THURSDAY, MAY 31, 1888.

AL-BÎRÛNÎ.

Al-Bîrûnî's India: an Account of the Religion, Philosophy, Literature, Chronology, Astronomy, Customs, Law, and Astrology of India about A.D. 1030. Edited in the Arabian original by Dr. Edward Sachau. (London: Trübner and Co., 1887.)

IT has often been said that India has no history and no historians. We look in vain through the ancient Sanskrit literature for any Herodotus or Thucydides. The very idea of chronicling the events of the day or gathering the recollections of the past seems never to have entered the Hindu mind, and their ancient chronology is hardly more than astronomical mythology. The historical growth of Indian literature, religion, and philosophy would indeed have remained a perfect riddle but for the few glimpses which we are able to catch of the real history of the country through other nations which were brought in contact with it. These are the Greeks, the Chinese, and the Arabs, whose successive accounts run like three broad bands of longitude across the ill-defined map of ancient India.

The Greeks do not tell us very much of what they saw of India, either before or after Alexander's invasion. We may indeed gather from Hecatæus (B.C. 549-486) that India existed, and that its chief river, the Indus, had a name of Sanskrit origin. We know, therefore, that Sanskrit was the spoken language of India in the sixth century B.C. But even that name had clearly passed through Persian channels before it reached Hecatæus, for it is only in Persian that the initial *s* of *Sindhu*, the river, could have been changed into *h*, and afterwards been dropped. Herodotus also mentions some Indian names—such as the *Gandarii*, the *Gandhâras* of the Veda—which clearly show that at his time the peoples and rivers and mountains of India had names which find their explanation in Sanskrit only. With Alexander's expedition we might have hoped that the full light of history would have burst upon India. But most of the works written by Alexander's companions have been lost, and even the work of Megasthenes, who stayed as ambassador at Palimbothra, the modern Patna, at the court of King Sandracottus, has been preserved to us in fragments only. Still the date of Sandracottus, in Sanskrit Chandragupta, has proved the sheet-anchor of ancient Indian chronology, and has once for all fixed the date of Chandragupta and of his grandson, the great Buddhist monarch Asoka, in the fourth and third centuries B.C.

The next witnesses to the actual state of political, social, and religious life in India are the Chinese. Buddhism had been adopted as a third State religion in China in the first century A.D. From that time the religious intercourse between China and India was never entirely interrupted. Buddhist priests travelled from India to China, and pious pilgrims went from China to India as the holy land of their religion. Some of these pilgrims have left very full descriptions of what they saw and did in India, the most important being those by Fa-hian (399-414 A.D.), Hiouen-thsang (629-645), I-tsing (673-695), and Khi-nie, who visited India in 964, at the head of 300 pilgrims. Most of these travels and diaries have been translated into French and English by Remusat, Stanislas Julien, Beal, and Legge; and they give us a picture of Indian life during the Middle Ages of which we should have had no idea if we had been restricted to Indian sources alone.

More important, however, than the descriptions of these Greek and Chinese authors, is the work to which we wish to call attention—namely, the account of India written by Al-Bîrûnî in the year 1030 A.D., and now published for the first time by Prof. Sachau, of Berlin. Al-Bîrûnî was a native of Khwârizm, the modern Khiva, born in 973. He had devoted himself to the study of astronomy and philosophy, and when Khiva was taken by Sultân Mahmûd of Ghazna in 1017, Al-Bîrûnî was induced to accompany him to India. The famous Avicenna, *i.e.* Abu Ali Ibn Sina, declined the same honour, and remained at home. During the thirteen years that Al-Bîrûnî spent in India, he devoted himself sedulously to the study of Sanskrit, and Sanskrit literature. He does not use the name of Sanskrit, but calls the language of India, both literary and vernacular, Hindi, *i.e.* Indian; the fact being that Sanskrit was not yet used as a proper name of the ancient literary idiom, but only as an *epitheton ornans*. What progress Al-Bîrûnî made in his studies seems somewhat doubtful. It was formerly supposed that he translated not only from Sanskrit into Arabic and Persian, but likewise from Arabic and Persian into Sanskrit. But Dr. Sachau has clearly proved that his knowledge of Sanskrit was far too elementary to enable him to perform such tasks by himself. He shows that he depended chiefly on the assistance of his pandits, like many Sanskrit scholars of more recent times, and that all we can assert with safety is that he was able to direct and to check their labours. With all that, Al-Bîrûnî was a most exceptional man for his time, a man of wide sympathies, a true philosopher, and acute observer. The very idea of learning a foreign language, except perhaps Persian and Turkish, never entered the head of a Muhammedan. His weapon was the sword, not the pen. Al-Bîrûnî, however, to quote Prof. Sachau's words, "convinced that those who want to meet the Hindus on the battle-ground of intellectual warfare, and to deal with them in the spirit of justice and equity, must first learn all that is peculiar to them in manners and customs as well as in their general modes of thought, produced a comprehensive description of Indian civilization, always struggling to grasp its very essence, and depicting it with due lights and shades, as an impartial spectator." The title of the book tells its own story: "*An accurate description of all the categories of Indian thought, as well those which are admissible, as those which must be rejected.*"

The existence of this work of Al-Bîrûnî's has been known for many years, and Sanskrit scholars have long clamoured for its publication and translation. Their appetite was first whetted by the specimens which Reinaud published in 1845 in his "Fragments Arabes et Persans relatifs à l'Inde," and some years later in his invaluable "Mémoire sur l'Inde" (1849). When Reinaud declined to undertake the editing of the whole text of Al-Bîrûnî's "Indica," Woepcke and MacGuckin de Slane undertook the difficult task. The former, however, died;

the latter began to feel the approach of old age, and the prospect of a speedy termination of this important undertaking became more and more doubtful, when, in the year 1872, a young German scholar, Dr. Sachau, boldly stepped into the breach, and promised to devote all his time to this great enterprise. After fifteen years of hard work he has redeemed his pledge. He has given us the Arabic text of Al-Bîrûnî, and he is now engaged in printing an English translation of it. We doubt whether anyone could have been found so well qualified for the task. Dr. Sachau has long been known as a hard-working, honest, and thoroughly sound scholar. He stands in the first rank among the students of Arabic and Persian, and he possesses, at the same time, a fair knowledge of Sanskrit. He is now one of the brightest stars in the Univerity of Berlin, and has lately been appointed there as Director of the newly-founded Imperial School of Oriental Languages. He was well prepared for his task by having previously published another work of Al-Bîrûnî's, the text and English translation of "The Chronology of Ancient Oriental Nations." Few people can appreciate the enormous difficulties of publishing for the first time an Oriental text like that of Al-Bîrûnî. Dr. Sachau was, no doubt, more fortunate than his predecessors in securing a manuscript of Al-Bîrûnî's, belonging to M. Schefer, which professes to have been copied from a copy in the handwriting of the author. But even thus the labour of editing and translating such a text, which had never been edited and translated before, was enormous. When speaking of the difficulties which he had to overcome in editing Al-Bîrûnî's chronological work, Dr. Sachau writes: "I have boldly attacked the sometimes rather enigmatic style of the author, and if I have missed the mark, if the bewildering variety and multiplicity of the subject-matter have prevented my reaching the very bottom of every question, I must do what more or less every Oriental author does at the end of his work—humbly ask the gentle reader to pardon my error and correct it." There is the true ring of the *bonâ fide* scholar in this. No one is nowadays considered a real Oriental scholar who has not won his spurs by an *editio princeps*. After a text has once been constituted by a comparison of manuscripts more or less faulty; after a translation has once been accomplished, however imperfect, it is easy enough to print a new so-called critical edition, or a new so-called improved translation. But the scholars who take the first, and the scholars who take the second, step belong to different races. They differ as Columbus who discovered America differs from the traveller who now crosses the Atlantic in seven days. "Generations of scholars," as Dr. Sachau says, "have toiled to carry the understanding of Herodotus to that point where it now is, and how much is wanting still!" To expect, therefore, that Al-Bîrûnî's text, as edited here for the first time, or its translation, should be free from mistakes would only show a complete ignorance of the conditions under which Oriental scholars have to work. There may be hereafter better editions of Al-Bîrûnî; there never can be one so creditable to its author as this *editio princeps*. We could have wished that a work of such importance to students of Indian history had been carried out by an English scholar. But, failing that, we have at least the satisfaction that the expense of publishing the Arabic original of the "Indica" has been generously defrayed by the Indian Government, following in this respect the noble example set by the patron of Al-Bîrûnî himself, the powerful Sultân Mahmûd of Ghazna.

THE SCIENTIFIC WRITINGS OF JOSEPH HENRY.

The Scientific Writings of Joseph Henry. Two Vols. 8vo, pp. 1082. (Washington: Smithsonian Institution, 1886.)

UNDER the above title, two handsome volumes have recently been published by the Smithsonian Institution, Washington, containing the papers published by its late distinguished Secretary in various scientific serials through the long period of fifty-four years. It is characteristic of the man that, although for thirty-two of those years he had almost unrestricted command of the publishing resources of that great institution, not one of his papers was given to the world through the medium of the "Smithsonian Contributions" or "Miscellaneous Collections," or in any way at the expense of its funds. They range over a great variety of subjects, chiefly in electrical physics and meteorology, and in date from 1824 to 1878.

As may be inferred from the earlier of these dates, when Faraday was still an assistant to Sir Humphry Davy, in the laboratory of the Royal Institution, and Henry a private tutor in a family at Albany, New York, many of these papers are reprinted for their historical interest rather than for their present scientific value; but his fellow-countrymen, in acknowledging Faraday's pre-eminence, delight to point out in how many particulars Henry walked *pari passu* with him in the then nearly untrodden paths of electro-magnetism, under immense relative disadvantages. As early as 1835, Henry, then a Professor at Princeton, New Jersey, connected his residence with his laboratory in the Philosophic Hall by a telegraph, in which the galvanic circuit was completed through the earth—probably the first realization of that familiar property on which all our telegraph circuits are now dependent. It was a little later (in 1842) that he showed the writer of this short notice, under promise of secrecy, an experiment which at the moment greatly interested him. A long bar of iron was wrapped in a coil or ribbon of copper, half an inch wide; two copper wires, each terminating in a small ball, were soldered to the bar. On holding these balls to the ears, and transmitting a strong current through the coil, a very distinct musical note was heard each time the current was made or broken. He narrowly missed forestalling Faraday in the great discovery of producing electric currents by the rotation of an electro-magnet or movement of its armature. Henry caused an electro-magnet of unusual power to be constructed in August 1831, with a view to realizing his conceptions on this subject. He was at the time accidentally interrupted in pursuing his experiments, and did not resume them until May or June 1832; and in the meantime (in February 1832) Faraday had made his independent discovery.[1] As early as 1843, Henry proposed "a new method of applying the instantaneous transmission of an electrical action to determine the time of the passage of a (cannon) ball between two screens, placed

[1] *Philosophical Magazine*, April 1832.

at a short distance from another in the path of the projectile," and contrived a self-recording apparatus reading to the one-thousandth part of a second. As at that time Hutton and the ballistic pendulum reigned supreme—and this is not an experiment easily made in a laboratory—it does not appear that he carried it out. Perhaps the most elaborate of his numerous researches is that on the transmission of sound in relation to fog-signalling, carried on at the expense of the United States Lighthouse Board for several years from 1865 onwards, concurrently with those on which Prof. Tyndall was at that time engaged for the Trinity Board. That these distinguished men did not always meet with the same effects, or draw the same conclusions from them, is but a natural consequence from the extreme complexity of the phenomena.

The great work of Prof. Joseph Henry's life—in which his strength and calmness of judgment, his high-minded independence and self-effacement, enabled him to achieve the highest results—was the organization of the Smithsonian Institution upon its present liberal basis, in the face of not a little opposition from persons of more contracted views.

"These I's are *egos*, and not *oculi*," is a line from some forgotten squib which he was wont to quote when self-interest seemed to obscure the only interest precious to him—that of science in its widest scope, and the advancement of human knowledge. He lived to see the wisdom of his policy gratefully acknowledged by his countrymen and the scientific world. Although a very fertile inventor, and the author of many ingenious contrivances now in use to facilitate the working of the electric telegraph, he never patented anything. In his own words, he "did not consider it compatible with the dignity of science to confine the benefits which might be derived from it to the exclusive use of any individual." The expression is not carefully chosen; it simply means that he declined to derive selfish advantage from his discoveries. A very brief and modest statement by himself of what these were in relation to the electro-magnetic telegraph is reprinted in vol. ii. from the Smithsonian Annual Report for 1857. In collecting and reprinting these papers, the Institution has raised a worthy monument to Henry's memory, and made a valuable contribution to the history of physical science. J. H. L.

AN ELEMENTARY TEXT-BOOK OF PHYSIOLOGY.

An Elementary Text-book of Physiology. By J. McGregor Robertson, M.A., M.B., Senior Assistant in the Physiological Department, University of Glasgow. 350 pp. (London: Blackie and Son, 1887.)

IN compiling this volume the author has sought to "present the essential facts and principles of physiology, not in a series of disconnected paragraphs, but woven into a continuous story." This being so, we look for a readable book rather than for the more empirical treatise nowadays predominant; and the the success of the work must consequently depend, in the main, upon the manner in which the narrative is strung together. That the book really is a readable one there can be no doubt, and for style and general accuracy it is very satisfactory. When we consider the method of arrangement adopted, however, we must confess that it is disappointing. The author lays it down as a tenet that "we cannot properly understand the physiology of the human body without reference to the form and build, . . . and thus we shall have to note the main anatomical facts regarding a part of the body before going on to consider the work which that part does." Very proper, and true to the letter. In spite of this, however, the reader is led straight away into a consideration of the chemical constitution of the body as a whole. Surely it would be more logical to treat of the constitution of the several structural elements in order of presentation, deferring the more general statements for a final *résumé*. A similarly dangerous position is approached when the writer deals with structure itself. Chapter II. is devoted to "Elementary Structures," that is to say, the author discusses the structural unit before entering upon a consideration of those organs and tissues which are its aggregates. This is an old grievance, and all experience shows that this method, though at first sight apparently natural, is in reality seductive, if not illogical. It is fair to the author to state that he does not adopt it throughout. In view of it, however, the following statements are the more unfortunate: "cells are little masses of a jelly-like material"; "usually the cell has an outer covering or membrane, called the *cell-wall*"; "from little nucleated masses of protoplasm cells are produced, and then from cells all the other textures of the body are derived."

