas.

UNDER the title of "Some Heroes of Travel," the Society for Promoting Christian Knowledge has issued a volume by that versatile and successful compiler Mr. Davenport Adams. It contains the stories of Marco Polo, G. F. Ruxton (Mexico and the Rocky Mountains), Barth, T. W. Atkinson (Siberia and Central Asia), Miss Tinné, Mr. McGahan, Col. Warburton, (Australia), Major Burnaby, and Sir Samuel Baker. Mr. Adams seems to have done his work conscientiously, and the book is likely to interest youthful readers and those fond of tales of adventure.

VOL. v. of Dr. Robert Brown's "Countries of the World" (Cassell) includes Siberia, the Chinese Empire, Burmah, and the other countries of the Indo-Chinese peninsula, India and neighbouring countries, Central Asiatic States, Russian Central Asia, and Persia. The new volume is quite up to the mark of the previous ones, and the numerous illustrations are well selected.

M. E. S. ZEBALLOS, writing from Buenos Ayres to *L'Exploration*, states that he has returned from the exploration of the Pampas of the Argentine Republic, and instead of finding them the featureless dead level which they are usually described, he discovered majestic mountains, lakes, rivers, and other features, which will materially change the map of South America. M. Zeballos kept minute records of his expedition, topographical, descriptive, scientific, meteorological, &c., which we hope will be placed within the reach of European geographers.

IN the last number of the *Bulletin* of the Eastern Siberian (Iskutsk) Section of the Russian Geographical Society is the continuation of the Report of M. Tcherski of the results of his three years geological exploration of the neighbourhood of Lake Baikal.

THE fourth Belgian expedition, under Capt. Raemackers, had got well into Central Africa from Bagamoyo by the end of August.

THE FIRST DECADE OF THE UNITED STATES FISH COMMISSION—ITS PLAN OF WORK AND ACCOMPLISHED RESULTS, SCIENTIFIC AND ECONOMICAL[1]

THERE are now no less than nine departments of the Government devoted, in part or wholly, to researches in pure and applied science—the Geological Survey, the Coast and Geodetic Survey, the Naval Observatory, the National Museum, the Department of Agriculture, the Entomological Commission, the Tenth Census, with its special agencies for the study of the natural resources of the country, the Smithsonian Bureau of Ethnology, and the Commission of Fish and Fisheries. The Smithsonian Institution, established upon an independent foundation, should also be mentioned, as well as the Medical Museum of the Army and the various laboratories under the control of the Army and Navy Departments.

The Geological Survey is not now carrying on any of the schemes of zoological and botanical investigation engaged in by its predecessors.

The work of the Entomological Commission and that of the Census, though of extreme importance, are limited in scope and duration, while that of the Agricultural Department is necessarily, for the most part, economical.

The work of the National Museum is chiefly confined to the study of collections made by Government Surveys, or individual collectors, as sent in to be reported upon.

The work of the Fish Commission, in one of its aspects, may perhaps be regarded as the most prominent of the present efforts of the Government in aid of aggressive biological research.

On the 9th of February, 1871, Congress passed a joint resolution which authorised the appointment of a Commissioner of Fish and Fisheries. Prof. Baird, at that time Assistant-Secretary of the Smithsonian Institution, was appointed, and entered at once upon his duties.

The summer of 1880 marks the tenth season of active work since its inception in 1871. The Fish Commission now fills a place tenfold more extensive and useful than at first. The present essay aims to show, in a general way, what it has done, is doing, and expects to do—its purposes, its methods, its results.

[1] Read before the American Association for the Advancement of Science, Boston, August 28, 1880, by G. Brown Goode.