As the work is of a readable character, we expect, furthermore, to find comparisons and illustrations drawn from the experience of daily life, and in this we are not disappointed. Stock comparisons, like that of the human body with the steam-engine, come in as a matter of course, and in his choice of novel ones the author has been very successful. Nothing can, however, be more easily overdone than this. If, for example, the human eye is compared with the photographer's camera, care ought to be taken to point out in what the two differ, especially when considering the lens in accommodation. This has not been done.

Taking the book as a whole, the author is to be congratulated, and especially so upon his treatment of certain leading topics—notably that of diet. By far the weakest parts of the work are those devoted to histology. The interminable striped muscle question is most feebly treated, and who but the author is to know what is meant by the words "the nerve-tubes end, it has been seen, in the (muscle) fibres"? The description of a secreting gland generally given is so worded as to imply that the "basement membrane" is a leading, if not the chief, constituent thereof. These and other defects referred to in the sequel demand immediate attention, and we would fain see the elimination of such old heresies as the capillary or "hair-like vessel" and the transmission of "messages" along the nerve-fibre. There would appear to be a fatality in the persistency with which teachers of a certain class continue to thrust these and similar stumbling-blocks in the way.

This volume is confessedly designed for the "requirements of candidates for the examinations of the Science and Art Department and of the Local Examination

Boards of the Universities," and the syllabus of the first-named body is appended to it. The book thus finds a place among the legion of cram-books which now threaten to overwhelm us. The majority of these are, as everybody knows, notoriously bad, and readers of NATURE will not need to be reminded that strong measures are being proposed for the purpose of checking the evil consequent upon their multiplication, and that of elementary text-books in general. Conspicuous among these is the recent proposal to establish a Publication Committee, whose members shall sit in judgment on all text-books, with power to suppress or modify at will. With this suggestion we have no sympathy: it is unscientific in principle, while its adoption would tend towards the establishment of a conservatism and narrow cliquism greatly to be dreaded. The introduction of such a measure would, in our opinion, only serve to strengthen that spirit of popery which threatens to invade certain branches of science in our own lands. The evil will assuredly work its own end, and, so far as professed cram-books are concerned, the publication of works of such relatively general excellence as the one before us cannot fail to be a far more potent remedy—a more natural one it most certainly is.

Chief among the defects referred to above, as standing in need of revision, are the following. Too little importance is throughout attached to the sources and evolution of heat in the animal economy; the parts played by the muscles and liver need especial comment, and we note that in the table of gains and losses given no count is taken thereof. The functional importance of the diaphragm in the mechanism of respiration is over-stated; on the other hand, that of the withdrawal of water by the kidney is under-stated as a fundamental of excretion. The distribution and function of glycogen are insufficiently noted. The references to non-nucleated cells (p. 26), and to the comparative anatomy of the central nervous system, might well be excised; while the long *résumé* (pp. 255–58) of brain-functions given might be advantageously replaced by a more concise description of the actual facts determinable in a typical case. The relegation (p. 48) of the sutures of the cranial bones to the category of "imperfect joints" is groundless.

Numerous illustrations are employed, and of these many are new and highly satisfactory. Figs. 42, 45, 80, and 118, are, however, little short of useless. It is a fact, and not a "*view*," that "the life of the body is the sum of the lives of the individual cells composing it," and it cannot be said that with the study of the anatomy of the lungs we begin our "*view*" of the means of purification of the blood.

OUR BOOK SHELF.

Evolution and its Relation to Religious Thought. By Joseph Le Conte, Professor of Geology and Natural History in the University of California. (New York: D. Appleton; London: Chapman and Hall, 1888.)

THE title of this book is somewhat misleading. The work is in effect a concise account of evolution and its principal evidences, contained in 253 pages, supplemented by 82 pages giving the author's views on the relation of evolution to materialism, which he rejects, and to several religious questions, of which we can only say in these columns that they are dealt with in a candid spirit, on the basis that the law of evolution is thoroughly established, and is indeed "a necessary condition of rational thought." The exposition of evolution is well-planned, the main problems and their significance and the modes of proof being clearly and simply set out, so that the general reader with a modicum of knowledge of natural history may realize them to a considerable extent. These chapters are illustrated by a number of well-selected comparative figures, such as the fore and hind limbs of typical vertebrates, the evolution of the horse family, and the vascular system and brain of vertebrates. Prof. Le Conte cordially accepts Mr. Romanes's "physiological selection" as the most important advance in the theory of evolution since Darwin; and it is significant that this new view should have already found a place in a popular work written by a man of science. It is, however, a little hazardous to apply with so much confidence a theory still requiring proof; and this appears to lead the author to put forward a still less proven idea, not new it is true, that the steps of evolution at certain times become comparatively rapid, so that there may be few generations, or perhaps only one, between successive species. Some of the author's statements are undesirably broad, as when he says, "All vertebrates, and none other, have a number of their anterior vertebral joints enlarged and consolidated into a box to form the skull, in order to inclose and protect a similar enlargement of the nervous centre, viz. the brain." Of course the author is excluding Amphioxus, but he does not say so. Similarly the statement that "by extensive comparison in the taxonomic and ontogenic series the whole vertebrate structure in all its details in different animals may be shown to be modifications one of another" is a little vague. But on the whole the book is sufficiently accurate, and should prove useful.

Outlines of Qualitative Analysis. By George W. Slatter, Science Master at the Salt Schools, Shipley. (London: Thomas Murby, 1888.)

THIS further addition to the already large number of books on elementary analysis is compiled from the author's laboratory notes issued to his students in the Salt Schools. Most teachers appear to have a few particular methods of their own, and the custom of writing a book to embody them seems to be fast gaining ground. With the matter of Mr. Slatter's book one can find very little fault; but at the same time, except for the use of his own students, one can scarcely see any reason why another book should be presented to the public, when all the facts, in a much more complete form, are already given in most of the larger laboratory guides now in vogue.

The majority of the methods recommended are certainly well-tried and convenient ones; and a very good point is the trouble taken in explaining the theory of the analysis tables. Exception, however, may be taken to Mr. Slatter's mode of separating antimony and tin by use of Marsh's apparatus: while theoretically good, experience shows that accidents are liable to happen, and this is especially the case among young students; hence the platinum and zinc electrolytic method is more frequently preferred. The author seems also to have a predilection for the use of nitro-hydrochloric acid in dissolving the sulphides of nickel and cobalt in Group III., while there can be no doubt that potassium chlorate and hydrochloric acid work far better, there being no danger of leaving nitrates in the solution.

The method of analyzing phosphates is one which works very well, and is probably the best known. Similarly the analysis of double cyanides by ignition with ammonium nitrate and sulphate is the one which in the writer's opinion is both the simplest and gives most satisfactory results.

A. E. T.

The Land of the Pink Pearl. By L. D. Powles. (London: Sampson Low, 1888.)

MR. POWLES served for some time as a circuit justice in the Bahama Islands, and in the present volume he communicates the impressions produced upon him both by the islands themselves and by their inhabitants. He makes no profession of an intimate knowledge of any branch of science, so that the work contains few elements of interest that call here for special notice. We may say, however, that the book is written in a lively and agreeable style, and that the author has brought together much useful general information about what he calls "this obscure corner of Her Majesty's dominions." The most valuable passages are those in which he deals with the relations between the white and the coloured population. His statements on this subject are certainly not lacking in vigour, for he speaks of the African race in the Bahamas as being "ground down and oppressed in a manner which is a disgrace to British rule." When Mr. Powles went to the Bahamas, he had an impression that negroes were "intended by Nature to be kept in subjection by the whites." Experience, however, led him to modify this extravagant notion. Referring to the statement, so often made, that "it is impossible to produce anything by free negro labour," he sensibly suggests that "perhaps if the Imperial Government would establish an agricultural college and give the coloured race in the Bahamas a fair chance, we might see a different state of things." The physical deterioration of the coloured people is, he thinks, sufficiently accounted for by their wretched food and by the unhealthy nature of the places in which they are compelled to live. Curiously enough, Africans in the Bahamas retain their original tribal distinctions; and Mr. Powles says that every August some tribes elect a queen whose will on certain matters is accepted as law.

A Treatise on Alcohol, with Tables of Spirit-Gravities. By Thomas Stevenson, M.D. Second Edition. (London: Gurney and Jackson, 1888.)

THE present edition of this useful little work, originally published under the title of "Spirit-Gravities," contains a critical account of the various determinations of the specific gravity of alcohol, and introduces the most recent investigations—those of Messrs. Squibb—on this subject. These investigations do not, however, affect the accuracy of the alcoholometric tables, which are therefore reprinted unchanged.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Dispersal of Seeds by Birds.

IT should be borne in mind by readers of NATURE in various parts of the world that many facts bearing on this matter may be collected with very little trouble. At Mr. Thiselton Dyer's suggestion I take this opportunity of supplementing my letter to Mr. Botting Hemsley (NATURE, vol. xxxviii. p. 40).

The frigate-birds, petrels, gannets, boobies, &c., that frequent in numbers the guano islands of the Pacific, will present opportunities of investigating this subject rarely found elsewhere. Not only the crops, but also the feathers and feet should be examined, since seeds have been sometimes found adhering to sea-birds that have been sitting on broken eggs. The industries connected with the ocean-ranging mutton-bird in Bass's Straits, and with the grebe in South America, may afford other opportunities. The seal-fisher in the Southern Ocean, and the sportsman on some remote coral islet, the voyager around the Cape, and the lighthouse-keeper in southern climes, these and many others might take a practical interest in this subject. It is important that not only should the seeds and fruits be preserved and sent to Kew, but that the species of bird should be known; and for this purpose, where there is any doubt, the wing or head of the bird might be also sent. H. B. GUPPY.

May 27.

Nose-Blackening as Preventive of Snow-Blindness.

AS a partial answer to Prof. Ray Lankester's inquiry on nose-blackening as preventive of snow-blindness, may I offer some observations which I have made in my many wanderings in the higher Alps in early summer, when I have necessarily had much experience of the effects of snow on the human body?

But first I should like to draw attention to a letter of the Hon. Ralph Abercromby in NATURE (vol. xxxiii. p. 559), which he was kind enough to send me, relating some experiences on nose and face blackening in Morocco to prevent sand glare, in Fiji to prevent water glare, and in Sikkim to prevent snow glare. It was very curious that the Fijians, who ordinarily painted their faces white and red for ornament, would, before going fishing on the reefs in the full glare of the sun, blacken them. Mr. Abercromby draws attention very naturally to "the strange anomaly of physiological experience apparently contradicting the teachings of pure physics. Charcoal black, which is used in physical experiments as the best absorbent of every kind of heat radiation, is practically used by three races at least, to protect one of the most sensitive human organs from reflected light and heat."

Experience has, I think, sufficiently shown that snow-blindness and snow-burn, or sunburn on snow, own the same causes for their production; and, as nowadays both guides and climbers in the Alps invariably take the precaution of protecting their eyes with coloured spectacles, snow-blindness is rarely heard of. My observations are almost entirely confined to the causes of sunburn.

It will, I think, be readily conceded by Alpine climbers that sun on the snow burns more quickly than on rocks or in the heated valleys at a lower elevation. This increased power of burning appears somewhat singular when one reflects that the heat rays must be occupied in the melting of the snow, and thus rendered latent.

Iron-workers, glass-workers, and others are constantly exposed to a heat of 400° or 500° F., and yet do not become burnt; and there can be little doubt that the enormous radiation from heated rocks and valleys, in addition to the direct rays of the sun, make up an amount of heat far greater than is ever experienced on even a very sunny snow slope, and yet one does not become sunburnt. No doubt the surface of the snow reflects and disperses much heat, but certainly far less than it receives, as heat rays are absorbed and rendered latent by the snow-melting and evaporation. Experience fully corroborates this, for one may often lie on one's back and freely expose the face for long periods to the sun and yet remain unburnt. There must therefore be some other factor in sunburn than heat alone.

In discussing the subject with Prof. Tyndall, he added the very interesting and significant fact that he was never more burnt on snow than whilst experimenting with the electric light at the North Foreland Lighthouse, where there was no heat sufficient to produce such an effect.

I am aware that sometimes, in peculiar conditions of the atmosphere, the direct sun's rays will burn. I have met with some singular instances where several persons have been burnt on the same day, even in England, who had never previously suffered in that way. I am further aware that sometimes (not always) in a dead calm on a ship's deck one may be severely burnt, and that in boating on a river the same may occasionally happen. Masks and veils have been long used as a protection on snow, and are more or less successful; *brown* veils and glasses in my experience being the most efficient. As bearing upon this, I may mention that a friend of mine after an ascent on snow had an enormously swollen face, and I observed that in the general swelling there were many pits or depressions, and that each pit corresponded to a freckle: the irritating rays had been intercepted by the brown colour of the freckle. About the same time, I encountered a paragraph in the *Lancet*, saying that a German *savant* had been experimenting on the effects of sunlight on the retina, and had found that it had destroyed the visual purple of the retina, but that the action was modified by transmitting the sun's rays through various coloured glasses, and that when transmitted through

brown glass the purple of the retina was unchanged. I have never seen any corroboration of these assertions, but they are worthy of further consideration. Stimulated by these observations, I painted my face brown with water-colour, and spent many hours on the snow of the Gorner Grat on the same day that about eighty out of a hundred people who were staying at the Riffel Alp went up to witness the first ascent of the season of Monte Rosa. In the evening everyone except myself and my daughter, who had carefully protected herself with a brown veil, was more or less severely sunburnt, whilst the remaining visitors, who had spent the day on the rocks and mountain-sides in the full sun, were untouched. Connected with this is the fact that visitors to the Engadine in winter become extremely brown, as though coloured by walnut-juice, whilst in summer, unless they go on the snow, this is not so, although of course the heat is greater. I have been there in winter and summer, and have had many opportunities of confirming this observation. Then again the very brown colour of the *châlets* is only to be seen at high altitudes where snow is, and even those parts of the *châlets* which by their position cannot receive rays reflected from snow do not become brown. And over the doors of these brown *châlets* in which the cows are kept the wood is invariably white and colourless just at that part which would always have, steaming up, the warm moist breath of the cows, and by this moisture the reflected rays would be intercepted. I think that all these observations bear upon and are related to the question raised by Prof. Ray Lankester.