The work is naturally divided into three sections—

1. The systematic investigation of the waters of the United States and of the biological and physical problems which they present.—In making his original plans the Commissioner insisted that to study only the food-fishes would be of little importance, and that useful conclusions must needs rest upon a broad foundation of investigations purely scientific in character. The life-history of species of economic value should be understood from beginning to end, but no less requisite is it to know the histories of the animals and plants upon which they feed, or upon which their food is nourished; the histories of their enemies and friends, and the friends and foes of their enemies and friends, as well as the currents, temperatures, and other physical phenomena of the waters in their relation to migration, reproduction, and growth. A necessary accompaniment to this division is the amassing of material for research to be stored in the National and other Museums for future use.

2. The investigation of the methods of the fisheries of the past and present, and the statistics of production and commerce in fishery products.—Man being one of the chief destroyers of fish, *his* influence upon their abundance must be studied. Fishery methods and apparatus must be examined and compared with those of other lands, that the use of those which threaten the destruction of useful fishes may be discouraged, and that those which are inefficient may be replaced by others more serviceable. Statistics of industry and trade must be secured for the use of Congress in making treaties or imposing tariffs, to show to producers the best markets, and to consumers where and with what their needs may be supplied.

3. The introduction and multiplication of useful food-fishes throughout the country, especially in waters under the jurisdiction of the general Government, or those common to several States, none of which might feel willing to make expenditures for the benefit of the others.

Although activity in this direction may be regarded in the light of applied rather than pure scientific work, it is particularly important to the biologist, since it affords opportunities for investigating many new problems in physiology and embryology.

Since the important fisheries centre in New England the coast of this district has been the seat of the most active operations in marine research. For ten years the Commissioner, with a party of specialists, has devoted the summer season to work at the shore at various stations along the coast from Connecticut to Nova Scotia. A suitable place having been selected, a temporary laboratory is fitted up with the necessary appliances for collecting and study. In this are placed from ten to twenty tables, each occupied by an investigator, either an officer of the Commission or a volunteer. From 1873 to 1879 important aid was rendered by the Secretary of the Navy, who detailed for this service a steamer to be used in dredging and trawling, and this year the steamer built expressly for the Commission is employed in the same manner.[1]

The regular routine of operations at a summer station includes all the various forms of activity known to naturalists: collecting along the shore, seining upon the beaches, setting traps for animals not otherwise to be obtained, and scraping with dredge and trawl the bottom of the sea at depths as great as can be reached by a steamer in a trip of three days. In the laboratory are carried on the usual structural and systematic studies, the preparation of museum specimens and of reports. Since the organisation of the Commission the deep-sea work and the investigation of invertebrate animals has been under the charge of Prof. Verrill, who had for many years before the Commission was established been studying independently the invertebrate fauna of New England.

In addition to what has been done at the summer station, more or less exhaustive investigations have been carried on by smaller parties on many parts of the coast and in interior waters.

[1] The number of dredging and trawling stations on record is as follows:—

1871.	Wood's Holl	345
1872.	Eastport. 200 by hand, 36 by steamer	236
1873.	Portland	149
1874.	Noank	223
1875.	Wood's Holl	169
1877.	Salem }	
,,	Halifax }	
1878.	Gloucester }	378
1879.	Provincetown }	
		1,500

The number of seine hauls is about 600.

The fauna of the Grand Banks and other off-shore fishing-grounds has been partly explored. In 1872, 1873, and 1874 dredging was carried on from the Coast Survey steamer *Bache* by Prof. Packard and Mr. Cooke, Prof. Smith, Mr. Harger, and Mr. Rathbun. In 1879 Mr. H. L. Osborne spent three months in a cod-schooner collecting material on the Grand Banks, and Mr. N. P. Scudder as long a time on the Holibut Grounds of Davis's Straits.

A most remarkable series of contributions has been received from the fishermen of Cape Ann. When the Fish Commission had its head-quarters at Gloucester, in 1878, a general interest in the zoological work sprang up among the crews of the fishing-vessels, and since that time they have been vying with each other in efforts to find new animals. Their activity has been stimulated by the publication of lists of their donations in the local papers, and the number of separate lots of specimens received to the present time exceeds 800. Many of these lots are large, consisting of collecting-tanks full of alcoholic specimens. At least thirty fishing-vessels now carry collecting-tanks on every trip, and many of the fishermen, with characteristic superstition, have the idea that it insures good luck to have a tank on board, and will not go to sea without one. The number of specimens acquired in this manner is at least 50,000 or 60,000, most of them belonging to species otherwise unattainable. Each holibut vessel sets, twice daily, lines from ten to fourteen miles in length, with hooks upon them six feet apart, in water 1,200 to 1,800 feet in depth, and the quantity of living forms brought up in this manner, and which had never hitherto been saved, is very astonishing. Over thirty species of fishes have thus been added to the fauna of North America; and Prof. Verrill informs me that the number of new and extra-limital forms thus placed upon the list of invertebrates cannot be less than fifty.

A permanent collector, Mr. Vinal N. Edwards, has been employed at Wood's Holl and vicinity since 1871, and many remarkable forms have also been discovered by him. No dredging has yet been attempted by the Commission south of Long Island. Dr. Yarrow, Mr. Earll, and others, have collected from Cape May to Key West. The Gulf States Coast was explored last winter by a party conducted by Mr. Silas Stearns, who spent nine months in studying the food-fishes and useful invertebrates in behalf of the Commission and the Census. The entire Pacific coast has been scoured by Prof. Jordan for the Commission and the Census, and the ichthyology of that region has been enriched by the discovery of sixty species new to the fauna, forty of them being new to science. A similar investigation on the great lakes has been carried over a period of several years by the late Mr. Milner and Mr. Kumlien. The ichthyology of the rivers of the country has received much attention from the many experts employed by the Commission in fish-cultural work.

In addition to these local studies may be mentioned the general explorations such as are now being carried on for the oyster by Mr. Ernest Ingersoll and Mr. John F. Ryder, for the shad by Col. McDonald, for the smelt and the Atlantic salmon by Mr. C. G. Atkins, and the Quinnat salmon by Mr. Livingston Stone.

A partial indication of what has been accomplished may be found in the number of species added to the various faunal lists. Take, for instance, the cephalopod mollusks of New England, in Prof. Verril's recently published monographs; twenty species are mentioned, thirteen of which are new to science. Ten years ago only three were known.

I am indebted to Prof. Verrill for the following estimate of the number of species added within the past ten years to the fauna of New England, mainly by the agency of the Commission:—

	Formerly known.	Additions.	Now known.
Crustacea	105	193	298
Pycnogonida	5	10	15
Annelida	67	238	305
Vermes	39	100	139
Mollusca	317	109	426
Echinodermata	47	41	88
Anthozoa or Polyps	20	35	55
Hydrozoa or Acalepha	102	78	180
Tunicata	26	25	51
Polyzoa	56	91	147
Brachiopoda	5	0	5
Sponges	10	80	90
	800	1,000	1,800

It is but just to say that many of these species were obtained by Prof. Verril in the course of his independent explorations in Maine and Connecticut previous to 1871.

A similar estimate for the fishes indicates the discovery of at least 100 species on the Eastern Atlantic coast within ten years; half of these are new to science. Forty species have been added to the fauna north of Cape Cod; sixteen of these are new and have been found within three years. Seventeen have been described as new from the Gulf of Mexico. Sixty and more have been added upon the west coast. The results of the summer campaigns are worked in winter in the Peabody Museum of Yale College, under the direction of Prof. Verril, and by the specialists of the National Museum.

One of the important features of the work is the preparation of life-histories of the useful marine animals of the country, and great quantities of material have been accumulated relating to almost every species. A portion of this has been published. More or less complete biographical monographs have been printed on the bluefish, the scup, the menhaden, the salmon, and the whitefish, and others are nearly ready. Another monograph which may be referred to in this connection is that of Mr. Starbick on the whale-fishery, giving its history from the earliest settlement of North America.