I have made many other experiments and observations, but for brevity's sake I omit them, as I think I have said enough to show that the subject is a large one, and worthy of consideration. In a comment on Mr. Abercromby's letter above-mentioned, Petrie says, "We should not look at the surface skin, which is constructed to bear local variations of temperature, &c., but at the delicate tissues beneath. White skin," he adds, "is translucent, but black stops out solar energy." It is possible that sunlight reflected from snow may have an influence in producing the improved health of consumptives who remain in the Engadine in winter, and Mr. Abercromby reminds me that the quality of heat which causes snow-burnt is not that which causes sun-stroke. Sun-stroke is very rare (if known at all) on mountains. Equatorial countries—Ceylon, Borneo, West Indies, &c.—are not the worst for sun-stroke; but sub-tropical and semi-tropical dry countries, such as Scinde, North-West Bengal, United States, Italy, &c.

He also says that photography is much slower in equatorial than in these latter countries. The cause undoubtedly is the absorption of violet and ultra-violet rays by water vapour, which is in excess near the Line. Photography is rapid—except for blue sky—at high altitudes. ROBERT L. BOWLES.

Folkestone, May 23.

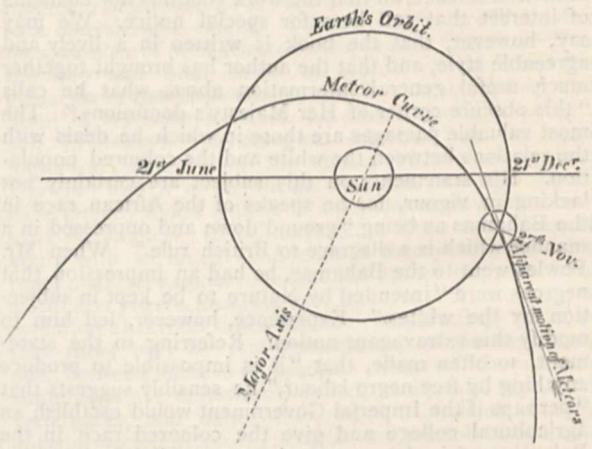
Mysterious Sky Lights.

ON turning over some back volumes of NATURE in search of information concerning the spectrum of the zodiacal light, I have discovered something which appears to be interesting and suggestive, viz. several communications describing what the writers supposed to be abnormal displays of the zodiacal light, displays occurring at the wrong time, *i.e.* near to the periods of the solstices instead of those of the equinoxes, and displays having the wrong shape, lacking the conical outline, but nevertheless nearly in the right place. The most interesting of these letters are from Mr. Maxwell Hall, and dated from Jamaica. He was so much exercised by the heterodoxy of the appearances he observed that he suggested a new theory, and illustrated it by a diagram on p. 204 of vol. vii.

He says in this letter that "for several nights lately the zodiacal light has been exceedingly bright and well-defined, and *more particularly on the nights of November* 24 *and* 27; on the evening of the 24th I found an explanation of what had often perplexed me before, viz. the existence of a faint, isolated band of light across the zenith, but as soon as it was dark in the evening, the zodiacal light was distinctly seen to *stretch across the whole sky*, forming that faint band of light previously observed; I then began to note its position, *but the best observations were made on the night of the* 27*th, when it was most distinct.*"

The italics in the above are mine. The dates given, November 24 and 27, 1872, are those of the remarkable meteoric shower supposed to be connected with the lost comet, Biela. The grandest display was on the 27th. May not the luminosity stretching "across the sky" have been due to sunlight reflected from the meteoric matter lying outside of the earth's atmosphere? Such a spurious zodiacal light does not demand our actual plunging into the meteoric stream producing it, but should be observable whenever such a stream exists between us and the sun, its apparent breadth varying with its actual breadth and its proximity to the earth.

On p. 85 of the same volume is a diagram of the Biela



meteor-path showing its relation to the earth's orbit and to the sun. From this, reprinted above, it is evident that the meteors should display a spurious zodiacal light at the time named, and on to that of the winter solstice, and later. In vol. xi. of NATURE, p. 115, reference is made to a letter from Mr. Hind, dated December 7, 1874, in which he points out "that the zodiacal light has been conspicuous for the last few evenings; and for several years past this phenomenon has been much more marked in December and January than about the vernal equinox."

The pages of NATURE and those of some of the older volumes of the *Gentleman's Magazine* contain many records of mysterious streaks and bands and "pillars" of light seen after sunset, variously ascribed to zodiacal light, to aurora borealis, celestial phosphorescence, &c. If I am right in assigning the spurious zodiacal light of the period above named to the Biela meteors, careful observations of such celestial luminosity in relation to other well-known meteor-streams may be very frui ful.

The Grange, Neasden. W. MATTIEU WILLIAMS.

Curious Apparent Motion of the Moon seen in Australia.

CAN any of your readers explain the phenomenon described in the following extract from a letter received from my daughter residing in Maryborough, Queensland, Australia:—

"We saw such a curious phenomenon on Sunday night, about 10.30. Miss C——, Miss H——, and I were sitting in the balcony, when we noticed the *moon apparently dancing up and down.* It is on the wane, so looked so extraordinary. The motion was visible only when she was behind a narrow stratum of cloud, and continued at intervals for thirty minutes. I felt quite sea-sick with watching it, and Miss H. was so frightened; she thought there might be an earthquake coming, so went to bed in her clothes to be ready for an emergency. Our house would soon fall in an earthquake, its walls are thin, and no cellars."

I presume the phenomenon is connected with the varying refrangibility of the atmosphere, perhaps arising from the mixing of hot and cold air; but should be glad of further information.

T. MELLARD READE.

Park Corner, Blundellsands, May 27.

Another Specimen of *Lepidosiren paradoxa.*

IT may interest some of your readers to know that I have lately received another specimen of this rare fish from my friend Dr. J. Barbosa Rodriguez, the energetic Director of the Museu Botanico do Amazonas at Manáos. This is the *fifth* specimen known. A short notice of the fourth specimen, an adult female of large size, caught in the Igarapé do Aterro near Manáos, also pre-

sented to me by Dr. Barbosa Rodriguez, appeared in NATURE more than a year ago (vol. xxxv. p. 343). Dr. Rodriguez published a note on that specimen in the *Jornal do Commercio* of Rio de Janeiro for October 15, 1886. I state this as his note might easily be overlooked, not having appeared in a scientific periodical.

The last specimen received was caught at Autaz near the Madeira River in September 1887; it came, Dr. Rodriguez writes, from a mud-pool, whence it issued forth wriggling on the mud during rain-storms. My friend received it dead and in a state of incipient decomposition; he did all he could to insure its preservation, but when it reached me all I could save was the skeleton and portions of the skin and tougher muscles. These I have put in strong alcohol for future study. This specimen is considerably smaller than the one previously received, being, as far as I can judge, about 0m. 400 millim. in length.

At Autaz this fish is called *Trayra-boia*, or *Turum-boia*; the latter name is onomatopœic for *Turum*, which expresses the grunt made by the fish, and *boia* means "snake." On the Rio Mahu, an affluent of the Rio Branco, Dr. Rodriguez tells me that the name of this fish in the Makuchy dialect is *Aramô*.

HENRY H. GIGLIOLI.

Royal Zoological Museum, Florence, May 22.

Dreams.

MR. R. L. STEVENSON, in his "Chapter on Dreams" in *Scribner's Magazine* for January last, brings forward one difficult point that must have puzzled many dreamers besides himself. The point is that the dreamer is often in the position of an ignorant onlooker, who, only when the plot or story is complete, sees the drift and motive of the different incidents that have been enacted before his eyes by what Mr. Stevenson calls "the Little People who manage man's internal theatre."

Perhaps it is one step further on in the puzzle to have the interpretation only vouchsafed to one after awaking; and the following example may be of some interest.

Much of my dreaming goes on in the form of reading; and it once happened to me to awake while looking at the outside of a pamphlet I dreamt I was holding. I saw it vividly enough before me; it had a mud-coloured cover, and the title was printed on it in plain Roman capitals: "Food, or the astrology of every day." "But this is nonsense," I thought; until, still having a vivid view of the title before me, I observed that the rough brown paper had been rubbed up after the word "the," and that there was a wide gap between it and the "astrology." Evidently a letter was missing, and I at once conjectured that the word had been printed "gastrology." But this I did not arrive at till I was wide awake.

I come back to Mr. Stevenson's query, "Who are the Little People?" and how comes their amazing independence of their employers?

E. H.

Strange Rise of Wells in Rainless Season.

A HOUSE near Fareham, standing in its own grounds, is principally supplied with water by two wells, about 16 feet deep. They are usually quite full in winter, and gradually empty before autumn. Owing to the small amount of rain last winter, the beginning of March found the wells with only 3 feet and 2 feet of water respectively: when, after a continuance of north-east wind, *without rain*, but with half a gale blowing, the water in these wells rose 14 feet and 12 feet.

Can you or any of your readers explain this mystery? There is a tradition in the neighbourhood that it is customary with the wells in the district to rise with a heavy gale even without rain; and a similar phenomenon has been observed before by my informant.

E. H.

May 23.

Milk *v.* Lightning.

IN Emin Pasha's letter published in NATURE (vol. xxxvii. p. 583), the Sudan Arabs are said to have a superstition that fire kindled by a flash of lightning cannot be extinguished until a small quantity of milk has been poured upon it. A similar belief seems to have existed formerly in this country. The earliest register-book of this parish contains the following note:—

"In the yeare of our Lord 1601 and uppon ye 14 day of May beinge thursday ther was great thundringe and lightninge and ye fyer descendinge from heaven kindled in a white-thorne bush growinge neere to a mudd-wall in Brook-street westward from Thomas Wake his house, it burned and consumed ye bush and tooke into ye wall about on yeard then by milke brought in tyme it was quenched and it did noe more hurt."

JOHN CYPRIAN RUST.

The Vicarage, Soham, Cambridgeshire, May 23.

The Renewed Irruption of *Syrrhaptes*.

MR. SCLATER having requested me to contribute to *The Ibis* an account of the present visitation of *Syrrhaptes* similar to that which I compiled for that journal in 1864, I would ask for information on the subject to be sent to me, and especially cuttings from foreign newspapers, the name of the publication and the date being always indicated thereon. I must add that I do trust my task will not be the unpleasant one of merely recording senseless slaughter. In 1863 the species bred both in Denmark and in Holland. There is no reason why it should not, if unmolested, breed this year in many parts of Britain. The visitations of 1872 and 1876 were of insignificant proportions, but that of the present year would seem to be of considerable magnitude, and sanguine hopes might be entertained as to the result if the malign influence of the "collector" could be neutralized or withstood.

ALFRED NEWTON.

Magdalene College, Cambridge, May 27.

"The Shell-Collector's Hand-book for the Field."

As your reviewer (NATURE, May 17, p. 51) has shown that the little book which bears the above title is certainly worth a large share of "powder and shot," I may, in all fairness, be allowed to reply to those strictures made by him which are the most unfair, and which I consider warrant a reply from me. In the first place, it is quite apparent that he has never used the "Authenticated British List" published by the Conchological Society, where he would have found *Clausilia parvula*, *C. solida*, and *Zonites draparnaldi* excluded, doubtless, on reliable authority; while *Bulimus Goodallii*, *Vertigo tumida*, and *Planorbis dilatatus* are included, also, doubtless, on reliable authority, as recognized members of the British fauna, even if they be "casuals." He has also, it is quite apparent, never read Prof. Macalister's "Introduction to Animal Morphology," where he will find it stated on p. 286 that "the operculum has always more conchiolin in its composition than the shell whose mouth it closes." He does not know, it is also quite apparent, that Pisidium and Sphærium are British fresh-water mussels, and *siphonated* British fresh-water mussels too, there being one siphon in the former and two in the latter genus (cp. the description of these genera in Westerlund's "Fauna of Sweden and Denmark"). He can scarcely know that the epiphragm has been called by some authors (as instance Macalister) the clausilium; and although recognizing this on p. 5 of my "Hand-book," I have described in a footnote to the genus Clausilium (p. 44) the only structure which we recognize to-day under that name. He does not know, it is evident, that Prof. Milnes Marshall ("Practical Zoology," p. 106) states that "the periostracum or outer layer is horny and uncalcified. To it the colour of the shell is due," and that "the middle layer" "is densely calcified, and has an opaque porcellanous appearance." And he scarcely knows that in Huxley and Martin's "Course of Elementary Instruction in Practical Biology," p. 274, the aperture of the shell is spoken of as the *peritreme* and not as the *peristome*, and that in the majority of works on comparative anatomy it is also solely mentioned under that name. I think it also my duty to tell your reviewer that the teeth-formulæ were not copied from Lankester, as he supposes, but from Woodward, and that upon comparison I find the copy correct (cp. Jeffrey Bell, "Comparative Anatomy and Physiology," p. 136).