The temperature of the water in its relation to the movements of fish has from the first received special attention. Observations are made regularly during the summer work, and at the various hatching-stations. At the instance of the commissioner, an extensive series of observations have, for several years, been made under the direction of the chief signal officer of the army, at lighthouses, light-ships, life-saving and signal stations, carefully chosen along the whole coast. This year thirty or more fishing schooners and steamers are carrying thermometers to record temperatures upon the fishing-grounds, a journal of the movements of the fish being kept at the same time. One practical result of the study of these observations has been the demonstration of the cause of the failure of the Menhaden fisheries on the coast of Maine in 1879—a failure on account of which nearly 2,000 persons were thrown out of employment. Another important series of investigations carried on by Commander Beardsley of the Navy shows the error of the ordinary manner of using the Casel-Miller deep-sea thermometer; still another series made by Dr. Kidder of the Navy, and to be carried out in future, had for its object the determination of the temperature of the blood of marine animals. Observations have also been made by Mr. Milner upon the influence of a change from sea water into fresh water, and from fresh water into sea water upon the young of different fishes. Mr. H. J. Rice carried on a series of studies upon the effect of cold in retarding the development of incubating fish-eggs. A series of analyses have been made by Prof. Atwater to determine the chemical composition and nutritive value of fish as compared with other articles of food. This investigation is still in progress. In connection with the work of fish-culture, much attention has been paid to embryology. The breeding times and habits of nearly all of our fishes have been studied and their relations to water temperatures. The embryological history of a number of species such as the cod, shad, alewife, salmon, smelt, Spanish mackerel, striped bass, white perch, and the oyster, have been obtained, under the auspices of the Commission, by Messrs. Brooks, Ryder, Schaeffer, Rice, and others.

The introduction of new species in water in which they were previously unknown is of special interest to the student of geographical distribution. Through the agency of the Commission the German carp has already been placed in nearly every State and Territory, although the work of distribution has only just begun, and the tench (*Tinca vulgaris*) and the golden orfe (*Idus melanotus*) have been acclimated; the shad has been successfully planted in the Mississippi valley and on the coast of California, and the California salmon in the rivers of the Atlantic slope. The lake whitefish of Europe has been introduced into a lake of Wisconsin. As an act of international courtesy, California salmon have been successfully introduced into New Zealand and Germany. The propagation work has increased in importance from year to year, as may be seen by the constant increase in the amount of the annual appropriation. A review of the results of the labours of the Commission in increasing the food supply of the country may be found in the annual reports. The rude appliances of fish-culture in use ten years ago have given way to scientifically devised apparatus, by which millions of eggs are hatched where only thousands were before, and the demonstration of the possibility of stocking rivers and lakes to any desired extent has been greatly strengthened. This work was for six years most efficiently directed by the late Mr. James W. Milner, and is now in charge of Major T. B. Ferguson, also Commissioner for the State of Maryland, by whom has been devised the machinery for propagation on a gigantic scale, by the aid of steam, which is now so successfully in use.

The investigation of the statistics and history of the fisheries has perhaps assumed greater proportions than was at first contemplated. One of the immediate causes of the establishment of the Commission was the dissension between the line and net-fishermen of southern New England with reference to laws for the protection of the deteriorating fisheries of that region. The first work of Prof. Baird as Commissioner was to investigate the causes of this deterioration, and the report of that year's work includes much statistical material. In the same year a zoological and statistical survey of the great lakes was accomplished, and various circulars were sent out in contemplation of the preparation of monographic reports upon the special branches of the fisheries, some of which have already been published.

Some thirty trained experts are now engaged in the preparation of a statistical report on the present state and the past history of the fisheries of the United States. This will be finished next year, but the subject will hereafter be continued in monographs upon separate branches of the fisheries, such as the holibut fishery, the mackerel fishery, the shad fishery, the cod fishery, the herring fishery, the smelt fishery, and various others of less importance.

Hundreds, and even thousands of specimens of a single species are often obtained. After those for the National Museum have been selected, a great number of duplicates remain. These are identified, labelled, and made up into sets for exchange with other museums and for distribution to schools and small museums. This is in accordance with the time-honoured usage of the Smithsonian Institution, and is regarded as an important branch of the work. Several specialists are employed solely in making up these sets and in gathering material required for their completion. Within three years fifty sets of fishes in alcohol, including at least ten thousand specimens, have been sent out, and fifty sets of invertebrates, embracing 175 species and 25,000 specimens. One hundred smaller sets of representative forms intended for educational purposes, to be given to schools and academies, are now being prepared. The arrangement of the invertebrate duplicates is in the charge of Mr. Richard Rathbun; of the fishes, in that of Dr. T. H. Bean. Facilities have also been given to many institutions for making collections on their own behalf. Six annual reports have been published, with an aggregate of 5,650 pages. These cover the period 1871 to 1878. Many papers relating to the work have been published elsewhere, particularly descriptions of new species and results of special faunal exploration.

The season of 1880 was opened by the participation of the Commission in the International Exhibition at Berlin. The first honour-prize, the gift of the Emperor of Germany, was awarded to Prof. Baird, not alone as an acknowledgment that the display of the United States was the most perfect and most imposing, but as a personal tribute to one who, in the words of the president of the Deutscher Fisherei Verein, is regarded in Europe as the first fish-culturalist in the world.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—This year the term commences somewhat later than usual. The professorial lectures on natural science begin next week. At the University Museum Dr. Odling lectures on Typical Alcohols, Prof. Clifton on Experimental Electricity, Prof. Price on Hydro mechanics, Prof. Story-Maskelyne, M.P., on the Elements of Crystallography, Prof. Prestwich on Stratigraphical Geology, and Prof. Rolleston on Digestion.

Lectures are also given in the Chemical Department at the Museum by Mr. W. W. Fisher, on Inorganic Chemistry, by Mr. J. Watts on Organic Chemistry, and by Dr. F. D. Brown on Chemical Affinity. In the Biological Department Messrs. C. Robertson, W. H. Jackson, and A. P. Thomas form classes for instruction in Microscopy and Zoology. Mr. Barclay Thompson gives a course on the Comparative Anatomy of the Mammalia. In the Clarendon Laboratory Mr. Stocker lectures on Elementary Mechanics, and, with Mr. V. Jones, gives instruction in practical physics.

At the University Observatory Prof. Pritchard will lecture on Spherical Astronomy, including instruments, and will give a course of six lectures on the Precession of the Equinoxes, including the Lunar Physical Libration. The Observatory is opened on Monday and Tuesday evenings during the term to members of the University who desire to obtain instrumental practice. In his annual report to the Board of Visitors the Professor gives an account of the work carried on during the past year at the Observatory. The long series of observations in reference to the Inequalities in the Moon's Rotation are now finished, and the results will be shortly published. The calculations were brought to a successful issue during the Long Vacation, and afford a general confirmation of the investigations of Bouvard, Nicollet, and Wichmann, and establish the existence of small but sensible inequalities in the moon's rotation. Careful measurements have also been made by Mr. Plummer of the relative positions of forty stars in the Pleiades, and Mr. Jenkins has measured the relative co-ordinates of 250 stars in the cluster 39 Messier. Careful observations have also been made of the component stars of ξ Ursæ Majoris and 70 Ophiuchi. With regard to the instruments the Professor writes:—

"The large refractor has been thoroughly examined and cleaned by Mr. Grubb, the artist who constructed it. This at present is in an efficient working condition in every respect. From our own resources we have thoroughly overhauled the De La Rue Reflector, and it also is in excellent condition. It is fortunate for the University that both these instruments pass from time to time under the experienced and critical eye of Dr. De La Rue himself. For a time Dr. De La Rue's metallic speculum was replaced by an excellent silvered glass mirror, executed by Mr. With; the newer mirror possessed the greater capacity of the two, in point of brilliancy of reflected light, but was not deemed quite equal to Dr. De La Rue's in point of definition; we have therefore returned to the use of the original speculum.