In the second place, with regard to those other strictures which I can characterize by no other name than *mere whims*. It is a mere whim, for instance, to consider *Anodonta anatina* as a variety of *A. cygnea*, since such has never yet been generally recognized. It is a mere whim to believe that *Achatina acicula* should be *Cæcilianella acicula*; *Bulimus acutus* should be *Helix* (*Cochlicella*) *acuta*; *Zonites* should be *Hyalinia*," and I had rather remain with my old system of nomenclature than get so

inextricably entangled in the medley of new systems made by Continental workers, all of which systems differ the one from the other as "chalk from cheese." It is a mere whim to imagine that chapters on "The Anatomy of a Snail" and "The Anatomy of a Fresh-water Mussel" should have been excluded since the basis of systematic zoology is anatomy. And it is a mere whim to cavil at the inclusion of the vars. *minor*, *maxima*, and "*albida*," (*exalbida*, if you please, Mr. Reviewer, for so was it named by Menke), and the monstrosity *sinistrorsum* of *Helix aspersa*, since Dr. Gwyn Jeffreys and Moquin-Tandon have named varieties and used variety-names, and since Prof. E. von Martens, than whom no better conchologist, expressly mentions that "it is certainly desirable that every local form, well-marked zoologically or geographically, should have a distinct name." And may I turn a reviewer on my own book, and ask myself how it is that I did not, as your reviewer desires, give the localities for every species, and make the book costly, and, by so doing, take it away from the reach of the poorer classes? Why also did I not give the definite localities for the now local species, when I considered rightly that some of them may turn up in other, and, perhaps, far distant spots to those now known? In conclusion, I would point out to your reviewer—for I must not occupy your valuable space to any greater extent—that as there is a virtue in the every-day affairs of this our mundane life which, to quote Seneca, is "the only immortal thing that belongs to mortality," so, as certainly, is there a virtue in right reviewing which is quite as exacting and quite as important to always bear in one's remembrance.

J. W. WILLIAMS.

51 Park Village East, N.W.

IN reviewing Dr. Williams's little book, I wished not merely to point out the author's mistakes, but to guard young conchologists, to whom the book is addressed, from placing too great reliance on the statements it contains.

I felt also convinced that the author was not practically conversant with his subject; indeed, that his knowledge was purely derivative, and this the foregoing letter fully confirms.

I will not occupy space with a detailed criticism on the author's method of compilation, but will simply refer to a single instance, quoted to show his want of care in referring to the original sources of information, so needful in such a task. The method of numeration of the tooth-formula, referred to by me as incorrect at p. 7 of the "Hand-book," is now justified by the author, who quotes Woodward as his authority; but upon referring to my brother's "Manual" I find that my statement was fully justified by the fact that the quotation is *not correct*, it having been taken by Dr. Williams from Prof. Jeffrey Bell's "Comparative Anatomy," where my brother's name is given as the authority for the instances quoted, and not for the whole paragraph to which it is appended, and which does not appear in his book. To the second part of Dr. Williams's *whimsical* letter I feel sure it is needless to reply.

HENRY WOODWARD.

129 Beaufort Street, S.W., May 28.

Freaks of Nature.

I INCLOSE a letter from my grandson Charles, a boy, son of St. Vincent Erskine, the explorer, with whose travels you are probably acquainted.

This singular instance of a change in the habits of birds, consequent on the advance of civilization, is extremely important and interesting, as it evinces almost reasoning powers and adaptation of habits to circumstances. As you are aware, some birds in South Africa build their nests on the pendant boughs of willow-trees as a defence against snakes and iguanas.

These willows, like other trees in Natal, are rapidly becoming scarcer, as they are cut down, whilst the boys who take the nests increase. This is, no doubt, the cause of the birds changing their nests to the telegraph-wires, where they are also safer from their natural enemies.

It would be interesting to know whether similar instances occur elsewhere.

D. ERSKINE.

47 Gratton Road, Kensington, May 25.

P.S.—It is remarkable also that the hole is at the side instead of the bottom, showing that the bird was aware that the situation was snake-proof. Darwin would have been glad of this proof of evolution.

WHILE watching the landscape of Natal between Ladysmith and Pietermaritzburg from a Natal Government Railway carriage, I saw some nests of the "golden weaver" bird. There were four of them hanging in a row, close together. They were the round kind, without the long arm. On one of the nests sat a cock weaver bird, but I saw no hens.

The nests seemed to be one or two years old, except one, which was greener than the others, and most certainly one of this season's. The chief peculiarity seemed to lie in the fact that the birds had woven grass round the wire for some six or eight inches, and two or three inches in circumference, before beginning to make the nest, and that the bird had to deal with a horizontal wire instead of a vertical stick or a branch. The bird always twists the grass round the branch (if he builds on a vertical twig) for some way up among the leaves and stalks, leaving the long ends free, thus forming his foundation. Weavers prefer to build on trees where the long slender twigs droop towards the ground, and so afford a nice vertical slender support. They are especially fond of the weeping-willow, whose slender switches generally branch off into two small shoots at the end: between these the bird loves to build his nest. Besides, the willow has lots of leaves very near together, and so holds the straws very well. On the wire he had no such support, but had to trust to his own ingenuity to overcome the novel situation, which task he seems to have accomplished very well.

The entrance to these nests was not at the bottom, as usual, but by a hole in the side, and all the nests did not look the same way.

I suppose there was only one nest a season or two ago, with a single pair of birds; soon we shall have a long string, or rather wire, of these ingeniously built homes with their happy quarrelsome occupants, making enough noise to stop all the messages ever sent that way. They will hear all the "Government" secrets: then we will be able to say truly, "A little bird told me."

C. H. ERSKINE.

WHIRLWINDS, WATERSPOUTS, STORMS, AND ROTATING SPHERES.[1]

IT is often necessary, in many branches of science, to halt in our steady progress along the beaten roads of induction, and say, "*Fiat experimentum.*" We may not always be able by this means to reproduce exactly all the physical conditions of the phenomenon, we are investigating, or to evolve a test crucial enough to enable us to decide between rival hypotheses. Nevertheless, the power we thus gain, especially in the case of an atmospheric phenomenon, of seeing the entire system of action in a *coup d'œil*, of gauging its relative proportions, and of examining its dependence and effects on its *entourage*, can hardly be over-rated.

Such would appear to have been M. Weyher's object in the delicate and ingenious experiments which he has so skilfully elaborated and described in the pamphlet of 91 pages before us.

The physical theory of atmospheric eddies, including the rotating flat disk or cyclone, and the rotating column which manifests itself as a tornado, waterspout, or dust-whirl, according to variations in its intensity and surrounding circumstances, has lately been developed to an extent not generally known, principally by Ferrel, Sprung, Oberbeck, and Marchi. It is therefore decidedly satisfactory to those who believe in the progress of meteorology by rational theory and deduction, to find that the motions exhibited in M. Weyher's experiments, in which the conditions in Nature are very fairly imitated, agree in every point with those which have been deduced from their physical theory.

Theory, for example, shows that a tornado is due primarily to an unstable condition of saturated air, accompanied by a gyrating motion (which may initially be very small, and which is practically always present to

[1] "Sur les Tourbillons, Trombes, Tempêtes, et Sphères Tournantes: Étude et Expériences." Par C. L. Weyher. (Paris, 1887.)

some extent, owing to the earth's rotation), relative to some central point.[1]

Given these conditions, the rest follow as necessary consequences, viz. (1) a current ascending up the *axis*, combined with rapid rotation round it; (2) a hyperboloidal funnel of rarefied air tapering downwards, and reaching the earth when the action is powerful, round the sides of which a condensed vapour-, or so-called water-spout, should usually prevail, owing to the sudden rarefaction of the air entering the central area through the sides or at the base, with the consequent lowering of the plane of condensation from the cloud-level which it usually occupies. When, therefore, it is said that "a waterspout is simply the cloud brought down to the earth by the rapid gyratory motion of the tornado,"[2] it is not meant that the cloud is actually carried downwards by an aërial current, since by theory the motion is precisely in the opposite direction; but that the *conditions* of *condensation* are propagated downwards from the cloud-stratum where they first commence. Neglect of this consideration, as well as the physical fact that condensation can only occur under most exceptional circumstances in a *downward* current, has led to many false deductions from apparent circumstances.

Theory, moreover, indicates that the current up the axis, together with gyration round it, which, by the conservation of rotational momentum, may become exceedingly rapid as the air approaches it, must combine to give a spiral character to the movement near the axis, while the conditions of continuity equally demand that there should be a compensatory descending current somewhere in the vicinity, gyrating spirally in the same sense, and of only moderate velocity, owing to its greater distance from the axis.

At the base of a tornado, or its milder form of waterspout, there should also be a rising up of the water at sea, or of light objects on land, which are supported by the ascending current until their collision or size carries them outside the central area, when they fall back to the earth, or to points where they are again brought within the influence of the whirl-currents. These and many other

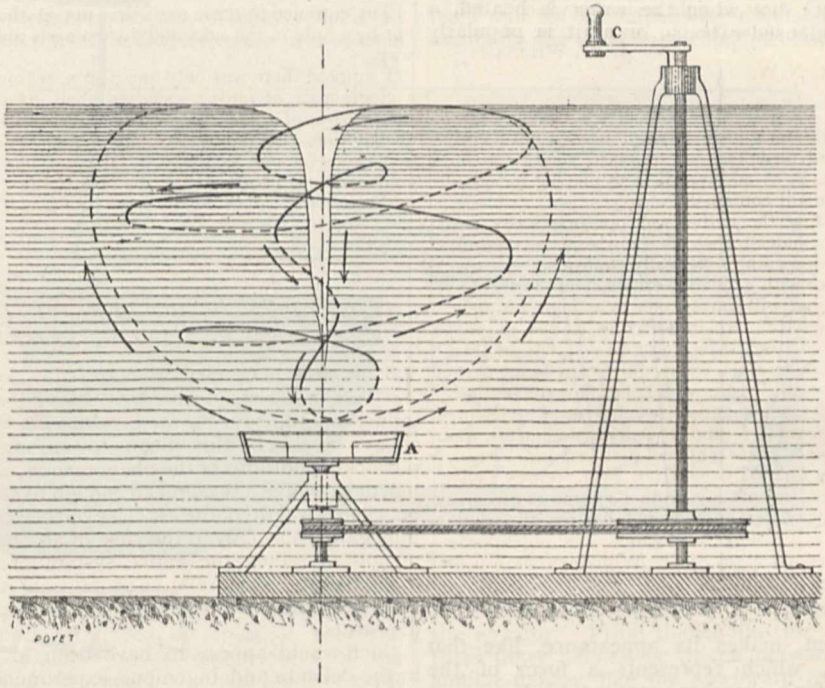


FIG. 1.

minor characteristics of tornadic action are confirmed and illustrated by M. Weyher's experiments.

M. Weyher commences by examining the conditions which prevail in an eddy produced in water, either by an outflow through a sluice, or a momentary rotation imparted by the stroke of an oar. In the former case the motion is well known, but in the latter it is somewhat new to find that besides the rotation round a vertical axis there is an interchanging vertical motion such that each particle describes a descending helix down the axis of the whirl, and ascends in a helix of the same sense to regain the surface.

Fig. 1 shows the same circulation produced by the revolution of a tourniquet, A.

If this figure be looked at upside down, it substantially depicts what is believed to be the motion of the air in a whirlwind, waterspout, or tornado, and is precisely similar to what is found to be the motion round those artificially produced by M. Weyher.

The important point to notice with respect to the water eddies, which are introduced mainly to show their analogy to air-whirls, is that, according to M. Weyher, their source of action must be at some distance *below* the surface. By artificially causing the liquid to rotate at its surface only, he found it impossible to obtain the central descending funnel of a complete water eddy.

A similar condition is found to hold in an *inverse* sense in the case of artificially-produced air-whirls. The action must in their case originate in the *upper* part of the air-column, whence the motion is communicated by degrees to its lower boundary. The analogy, therefore, between the water eddy with a descending motion round its axis and the atmospheric whirlwind is completely *inverse*, and not *direct*, as some have supposed.

[1] Sergeant Finley found, in his review of 600 tornadoes in the United States, that the direction of rotation round the axis was invariably cyclonic, or against watch-hands ("Signal Service Notes," No. xii. p. 10).

[2] "Recent Advances in Meteorology" (p. 301), by W. Ferrel. (Washington, 1885.

M. Weyher next proceeds to discuss the motions which should theoretically occur in an air-whirl. These are shown in vertical section in Fig. 2.

In the annular region bordering the inner rarefied space, and represented by A *a c* C, *b* B D *d*, the air is assumed to be rendered denser than the normal by the centrifugal force of gyration, and according to M. Weyher it is by the *descent* of this denser air upon the depression caused by the air below rushing up to fill the central area, that the rotation system propagates itself from above towards the earth.

We do not think this explanation is either correct or necessary. It is contrary to the physical theory that there should be a sheath of dense air surrounding the rarefied region, and, apart from this, friction, and the transference of air up the axis from its lower end amply account for the downward propagation.

The most interesting of M. Weyher's experiments are those in which he artificially produces the phenomena of the waterspout. By means of a rotating tourniquet placed over cold water, an aërial eddy is caused which draws up the water, in the form of a spout composed of drops, to a considerable height; but when the water is heated, a clearly-defined condensed-vapour-, or, as it is popularly

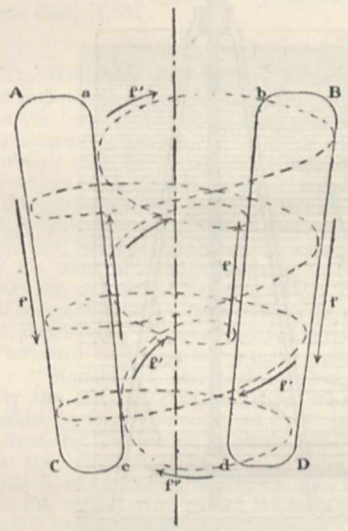


Fig. 2.

termed, water-spout, makes its appearance, like that shown in Fig. 3, which represents a form of the apparatus suitable for a chamber experiment.[1]

With from 1500 to 2000 rotations per minute, the vapour from the heated water is found to condense itself into a visible sheath enveloping a clearly-defined and rarefied central nucleus, conical, and tapering downwards. The diameter of the sheath is from ¾ inch to 1 inch. Besides this vapour-spout, water-drops are carried up, as in natural marine spouts, until they are thrown out beyond the influence of the upward current.

Other features of spouts are then imitated, particularly what is called the *hérisson*, which appears to be identical with what the French sailors call the *buisson*, or bush-like ploughing up of the sea, which occurs at their bases, both before and during the period of complete formation. This is effected by placing twenty or thirty small air-balloons in the place of the water, underneath the tourniquet. These are then seen to rise up a short distance, and fall back in graceful interlacing elliptical curves. The entire motion throughout the *hérisson*, as well as the whole system, is further studied by placing underneath the tourniquet a quantity of oatmeal in a glass vessel, and observing its motion by means of eye-pieces fitted into the top of the vessel. The motions are thus seen to be precisely the same as those theoretically inferred, and when the rotation is stopped, the ascending spires of the currents at the lower end, are found engraven in lines on the finer particles, which, in obedience to these currents, lie in a conical heap round the vertical axis of the whirl.

Several other experiments are made with cotton-wool and smoke, each of which exhibits some special feature characterizing the spouts of Nature.

The pressure and temperature conditions in different parts of the area are next investigated.

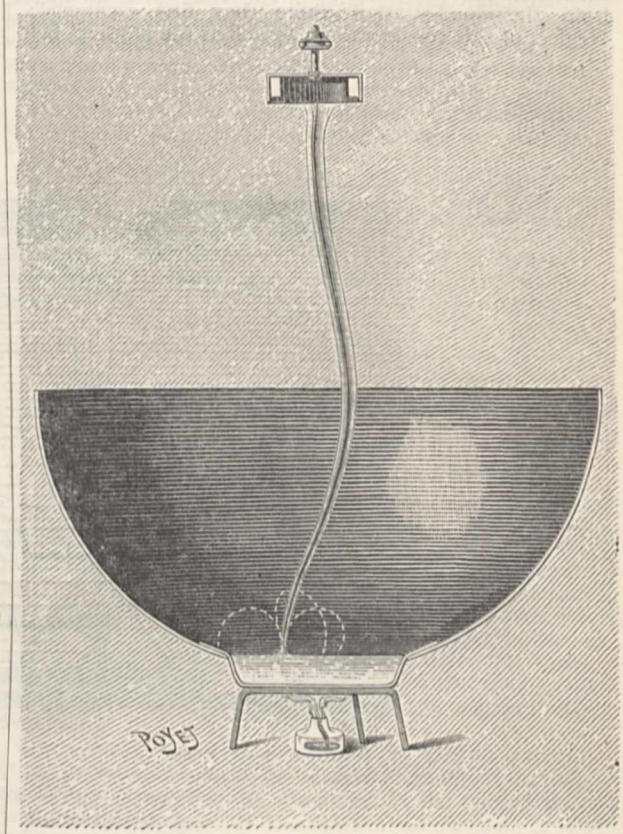


Fig. 3.

By means of a manometer, it is found that the rarefaction at the centre of the rotating tourniquet is transmitted almost unaltered in intensity (probably proportionally diminished in area) to the centre of the whirl on the surface, while the thermometer at the same point, at first shows a fall and then a rise of temperature, the latter evidently due to the friction of the rapidly moving air against the surface.

The analogous phenomenon of a cyclone is very fairly imitated by the apparatus shown in the accompanying diagram (Fig. 4), consisting of a large tourniquet placed over a table covered with a number of pins mounted with movable threads of red wool. The tourniquet is arranged so as to be capable of translation as well as rotation. At the centre, the table is pierced with a small hole at D, communicating by means of a caoutchouc tube with a manometer, which thus registers the changes of pressure

[1] For those desiring to repeat the experiment the dimensions are as follows. The tourniquet is made of tin from 5 to 6 inches in diameter by 1 to 1½ inch in height. There are from 10 to 12 rectangular fans 1 inch by ¾ inch. The vessel holding the water is placed 31 to 39 inches from the tourniquet, and is from 7 inches to 1 foot in diameter by 1½ to 2 inches deep. The hemispherical continuation of the vessel, to keep off local air-currents, which disturb the continuity of the spout, is 3 feet in diameter.

as the supposed cyclone passes over it. On rotating the tourniquet and passing it along over the table, the directions and positions of the threads are seen to indicate not only the horizontal, but also the vertical components of the winds thus produced, including the region of calm in the centre, as well as the downward and outward motion at the anticyclonic border. The variations of pressure recorded by the manometer, when plotted out, show a curve similar to that in a symmetrical cyclone, including the rise of pressure at the border where the motion is descending and outwards.

Hail is then explained, as being caused by vapour drawn up into the *hérisson* of what M. Faye terms a *trombe internubaire*, which descends from the upper regions as far as the surface of the cloud, whence the hail proceeds. The rest of the explanation, which mainly involves a continual churning up and down of the frozen particles, is similar to that given by Ferrel and Möller, except that the hailstones impinging upon one another at the focus of the *hérisson* are supposed, by the heat thus engendered, to aid in effecting the temporary melting of their surfaces necessary to account for the concentric coats of snow and ice they usually exhibit.

M. Weyher's experiments do not, of course, fulfil all the conditions which prevail in Nature, since in that case the rotation is doubtless kept up, after it has once been started in the air at some distance above the surface, by the upward movement along the axis, and the consequent aspiration of the surrounding air into the area of gyration. With this exception, however, there seems little wanting.

The position of the source from which the vapour is drawn is not so important as might be thought, since the vapour condensed in the natural waterspout is not the cloud actually brought down to the surface, any more than it is—except for the space of a few feet at its lower extremity—the water bodily carried up, but is the result of the condensation, by rarefaction, of vapour previously contained invisibly, but certainly amply enough for the purpose, right down to the earth's surface. In fact, the origin of the vapour, being at the base, more nearly imitates Nature than if it were only supplied above in the form of a cloud.

M. Weyher's experiments so far, therefore, bear out the hypothesis that a system of rotating air-currents above the earth's surface, causes tornadic, waterspout, and dust-spout phenomena, by an aspiration *towards*, and a flow *up*, its axis, and show that such a system can propagate itself and its accompanying effects downwards without assuming any downward component along the axis.

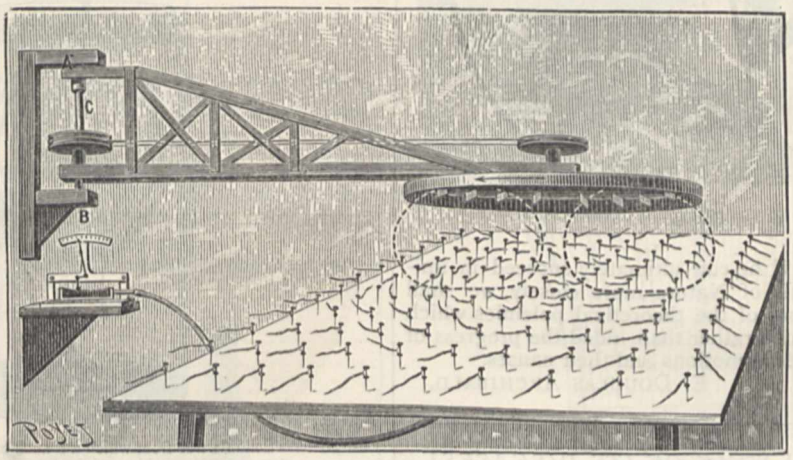


FIG. 4.

The last part of the work is devoted to a description of certain curious effects produced by rotating spherical tourniquets. Fig. 5 shows a convenient form of the apparatus, in which S represents a sphere made of eight or ten circular fans, fixed on an axis passing through two vertical disks whose function it is to keep off disturbing currents, and also to concentrate the action. M is an air-balloon, which, when the tourniquet is set in motion, is found to revolve round it in the plane of its equator, and be attracted instead of repelled.

M. Weyher thus explains this, at first sight, paradoxical motion. A rotating spherical ventilator draws in the air chiefly at its poles, and expels it in the plane of the equator, but, except *in this plane*, there is a general motion of the air all round *towards* the ventilator. The stream of air issuing from the ventilator in the plane of the equator is divided by the balloon, and forms vortices, which, together with the currents centrally directed on its reverse side, tend to urge it towards the ventilator. Whether this explanation be considered satisfactory or not, the balloon certainly revolves like a satellite round the ventilator. By means of floating gold-leaves, the action of the ventilator is seen to cause two dissymmetrical aërial whirls, whose inner gyrations commencing at some distance from the generating sphere, run round the polar axis in opposite directions, and meet on the plane of the equator. From thence the air jointly brought by these inner hélices is driven outwards, and returns by similar helices, like the downward return-current of the tornado, to the points at the extremities of the prolonged polar axis. So far well, but we cannot quite admit the validity of the manometer experiment by which, on p. 74, the author attempts to show the existence of the aspiration in the plane of the equator requisite to explain the attraction it exerts on the air-balloon. The effect of velocity in decreasing pressure, as exemplified by Hawksbee's famous experiment, would probably mask any other vortical effects such as those sought by M. Weyher.

It appears to be a recognized custom for an author, after describing his experiments, to indulge in some pet speculations, and even to make the orthodoxy of the former an excuse for the frequently Utopian character of the latter.

M. Weyher certainly treats himself to an ample dessert of this description in his concluding section, in which, assuming the existence of a *ponderable* ether, the phenomena of the *tourbillon* are by analogy transferred to the solar system, which is supposed to be the *hérisson* of a whirl system reaching it from space, the sun being in the focus, and in which the planets, by the mutual

influence of the ethereal whirls due to their axial rotation, cause simultaneously spots on the sun and cyclones on the earth.

We fail to follow M. Weyher here, and think it would have been better if he had not only hesitated, as he admits he did, but decided not to publish such wild speculations. His experiments are exceedingly instructive

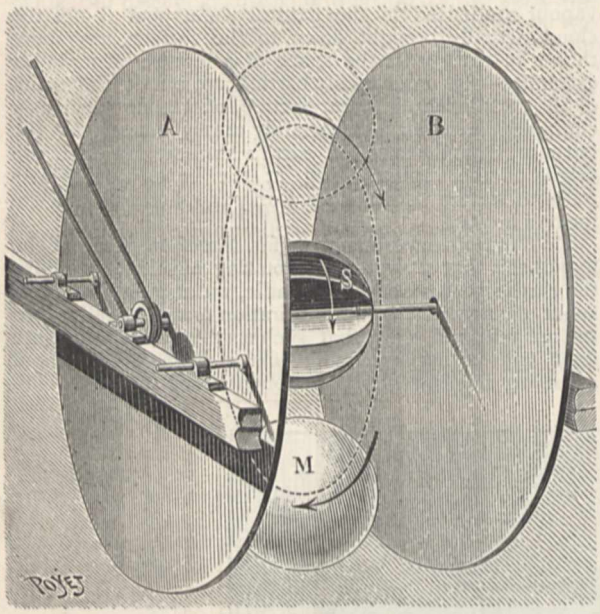


FIG. 5.

and suggestive, and if he can ultimately succeed in imitating the conditions of Nature more closely, we shall doubtless have an end of the theoretical polemics which have hitherto retarded rather than aided the progress of our knowledge of aërial motions and their causes.

E. DOUGLAS ARCHIBALD.

TIMBER, AND SOME OF ITS DISEASES.[1]

VII.

IF we pass through a forest of oaks, beeches, pines, and other trees, it requires but a glance to see that various natural processes are at work to reduce the number of branches as the trees become older. Every tree bears more buds than develop into twigs and branches, for not only do some of the buds at a very early date divert the food-supplies from others, and thus starve them off, but they are also exposed to the attacks of insects, squirrels, &c., and to dangers arising from inclement weather, and from being struck by falling trees and branches, &c., and many are thus destroyed. Such causes alone will account in part for the irregularity of a tree, especially of a Conifer, in which the buds may be developed so regularly that if all came to maturity the tree would be symmetrical. But that this is not the whole of the case, can be easily seen, and is of course well known to every gardener and forester.

If we remove a small branch of several years' growth from an oak, for instance, it will be noticed that on the twigs last formed there is a bud at the axil of every leaf; but on examining the parts developed two or three years previously it is easy to convince ourselves of the existence of certain small scars, above the nearly obliterated leaf-scars, and to see that if a small twig projected from each of these scars the symmetry of the branching might be

[1] Continued from vol. xxxvii. p. 516.

completed. Now it is certain that buds or twigs were formed at these places, and we know from careful observations that they have been naturally thrown off by a process analogous to the shedding of the leaves; in other words, the oak sheds some of its young branches naturally every year. And many other trees do the same; for instance, the black poplar, the Scotch pine, *Dammara*, &c.; in some trees, indeed, and notably in the so-called swamp cypress (*Taxodium distichum*) of North America, the habit is so pronounced that it sheds most of its young branches every year.

But apart from these less obvious causes for the suppression of branches, we notice in the forest that the majority of the trees have lost their lower branches at a much later date, and that in many cases the remains of the proximal parts of the dead branches are sticking out from the trunk like unsightly wooden horns. Some of these branches may have been broken off by the fall of neighbouring trees or large limbs; others may have been broken by the weight of snow accumulating during the winter; others, again, may have been broken by hand, or by heavy wind; and yet others have died off, in the first place because the over-bearing shade of the surrounding trees cut off the access of light to their leaves, and secondly because the flow of nutritive materials to them ceased, being diverted

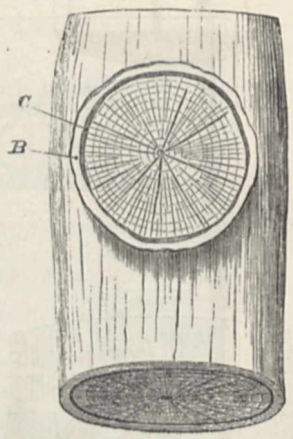


FIG. 21.—Portion of a tree from which a branch has been cut off close to the stem. *C*, the cambium of the branch; *B*, the cortex.

into more profitable channels by the flourishing, growing parts of the crown of leaves exposed to sunlight and air above.

The point I wish to insist upon here is that in these cases of branch-breaking, however brought about, open wounds are left exposed to all the vicissitudes of the forest atmosphere; if we compare the remnant of such a broken branch and the scar left after the natural shedding of a branch or leaf, the latter will be found covered with an impervious layer of cork, a tissue which keeps out damp, fungus-spores, &c., effectually.

It is, in fact—as a matter of observation and experiment—these open wounds which expose the standing timber to so many dangers from the attacks of parasitic fungi; and it will be instructive to look a little more closely into the matter as bearing on the question of the removal of large branches from trees.