"In order to carry out a new and important series of astronomical observations I soon found that the use of a chronograph was indispensable; accordingly I have, in conjunction with Mr. Grubb, devised a very inexpensive but practically efficient form of that instrument. The total cost of this instrument, together with a corresponding and necessary addition to the mechanism of the sidereal clock, has not exceeded 10*l*. I am told on the best authority that this form of the chronograph will henceforth prove a desirable adjunct in other observatories.

"With the view of bringing practical astronomy within the reach of a moderate expenditure I have (again in conjunction with Mr. Grubb) devised a modification of existing small equatorial telescopes, which I anticipate will prove a boon to beginners in astronomical science.

"Lastly, I have devised and carried into execution a simple form of precessional globe for the use of students in astronomy. It affords very ready means of representing the risings and settings of the stars, and the general aspect of the heavens at the remotest periods of time, past and future, and as seen at any locality."

In the Botanic Garden Prof. Lawson will give instruction on the Minute Anatomy of the Vegetable Tissues.

The following lectures are given in those colleges which possess laboratories. At Christ Church Mr. Vernon Harcourt lectures on the Non-metallic Elements, and Mr. R. E. Baynes on Dynamical Electricity and Conduction of Heat. At Balliol College Mr. J. W. Russell lectures on Problems in Mechanics, and Mr. H. B. Dixon on Elementary Heat and Light. At Exeter College Mr. Lewis Morgan lectures on Practical Histology, and at Magdalen College Mr. C. J. Yule gives a course of demonstrations on the Chemical Composition of the Body.

AN examination for Natural Science Scholarships is being held by Trinity and Exeter Colleges. The former College has this year for the first time offered a scholarship for proficiency in science. At Merton College the science scholarship (Postmastership) was not awarded.

AT Balliol College there will be offered next month a science scholarship, on the foundation of Miss Brakenbury, open to all candidates without limitation of age, who shall not have exceeded eight terms from matriculation. The scholarship is of the annual value of 80*l*., and is tenable for four years during residence. Papers will be set in the following subjects:—(1) Mechanical Philosophy and Physics, (2) Chemistry, (3) Physiology. Candidates will not be expected to offer themselves in more than two of these. There will be a practical examination in one or more of the above subjects if the examiners think it expedient. Intending candidates should communicate with the Master of Balliol before November 12. There will also be offered two exhibitions worth 40*l.* a year, the examination for which will comprise the elements of Physics, Chemistry, or Physiology, as well as Classics and Mathematics.

CAMBRIDGE.—Dr. Michael Foster will lecture on elementary physiology; Mr. Langley will lecture to the advanced class on general physiology twice a week; Mr. Lea takes physiological chemistry; and Dr. Gaskell the physiology of the circulation.

Mr. VENN will lecture during the next two terms on scientific method.

MR. FREEMAN of St. John's College is to lecture as deputy for Prof. Challis, owing to his infirm health.

DR. REGINALD THOMPSON of Trinity College is to be one of the Examiners for 3rd M.B., and Dr. Cheadle to be Assessor to the Regius Professor of Physic.

THE list of lecturers at Newnham College this term includes the names of Miss Crofts (English History and Literature), Miss Merrifield (Greek), Miss Harland (Algebra), and Miss Scott (Analytical Conics). The lectures are now delivered at the College, and not in Alexandra Hall.

AT St. Thomas's Hospital Medical School Mr. Robert Lawson has obtained the Entrance Scholarship in Natural Science, of the value of 100*l.*, and Mr. Herbert Lankester that of 60*l.*