If a fairly large branch of a tree, such as the oak, is cut off close to the trunk, a surface of wood is exposed, surrounded by a thin ring of cambium and bark (as in Figs. 21 and 22). We have already seen what the functions of the cambium are, and it will be observed that the cut edge of the cambium (*C*) is suddenly placed under different conditions from the usual ones; the chief change, and the only one we need notice at present, is that the cambium in the neighbourhood of the cut surface is released

from the compressing influence of the cortex and bark, and owing to this release of pressure it begins to grow out at the edges into a cushion or "callus," as shown in Figs. 23 and 24. A very similar "callus" is formed in the operation of multiplying plants by "cuttings," so well

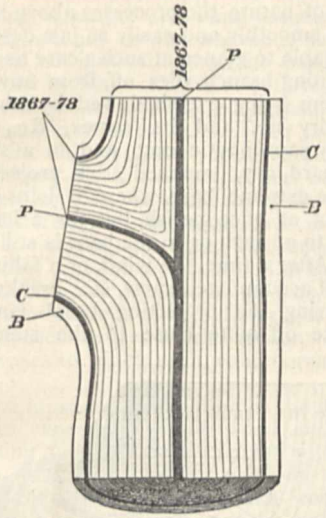


FIG. 22.—The same in longitudinal section. *P*, the pith of stem and branch; on either side of this are the twelve annual zones of wood produced during the years 1867–78, as marked. The cambium, *C*, separates these from the cortex, *B*.

known to all: the cambium at the cut surface of the "slip" or "cutting," is released from the pressure of the cortex, and begins to grow out more rapidly in the directions of less pressure, and forms the callus.

Now this callus (Fig. 23, *Cal*) is in all cases something more

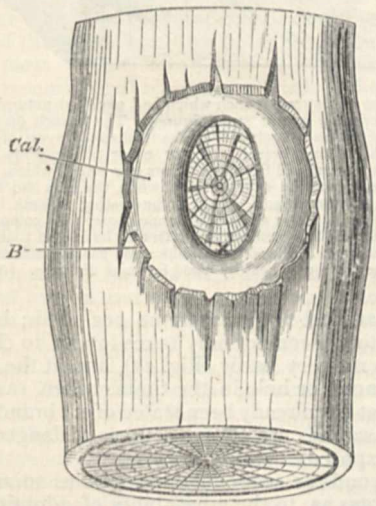


FIG. 23.—The same piece of stem four years later. The cushion-like development, *Cal*, resulting from the overgrowth of the cambium and cortical tissues of the cut branch, has extended some distance from the edges, and is covering in the exposed wood. *B* is the dead outer corky tissue, incapable of growth, and partially cracked under the pressures exerted by the thickening of the stem. The latter is somewhat swollen transversely, owing to the release of pressure in this region enabling the cambium to develop a little more actively here; the quicker growth of the occluding cushion in the horizontal direction is due to the same cause.

than mere cambium—or rather, as the cambium extends by cell-divisions from the cut edge of the wound, its outer parts develop into cortex, and its inner parts into wood, as in the normal case. The consequence is that we have in the callus, slowly creeping out from the margins of the wound, new layers of wood and cortex with cambium between them (Fig. 24); and it will be noticed that each year the layer of wood extends a little further over the surface of the wound, and towards the centre of the cut branch; and in course of time, provided the wound is not too large, and the tree is full of vigour, the margins of the callus will meet near the middle, and what was the exposed cut surface of the branch will be buried beneath layers of wood and cortex, between which lies the cambium, now once more continuous over the whole trunk of the tree (Figs. 25 and 26).

It is not here to the purpose to enter into the very interesting histological questions connected with this callus-formation, or with the mechanical relations of the various parts one to another. It is sufficient for our present object to point out that this process of covering up, or *occlusion*, as I propose to term it, requires some time for its completion. For the sake of illustration, I have numbered the various phases in the diagram, with the years during which the annual rings have been formed; and it

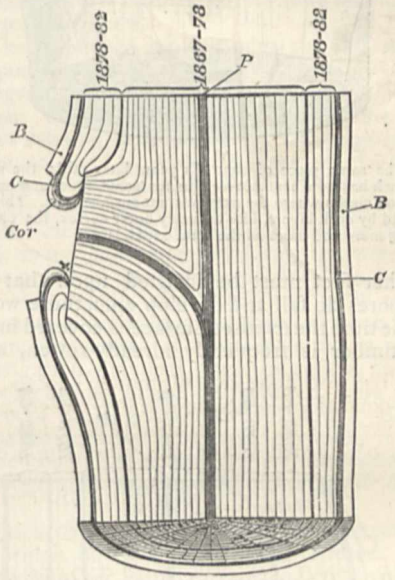


FIG. 24.—The same in longitudinal section: *P*, *B*, and *C* as before. The four new layers of wood formed during 1879–82 are artificially separated from the preceding by a stronger line. On the left side of the figure it will be noticed that the cambium (and therefore the wood developed from it) projected a little further over the cut end of the branch each year, carrying the cortical layers (*Cor*) with it. At ×, in both figures, there is necessarily a depression in which rain-water, &c., is apt to lodge, and this is a particularly dangerous place, since fungus-spores may here settle and develop.

will be seen at a glance that, in the case selected, it required seven years to cover up the surface of the cut branch (cf. Figs. 21–26). During these seven years more or less of the cut surface was exposed (Fig. 24) to all the exigencies of the forest, and it will easily be understood that abundant opportunities were thus afforded for the spores of fungi to fall on the naked wood, and for moisture to condense and penetrate into the interior; moreover, in the ledge formed at × in Figs. 23 and 24, by the lower part of the callus, as it slowly creeps up, there will always be water in wet weather; and a sodden condition of the wood at this part is insured. All this is, of course, peculiarly adapted for the germination of spores; and, since the water will soak out nutritive materials, nothing could be more favourable for the growth and development of the mycelium of a fungus. These circumstances, favourable as they are for the fungi, are usually rendered even more so in practice, because the sawyers often allow such a branch to fall, and tear and crush the cambium and cortex at the lower edge of the wound. These and

other details must be passed over, however, and our attention be confined to the fact that here are ample chances for the spores of parasitic and other fungi to fall on a surface admirably suited for their development.

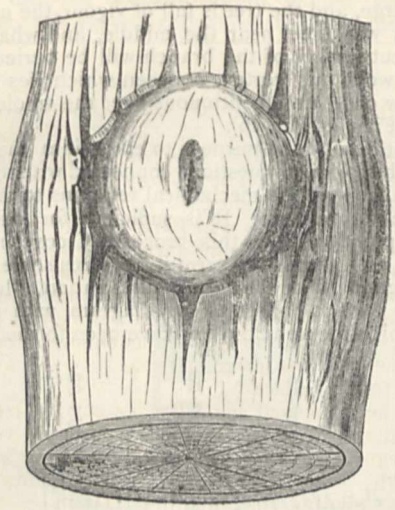


FIG. 25.—The same piece of stem six years later still: the surface of the cut branch has now been covered in for some time, and only a boss-like projection marks where the previous cut surface was. This projection is protected by cork layers, like ordinary outer cortex, the old outer cortex cracking more and more as the stem expands.

The further fact must be insisted upon that numerous fungus-spores do fall and develop upon these wounds, and that by the time the exposed surface is covered in (as in Fig. 25) the timber is frequently already rotten, usually for

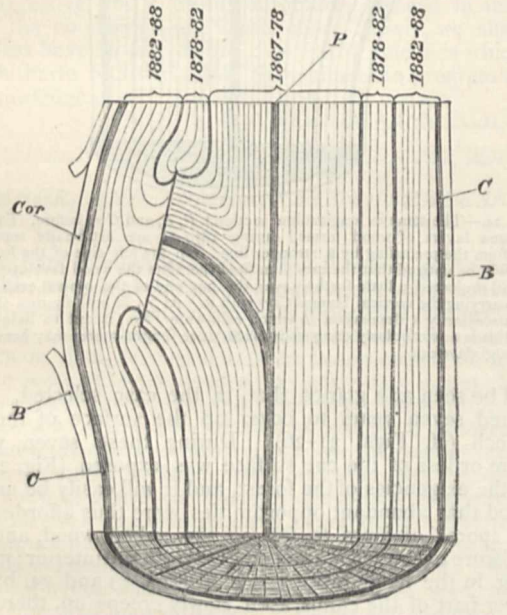


FIG. 26.—The same in longitudinal section: lettering as before. Six new layers of wood have been developed, and the cut end of the branch was completely occluded before the last three were formed—*i.e.* at the end of 1885. After that the cambium became once more continuous round the whole stem, and, beyond a slight protuberance over the occluded wound and the ragged edges of the dead corky outer layers, *B*, there are no signs of a breach.

some distance down. In the event of fungi, such as have been described above—parasites and wound-parasites—gaining a hold on such wounds, the ravages of the mycelium will continue after the occlusion is complete, and I have seen scores of trees, apparently sound and whole, the interior of which is a mere mass of rottenness: when a heavy gale at length blows them down, such trees are found to be mere hollow shells, the ravages of the mycelium having extended from the point of entry into every part of the older timber.

In a state of nature the processes above referred to do not go on so smoothly and easily as just described, and it will be profitable to glance at such a case as the following.

A fairly strong branch dies off, from any cause whatever—*e.g.* from being overshadowed by other trees. All its tissues dry up, and its cortex, &c., are rapidly destroyed by saprophytic fungi, and in a short time we find only a hard, dry, branched stick projecting from the tree. At the extreme base, where it joins the tree, the tissues do not at once perish, but for a length of from half an inch to an inch or so the base is still nourished by the trunk. After a time, the wind, or a falling branch, or the weight of accumulated snow, &c., breaks off the dead branch, leaving the projecting basal portion: if the branch broke off quite close to the stem, the wound

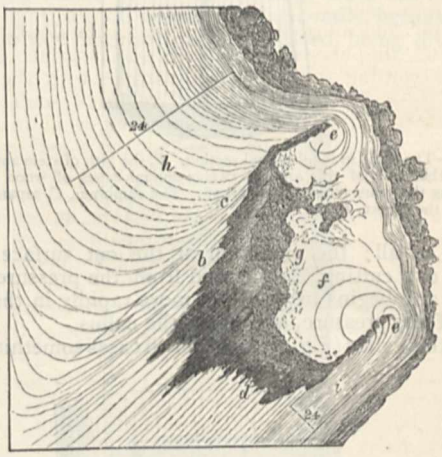


FIG. 27.—Base of a strong branch which had perished naturally twenty-four years previously to the stage figured. The branch decayed, and the base was gradually occluded by the thickening layers of the stem: the fall of the rotting branch did not occur till six years ago, however, as can be determined from the layers at *e* and *f*, which then began to turn inwards over the stump. Meanwhile, the base had become hollow and full of rotten wood, *g*. It is interesting to note how slight the growth is on the lower side of the branch base, *i*, as compared with that at *h* above: the line numbered 24 refers to the annual zones in each case. As seen at *b* and *d*, the rotting of the wood passes backwards, and may invade the previously healthy wood for some distance. (After Hartig.)

would, or at least might, soon be occluded; but, as it is, the projecting piece not only takes longer to close in, but it tends to rot very badly (Fig. 27), and at the best forms a bad "knot" or hole in the timber when sawn up. Of course what has already been stated of cut branches applies here: the wounds are always sources of danger so long as they are exposed.

It is beyond the scope of these articles to set forth the *pros* and *cons* as to the advisability of adopting any proposed treatment on a large scale: the simple question of cost will always have to be decided by those concerned. But whether it is practicable or not on a large scale, there is no question as to the desirability of adopting some such treatment as the following to preserve valuable trees and timber from the ravages of these wound-parasites. Branches which break off should be cut close down to the stem, if possible in winter, and the clean cut made so that no tearing or crushing of the cambium and cortex occur; the surface should then be painted with a thorough coating of tar, and the wound left to be occluded. If the cutting is accomplished in spring or summer, trouble will be caused by the tar not sticking to the damp

surface. Although this is not an absolute safeguard against the attacks of fungi—simply because the germinal tubes from spores can find their way through small cracks at the margin of the wound, &c.—still it reduces the danger to a minimum, and it is certain that valuable old trees have been preserved in this way.

Before passing to treat of the chief diseases known to start from such wounds as the above, it should be remarked that it is not inevitable that the exposed surface becomes attacked by fungi capable of entering the timber. It happens not unfrequently that a good closure is effected over the cut base of a small branch in a few years, and that the timber of the base is sound everywhere but at the surface: this happy result may sometimes be attained in pines and other Conifers, for instance, by the exudation of resin or its infiltration into the wood; but in rarer cases it occurs even in non-resinous trees, and recent investigations go to show that the wood formed in these healing processes possesses the properties of true heart-wood. At the same time there is always danger, as stated, and we will now proceed to give a brief account of the chief classes of diseases to which such wounds render the tree liable.

The first and most common action is the decay which sets in on the exposure of the wood surface to the alternate wetting and drying in contact with the atmosphere: it is known that wood oxidizes under such circumstances, and we may be sure that wounds are no exception to this rule. The surface of the wood gradually turns brown, and the structure of the timber is destroyed as the process extends.

The difficulty always arises in Nature, however, that mould-fungi and bacteria of various kinds soon co-operate in and hurry these processes, and it is impossible to say how much of the decay is due to merely physical and chemical actions, and how much to the fermentative action of these organisms. We ought not to shut our eyes to this rich field for investigation, although for the present purpose it suffices to recognize that the combined action of the wet, the oxygen of the air, and the fermenting action of the moulds and bacteria, &c., soon converts the outer parts of the wood into a mixture of acid substances resembling the humus of black leaf-mould.

Now as the rain soaks into this, it dissolves and carries down into the wood below certain bodies which are poisonous in their action on the living parts of the timber, and a great deal of damage may be caused by this means alone. But this is not all: as soon as the decaying surface of the wound provides these mixtures of decomposed organic matter, it becomes a suitable soil for the development of fungi which are not parasitic—*i.e.* which cannot live on and in the normal and living parts of the tree—but which can and do thrive on partially decomposed wood. The spores of such fungi are particularly abundant, and most of the holes found in trees are due to their action. They follow up the poisonous action of the juices referred to above, living on the dead tissues; and it will be intelligible that the drainage from their action aids the poisonous action as it soaks into the trunk. It is quite a common event to see a short stump, projecting from the trunk of a beech, for instance, the edges of the stump neatly rounded over by the action of a callus which was unable to close up in the middle, and to find that the hollow extends from the stump into the heart of the trunk for several feet or even yards. The hollow is lined by the decayed humus-like remains of the timber, caused by the action of such saprophytes as I have referred to. Similar phenomena occur in wounded or broken roots, and need not be described at length after what has been stated.

But, in addition to such decay as this, it is found that if the spores of true wound-parasites alight on the damp surface of the cut or broken branch, their mycelium can extend comparatively rapidly into the still healthy and living tissues, bringing about the destructive influences described in Articles III. and IV., and then it matters not whether the wound closes over quickly or slowly—the tree is doomed. H. MARSHALL WARD.

(*To be continued.*)

HERVÉ MANGON.

IN the current number of *La Nature* there is an interesting article, by M. Gaston Tissandier, on Charles François Hervé Mangon, whose death we announced last week. The following are the essential facts noted by M. Tissandier.

Hervé Mangon was born in Paris on July 31, 1821, and was trained by his father, a military surgeon, who devoted himself almost entirely to the education of his son. At the age of nineteen the young man entered l'École Polytechnique, and two years later l'École des Ponts et Chaussées. He afterwards acted as engineer for several railways, but his chief interest at that time was in science as applied to agriculture.

In 1850 he published his "Études sur les Irrigations de la Campine Belge," and on the "Travaux Analogues de la Sologne." This work attracted great attention, and brought about important improvements in the French laws relating to agriculture. Drainage was then scarcely known, even by name, in France. In 1851, M. Hervé Mangon published a work on the subject, which was considered so valuable that he received from the Academy of Sciences the decennial prize for the most useful work on agriculture issued during the previous ten years. His practical instructions on drainage, of a little later date, were widely circulated, and it is estimated that the results of his researches have led to an increase, in the French revenue, of fourteen millions of francs yearly. Irrigation, manures, chemical refuse, and everything by which land might be fertilized, were made by him subjects of prolonged and careful study. He visited the principal agricultural works and irrigations in France, Belgium, Scotland, Spain, and Algiers, and summed the knowledge thus acquired in his "Traité de Génie Rural."

These researches were followed by meteorological studies, in which he took the deepest interest. He invented or improved many meteorological instruments, and on his estate at Brécourt in Normandy he organized a model meteorological station, provided with the latest scientific improvements. Towards the end of his career he played a most important part in the reorganization of the French meteorological service, and he became the President of the Meteorological Council. He contributed also to the organization of the scientific mission to Cape Horn, and to many other enterprises useful to science.

As a Professor, he created at the École des Ponts et Chaussées the course on "Hydraulique Agricole" (1849); at the Conservatoire des Arts et Métiers the course on "Travaux Agricoles et de Génie Rural" (1864); and at the new Institut National the course on "Génie Rural" (1876), a science of which he may be considered one of the founders. He lectured with ease, and his expositions were always clear and methodical.

He possessed an extraordinary power of work. He rose early, carried on his own correspondence, and did all his literary work without assistance. His personal tastes were simple, and the activity of his body seemed to keep pace with that of his mind. He welcomed fellow-workers cordially, and readily offered them counsel and help, his disposition being one of rare generosity. He was skilful in working in wood and metal, and always kept in his library a quantity of apparatus made by himself. With this he was constantly experimenting, sometimes even getting up during the night to carry on some research of special interest.

In 1872 he was elected a member of the Academy of Sciences; in 1880, Director of the Conservatoire des Arts et Métiers; and in 1887, Vice-President of the Academy of Sciences. Notwithstanding the manifold calls on his time, he worked hard to secure the success of the Exhibition of 1867, and of all the succeeding Paris Exhibitions.

Believing it to be important that men of science should take part in politics, he entered the Chamber as Deputy for La Manche, and became Minister of Agriculture in the Brisson Ministry, in which he was of eminent service.

During the war of 1870 he gave proof of ardent patriotism. Night and day, during the siege of Paris, he made incessant observations in order to facilitate the despatch of letters by balloon. For six months he did not miss the departure of one of the balloons; he was always present, encouraging the aëronauts, and giving them valuable directions. When M. Tissandier was about to leave Paris in a balloon, laden with messages for the Government at Tours, M. Hervé Mangon said to him, "Vous avez bon vent est-nord-est; vous allez filer dans la direction de Dreux," and the balloon descended at the gates of that very town.

M. Hervé Mangon was the son-in-law of J. B. Dumas. He had a wide circle of friends, and many young men of science owe him a deep debt of gratitude for the encouragement they received from him in their work. For a long time he suffered from a painful malady, and on the 15th of May he died at Paris, in his sixty-seventh year.

NOTES.

THE annual Ladies' *Conversazione* of the Royal Society will be held on Wednesday, June 6.

MR. R. G. HALIBURTON writes from Oran, Algeria, that a few hours after he had read the account in the *Times* of the recent *soirée* of the Royal Society, at which two skeletons of Akkas, sent by Emin Pasha from Equatorial Africa, were exhibited, the discovery, made by himself in February last, of the existence of another dwarf race, in North Africa, also only 4 feet high, and called by the same name, Akkahs, was confirmed by the receipt of a letter on the subject from our late Minister at Morocco, Sir John Drummond Hay.

THE creation of the new Chair of Philosophie Biologique is to be proposed to the Sorbonne in the course of the next few days. There will be much opposition to the scheme, but not enough to prevent it from being carried out.

THE ceremony in honour of Prof. Donders, at Utrecht, on Monday, passed off most successfully. Many friends and admirers, not only from all parts of Holland, but from the Dutch colonies and other countries, assembled to show their respect for the illustrious investigator, and the Dutch Government was represented on the occasion by the Home Minister. A medal commemorative of the ceremony was struck, and the King of Holland conferred on Prof. Donders the distinction of Commander of the Golden Lion. King Humbert sent him the Order of the Crown of Italy, and Sir Joseph Lister congratulated him on behalf of the Royal Society of England. In responding to the address recognizing his services to science and humanity, Prof. Donders declared that although the law rendered it necessary for him, on the attainment of his seventieth birthday, to resign his professorship, he did not consider that he had finished his task. The sum subscribed as an expression of gratitude for Prof. Donders' work is to be appropriated, in accordance with his own decision, for the benefit of young physiologists and ophthalmologists at the University.

DURING the recent cruise of the Liverpool Marine Biology Committee in the s.s. *Hyæna*, the electric light was applied to deep and surface tow-netting after dark with important results. We hope shortly to publish fuller details.

A MARINE zoological station, on the plan of the one at Naples, is shortly to be established at Ostend. The proposal is supported by four Belgian Universities.

A LETTER has been received by Sir J. D. Hooker from Mr. Joseph Thomson, dated Mogador, May 6, stating that he is on the eve of starting by a route through the province of Shedma to Saffi, where, after a short stay with M. Hunot, H.B.M.'s Consul there, he will go direct to Demenat, an entirely unexplored part of the Atlas, north-east of the city of Morocco. Mr. Thomson describes the past season as having been exceptionally late and cold, and with an extraordinary rain and snowfall; the season's rainfall at Mogador having been more than 32 inches, against an average of less than 18 inches.

IT is stated that Mr. Knipping, of the Meteorological Department of Japan, is coming to Europe on a mission to report on European meteorological observatories.

IN the *American Meteorological Journal* for April, Mr. A. L. Rotch continues his article on the history of the meteorological organizations, dealing with the German Institute, and the various newspaper services. Prof. F. Waldo contributes a very interesting paper on the instruments for making observations of the amount and direction of the wind. Special attention is given to Dr. Robinson's anemometer, as the instrument almost universally adopted, and so called from his investigation of its principle, published in 1850. Its invention is attributed to Edgeworth, who first used it as a scientific instrument, but a similar apparatus, made of wood, with oval cups, is described in the *Mongolische Völker*, 1770. Dr. Robinson found that the velocity of the cups must be multiplied by the factor 3 in order to get the true wind velocity, and this value was generally adopted. Mr. Stow and Prof. Stokes in this country, and Dr. Dohrandt in Russia, first questioned the accuracy of this value, and recent careful experiments by Mr. Dines, just communicated to the Royal Meteorological Society, show that the factor for anemometers of this class must be reduced to about 2·15. And further, it has been found that the formula for conversion of velocity to pressure ($P = \cdot 005V^2$) adopted by Smeaton (Phil. Trans. 1763), and repeated subsequently in text-books, requires amendment, so that the pressures deduced from velocity anemometers have been greatly exaggerated. In fact great doubt has been expressed by competent authority as to the value of the records of this class of instruments. Prof. Waldo's discussion of the subject is therefore very opportune.

AT Cragside, Rothbury, Northumberland, the seat of Lord Armstrong, a very fine female of Pallas's sand grouse (*Syrrhaptes paradoxus*) killed itself against the telegraph-wires near Cragside on Wednesday, May 23. The bird was picked up by the gamekeeper, and was sent by Lord Armstrong to Mr. John Hancock at the Natural History Museum, Newcastle-on-Tyne, where it will be carefully preserved. This bird was in fine plumage, and was proved by dissection to be a female, the ovary containing seven ova about the size of No. 1 shot, and numerous others of very much smaller size. It is a curious coincidence that the first specimens of Pallas's sand grouse, recorded in 1863, were shot at Thropton, a few miles west of Rothbury, on May 21, and were sent to Mr. Hancock. The crop of another specimen (male) of this bird, which we are told was obtained at Winlaton, five or six miles west of Newcastle-on-Tyne, was sent to the Museum on the 23rd inst. The crop was full of the seed of a wild plant, probably charlock or wild mustard (*Sinapis arvensis*, L.).

DR. TRIMEN'S report on the five Royal Botanic Gardens of Ceylon, which has just been issued, contains much interesting

matter relating to the economic aid given by the institution to planting in Ceylon and elsewhere. Referring to the gradual decline in the cultivation of coffee, Dr. Trimen mentions, as one of the causes, that it has suffered severely during the last few years from the attacks of a scale-insect or "bug" which has in some places actually killed out the bushes. Practical planters think the insect different from either of the "bugs" familiar hitherto as foes to coffee—*Lecanium coffeæ* and *L. nigrum*, the brown coffee and black bugs. The distinctions between the three have been pointed out by Mr. E. Green in a paper with illustrations printed by the Government of Ceylon. He names the new pest *L. viride*, it being generally known as the green bug. Dr. Trimen mentions that his principal employment during the past year has been the compilation, with the aid of the library and herbarium, of a catalogue of the contents of the gardens, for use by the staff, the public, and correspondents in other countries. The list as now completed is brought down to the end of 1886, and contains about 3000 species, mostly trees and shrubs. He also reports the commencement of the long projected museum of economic botany.

A VOLUME on the life and works of Lavoisier, by Prof. E. Grimaux, of the Polytechnic School of Paris, has just been published. It is illustrated by many interesting engravings, two of which represent Lavoisier in his laboratory. A number of hitherto unknown documents relating to Lavoisier have been discovered by Prof. Grimaux.

MESSRS. MACMILLAN AND BOWES, Cambridge, will have ready in a week a "Bibliography of the Works of Sir Isaac Newton, together with a List of Books illustrating his Life and Works," by G. J. Gray.

MESSRS. MACMILLAN AND CO. will shortly publish a work on "The Theory and Practice of Absolute Measurements in Electricity and Magnetism," by A. Gray, M.A., Professor of Physics in the University College of North Wales. Though nominally a second edition of the small book by the same author published in 1884, it has been entirely re-written and extended in plan, so as to form a fairly complete treatise on the absolute measurement of electric and magnetic quantities. This has necessitated the division of the work into two volumes, of which the first, extending to over 450 pages, is about to be issued. The following is a synopsis of the contents:—Vol. I. contains a sketch of the theory of electro-statics and flow of electricity, chapters on units, general physical measurements, electrometers, comparison of resistances, comparison of capacities, and measurement of specific inductive capacities, and concludes with an appendix of tables of units, resistances, and useful constants. The chapter on the comparison of resistances contains full details of the various methods of comparing high and low resistances, calibration of wires, &c.; the chapter on capacities discusses methods generally, and contains an account, as full as possible, of the principal determinations of specific inductive capacity made up to the present time. Vol. II. will contain an account of magnetic theory, units and measurements; electro-magnetic theory and absolute measurement of currents, potentials and electric energy; the definitions and realization of the ohm and other practical units; the relations of electro-magnetic and electro-static units and the determination of v; practical applications of electricity, and especially related points of theory and measurements. (This volume is in hand, and will be issued as soon as possible after Vol. I.) An attempt has been made to arrange the work so as to avoid any too sharp distinction between what is theoretical and what is practical, and at the same time preserve a logical order in the former and prevent the constant introduction of digressions on theory into accounts of instruments and processes of manipulation.

A WORK of some interest and importance, "Excursions zoologiques dans les Iles de Fayal et de San Miguel (Açores)," has just been producedby M. Jules de Guerne, at the expense of Prince Albert de Monaco. Of the new species mentioned, some, perhaps all, have been elsewhere recorded in contemporary periodicals. M. de Guerne concludes from his researches that the land fauna of the Azores has a definitely European character; that the fresh-water fauna has the same character, many of the species composing it being probably cosmopolitan, most of them provided with powerful means of dissemination, which have enabled them to reach the Azores; that most of the species have been brought by the wind and by birds, the wind playing only a secondary part; that the lakes in the craters are of modern origin, due to the accumulation of rain-water, and have not taken long to people; that the character of the aquatic types and the absence of any great struggle for existence suffice to explain this rapid peopling of the waters; that the land species, like those of the water, have been fortuitously introduced from the nearest islands and continents, though at a remoter epoch and more distant intervals, this greater antiquity accounting for the greater differentiation of the land fauna, and in especial of the Mollusca; that the alpine character of the land fauna has not been demonstrated, and that, on the theory of the gradual submergence of the islands, the animals of the littoral region in retiring to the higher grounds would have there produced a varied and numerous assemblage of species, which, as a fact, is not found. Incidentally, M. de Guerne points out a mistake which has crept into works of importance—a sudden depth of 58 fathoms at a single spot being attributed to the little Lagoa Grande in the Island of San Miguel, instead of the true depth, which is about 17 fathoms.