AT the meeting of the Council of the College of Physical Science, Newcastle-on-Tyne, on October 11, it was decided without opposition that a lady candidate, Miss Isabel M. Aldis, should be allowed to hold an exhibition in the College. This decision completes the opening of the advantages of the College to lady students. They were previously admitted to all the lectures, but this is the first time that a lady has been a candidate for an exhibition.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, October 11.—M. Wurtz in the chair. The following papers were read:—On the *rôle* of time in the formation of salts, by M. Berthelot. Experiments with several hundred saline mixtures prove that the period of change in saline reactions, comprised between the moment when the system has become physically homogeneous and that when it attains its chemical equilibrium, is excessively short, and wholly included in the short duration of the calorimetric experiment. The same period in ethene reactions, on the other hand, is incomparably longer. The instantaneity in the former case is proved by an application of the author's theorem of slow actions.—On pellagra in Italy, by M. Faye. In the past year there have been 40,000 well-marked cases of the disease in Lombardy, and 30,000 in Venetia, the richest and most productive provinces in Italy. It is unknown in Naples, Sicily, and Sardinia (so poverty and bad hygiene do not seem to be the causes). Wherever pellagra appears in the endemic state *polenta* or *cruchade* are eaten, *i.e.*, varieties of unfermented bread (made from maize and millet), and M. Faye thinks the substitution of fermented bread would prove salutary.—On the photophonic experiments of Prof. Bell and Mr. Sumner Tainter, by M. Breguet.—On algebraic equations, by Mr. West.—Earthquakes at Smyrna on July 29, by Dr. Charpentin. The ravages and phenomena of this earthquake were limited to the Sipyle chain and the adjoining plains in a perimeter of only a few leagues; but the *contre-coup* was felt at great distances (Broussa, Rhodes, &c.). Chronometers at Athens were stopped. More than 3,000 years ago there seems to have been a volcano under Sipyle, and this point has been the centre of earthquakes in that region. The approximate coincidence (in time) of this last Smyrna earthquake with earthquakes at Manilla, the Azores, and Naples, is remarkable.—On the effects produced by cultivation of absinthe as insectifuge, and on its preventive application against phylloxera, by M. Poirot. Among the absinthe plants covering large tracts in North America the author has never seen flies, ants, worms, or any insects, nor yet scorpions, tarantulas, nor rattlesnakes. Land manured with absinthe might be fatal to the metamorphoses of phylloxera.—Ephemerides of comet *b* 1880 (continued), by M. Bigourdan.—Observations of comet *d* 1880 (discovered by Dr. Hartwig at Strassburg) at the Paris Observatory, by M. Bigourdan.—On the resolvent function of the equation $x^m + px + q = 0$, by M. Pujet.—On a property of Poisson's function, and on the integration of equations with partial derivatives of the first order, by M. Gilbert.—On a very extensive class of linear differential equations with rational coefficients, whose solution depends on the quadrature of an irrational algebraic product, by M. Dillner.—Principle of an algebraic calculus which contains as particular species the calculus of imaginary quantities and quaternions, by M. Lipschitz.—On the partition of numbers, by M. David.—On the mechanical actions of light, theoretical considerations capable of serving in interpretation of Prof. Bell's experiments, by M. Cros. In 1872 M. Cros presented a memoir to the Academy, in which, guided by theoretical considerations, he affirmed *à priori* the results of experiments which he thinks have a notable similarity to Prof. Bell's. In one experiment a ray of light interrupted n times a second was to be sent into a tube resonating with a note of n vibrations. The alternate rarefaction and condensation of the gaseous medium might make the tube speak.—Study of the distribution of light in the solar spectrum, by MM. Macé and Nicati. The maximum intensity is in the yellow, very near D. The perception of blue and violet diminishes much more slowly with diminished illumination than that of less refrangible colours. From the extreme red to green of about 0·5 μ wave-length, the law of distribution of intensity is the same whatever the illumination. Between eyes equally capable of discerning colour, there are very sensible differences.—Vibratory forms of circular pellicles of saposaccharic liquid, by M. Decharme. With a given diameter of pellicle the numbers of nodals are inversely proportional to the corresponding lengths of the vibrating rod (which produces the waves).—On the place which boron occupies in the series of simple bodies, by M. Etard. He places boron in the family of vanadium, very near that of phosphorus.—On propylacetal and isobutylacetal, by M. de Girard.

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