THE Bancroft Company, San Francisco, announces that there will shortly be added to the series of guide-books to the Pacific Coast a hand-book of the Lick Observatory, which has been prepared by Prof. Edward S. Holden, Director of the Observatory. This book is intended to give all the information which will be of value to each one of the many visitors to the Lick Observatory, which possesses the largest and most powerful telescope in the world, and is situated in one of the wildest and most romantic portions of California. Besides the useful and necessary information of a mere guide-book, the work is to contain interesting and popular accounts of the various astronomical instruments, and of the way in which they are made and used. It will be illustrated by twenty or more woodcuts from photographs and drawings.

MR. HENRY BEDFORD, of All Hallows College, Dublin, writes to us:—"I see among the notes in your last number (p. 87) that Herr Sander, in his paper on some recently deciphered runic inscriptions in Sweden, says that 'in four of them appeared the word *Pim* or *Piment* (*i.e.* a strong drink composed of wine, honey, and spice), which, as well as *Klaret*, was mentioned in the *Saga* of Rollo the Ganger and the Normans,' and that 'all these inscriptions were referred to the close of the pagan age.' Now if the word *Klaret* refers like *Piment* to some kind of drink, does not this point to the direction in which we are to look for some more satisfactory explanation of our modern word *Claret* than that which our dictionaries give—as a derivation from the French *clairet*—although the word is not used in that language to describe the French wine to which we apply it. Perhaps you or some of your readers will throw some light upon the origin of this obscure word."

THE 800th anniversary of the University of Bologna will be celebrated on June 12 next. An oration will be delivered by the poet Giosué Carducci. There will also be a musical performance, an ode having been written for the occasion by Panzacchi, and set to music by Baron Franchetti.

LAST week we printed a letter from M. Julius, of Delft, Holland, asking a question with regard to tables of reciprocals. Mr. T. S. Barrett and Mr. A. Freeman write to us recommending Barlow's tables of squares, cubes, square roots, cube roots, and reciprocals of all integers up to 10,000. The reciprocals are given to seven places of significant figures, besides the leading zeros. The work was edited by the late A. De Morgan, and published for the Useful Knowledge Society by Taylor and Walton, London, 1840.

PROF. BALL, General Director of the Science and Art Museum, Dublin, mentions in his report for 1887, that early in the year he brought before the Council of the Royal Irish Academy the desirability of its handing over to the Museum an old collection of moulds of Irish crosses and miscellaneous sculptures, together with casts, most of which had been prepared for the Exhibition of 1853. To this proposition the Academy cordially assented, and, after much piecing together of broken fragments, it was found that the material provided a very valuable and representative set of casts. It is proposed that casts of many objects of ancient Irish art not included in this collection shall also be obtained. The collection, when completed and properly arranged in the new Museum, ought to be of great service not only to archæologists but to workmen, who would be well rewarded for a careful and elaborate study of the ideas of the mediæval craftsmen of Ireland.

HERR H. FORSELL has been chosen President of the Swedish Royal Academy of Science for the ensuing year, in place of Herr C. G. Malmström.

THE Biological Society of University College will hold its annual *soirée* at the College on Thursday, June 7, beginning at 8 p.m. Prof. W. H. Flower, F.R.S., will deliver a lecture at 9 p.m. on "The Pygmy Races of Men." Tickets may be had on application to the secretaries of the Society.

WE have received the *Annuaire* for the year 1888 of the Paris Society for the Encouragement of National Industry. Among the contents are a list of the members, and an extract from the programme relating to the prizes to be given by the Society from 1888 to 1893.

THE Danish Government has granted a sum of £500 for the purpose of having the oyster-banks in Denmark examined by an expert. His object will be to ascertain the results of their continued preservation, with a view to the resumption of fishing.

SOME months ago a large consignment of salmon ova was despatched from Denmark to Buenos Ayres, *viâ* Hamburg, for the stocking of certain lakes and rivers in the Argentine Republic. The experiment has proved very successful, the ova ariving in excellent condition, and further consignments are to be made.

THE following incident in the trial of the great patent case, Edison and Swan Electric Light Company *v.* Holland and others, now proceeding in the Chancery Division of the High Court of Justice, before Mr. Justice Kay, is taken from the shorthand report in the *Electrician* of May 18. On May 16, Prof. James Dewar, F.R.S., Professor of Chemistry in the University of Cambridge was under examination. A small crucible was produced and handed to the witness, who said: In that crucible I have, with Mr. Gimingham, carbonized filaments in the precincts of the court, using no packing and no luting of any description. The filament was a thread so far as he could remember.

Sir Horace Davey urged that this did not arise out of the cross-examination.

Mr. Justice Kay said it should have been produced in the examination-in-chief. If it were pursued, Sir Horace Davey would be entitled to ask any questions upon it.

Sir Horace Davey, cross-examining:—About what heat was this produced at?—It was a mere experiment. It was a spirit-lamp that was used.

Do you suggest that this coil, or whatever you like to call it, has been heated to a sufficient heat for use as a conductor in an incandescent lamp?—Not at the present time.

Then it is not completely carbonized?—It is carbonized; but it does not conduct well enough. It wants to be heated for a longer time at a higher temperature.

Has it been heated to a degree at which the oxygen would combine with or attack the carbon?—That I cannot say. I think it is probably at a low red heat.

Mr. Justice Kay: I am very much disgusted. I am here trying all I can to understand the case, and this is clearly an attempt to mislead. I am greatly disgusted.

Prof. Dewar: I have no desire to mislead your lordship. I have stated that this was a mere experiment. I did not produce it. It was put to me.

Mr. Justice Kay: You may stand down.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Mr. George Somerford; a Barbary Ape (*Macacus inuus* ♀) from North Africa, presented by Miss Waterman; a Brazilian Tree Porcupine (*Sphingurus prehensilis*) from Pernambuco, presented by Mr. Clement J. Bateman; a Barbary Wild Sheep (*Ovis tragelaphus*), from North Africa, presented by Mr. E. H. Forwood; a Greater Black-backed Gull (*Larus marinus*), British, presented by Prof. E. Ray Lankester, F.R.S., F.Z.S.; a Herring Gull (*Larus argentatus*), British, presented by Mr. E. Wright: a Cape Dove (*Œna capensis*), a Tambourine Pigeon (*Tympanistria bicolor*) from South Africa, presented by Mr. R. H. Milford; a White-handed Gibbon (*Hylobates lar*) from the Malay peninsula, a Chimpanzee (*Anthropopithecus troglodytes* ♀), a Marabou Stork (*Leptoptilus crumeniferus*) from West Africa, two Caracals (*Felis caracal juv*) from Africa, three Red-crowned Pigeons (*Erythrœnas pulcherrimus*), a Praslin Parrot (*Coracopsis barklyi*), two —— Kestrels (*Tinnunculus gracilis*) from the Seychelles, a Laughing Kingfisher (*Dacelo gigantea*), a Black-backed Piping Crow (*Gymnorhina tibicen*), a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, two Glass Snakes (*Pseudopus pallasi*) from Dalmatia, deposited; six Common Pintails (*Dafila acuta*), eight Common Teal (*Querquedula crecca*), eight Garganey Teal (*Querquedula circia*), ten Wigeon (*Mareca penelope*), a Shoveller (*Spatula clypeata*), British, purchased; a Red Kangaroo (*Macropus rufus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET 1888 *a* (SAWERTHAL).—At the beginning of last week, apparently on May 20 or 21, the comet suddenly became very much brighter, gaining fully three magnitudes. It has since faded again. Only a few observations have as yet come to hand, but it is to be hoped that everyone who has observed it during the last fortnight, and made any estimate of its brightness, will publish his observations without delay.

THE SHORT PERIOD COMETS AND ASTEROIDS.—Prof. Kirkwood, who has already given reasons for thinking that two short period comets originally belonged to the group of asteroids, has extended his argument in the *Sidereal Messenger* for May to include the class of short period comets as a whole. He points out that, of the twenty comets concerned, seven have disappeared, either by dissolution into fragments, like Biela's comet, or by the transformation of the orbit by the influence of Jupiter, as in the case of Lexell's comet. The instances of the comets of Lexell and Wolf (1884) are representative, Prof. Kirkwood considers, of the mode in which asteroidal may have been changed into cometary orbits. Had the latter, indeed, been discovered before its perturbation, it would probably have been considered simply an asteroid of unusually long period, for its eccentricity and inclination were

well within asteroidal limits. Of the twenty comets, not only have seven disappeared, but five, or, including Encke's and Biela's, seven, have periods commensurable with that of Jupiter; all the twenty have direct motion; all but one have smaller inclination than Pallas; and, as with the asteroids, there is a tendency of the perihelia to concentrate in the 180° from 290° to 110°.

NEW MINOR PLANET.—A new minor planet was discovered by M. Borrelly on May 12 at Marseilles. This may possibly, but not very probably, prove to be Xanthippe, No. 156. Should it be really a fresh discovery, it will rank as No. 278, whilst the one discovered by Herr Palisa on May 16 (see NATURE, vol. xxxviii. p. 89) will be numbered 279.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *JUNE* 3-9.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on June 3

Sun rises, 3h. 49m.; souths, 11h. 57m. 57·6s.; sets, 20h. 7m.: right asc. on meridian, 4h. 47·4m.; decl. 23° 24′ N. Sidereal Time at Sunset, 12h. 58m.

Moon (New on June 9, 17h.) rises, 1h. 42m.; souths, 7h. 30m.; sets, 13h. 29m.: right asc. on meridian, 0h. 18·6m.; decl. 2° 54′ S.

Planet.	Rises.	Souths.	Sets.	Right asc. and declination on meridian.
	h. m.	h. m.	h. m.	h. m. ° ′
Mercury..	5 4 ...	13 35 ...	22 6 ...	6 25·2 ... 25 23 N.
Venus ...	3 21 ...	11 14 ...	19 7 ...	4 3·4 ... 20 4 N.
Mars ...	14 19 ...	19 57 ...	1 35*...	12 47·6 ... 5 3 S.
Jupiter ...	18 39 ...	23 0 ...	3 21*...	15 51·7 ... 19 12 S.
Saturn ...	7 38 ...	15 32 ...	23 26 ...	8 22·0 ... 20 5 N.
Uranus...	14 19 ...	19 59 ...	1 39*...	12 49·8 ... 4 37 S.
Neptune..	3 20 ...	11 5 ...	18 50 ...	3 53·9 ... 18 38 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

June. h.
8 ... 20 ... Venus in conjunction with and 3° 39′ north of the Moon.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·4 ...	81 16 N. ...	June 6,	0 16	*m*
Mira Ceti	2 13·7 ...	3 29 S. ...	,, 9,		*m*
R Leonis	9 41·5 ...	11 57 N. ...	,, 4,		*M*
S Ursæ Majoris ...	12 39·1 ...	61 42 N. ...	,, 9,		*M*
V Virginis	13 22·0 ...	2 36 S. ...	,, 8,		*M*
U Coronæ	15 13·6 ...	32 3 N. ...	,, 7,	22 20	*m*
U Herculis	16 20·9 ...	19 9 N. ...	,, 3,		*m*
U Ophiuchi... ...	17 10·9 ...	1 20 N. ...	,, 7,	23 48	*m*
W Sagittarii ...	17 57·9 ...	29 35 S. ...	,, 8,	22 0	*m*
U Sagittarii... ...	18 25·3 ...	19 12 S. ...	,, 3,	2 0	*m*
			,, 6,	1 0	*M*
R Scuti...	18 41·5 ...	5 50 S. ...	,, 4,		*m*
β Lyræ...	18 46·0 ...	33 14 N. ...	,, 3,	3 0	*m*
R Capricorni ...	20 5·0 ...	14 36 S. ...	,, 4,		*M*
X Cygni	20 39·0 ...	35 11 N. ...	,, 8,	21 0	*m*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
Near Antares	248° ...	20° S.	
,, *σ* Ophiuchi	260 ...	5 N. ...	Rather slow.

GEOGRAPHICAL NOTES.

IN the Report of the Survey of India for 1886-87, Colonel Strahan gives an account of the survey and exploration of the Nicobar Islands by himself and party. A very careful survey of the whole group was made, and the coast-lines at last accurately laid down. Owing to the dense vegetation, the party were unable to penetrate any distance into the interior, and only a few heights could be measured. The culminating point of the whole group, 2105 feet above sea-level, stands near the south-east corner of Great Nicobar, the area of which is 375 square miles, the total area of the group being 678 square miles. The scenery, especially of Great and Little Nicobar, is of indescribable beauty. There are several rivers in the former island which are navigable by boats for some miles, especially the Galatea, on the south coast. Its course is very tortuous, the banks are fringed with tree-ferns, canes, bamboos, and tropical vegetation of infinite variety, through which occasional glimpses are obtained of high mountains in the interior covered with dense forests to their very summits, and generally cloud-capped. The country through which the stream runs is almost uninhabited; a few huts appear here and there tenanted by an inland tribe of savages called "Shom Pen," of whom very little is known, except that they are in such an utter state of barbarism as to be held in contempt even by the Nicobarese inhabiting the coasts. On most of the islands the forest grows luxuriantly down to the beach. Mangroves, except in the island of Kamorta, are not very plentiful, and in this respect these islands differ widely from the neighbouring Andaman group, where the creeks are fringed with mangroves mile after mile. The sea-beach consists largely of coral. The climate is very equable day and night all the year through, and most pleasant to one's feelings, but unfortunately its character for unhealthiness is only too well established. The rainfall, which averages about 100 inches, is pretty evenly distributed throughout the year. The thermometer stands very steadily between 80° and 85° in the shade, and hardly varies day or night. The inhabitants of these islands, Colonel Strahan states, are allied to the Malays, and are a complete contrast to their tiny, intensely black, woolly-haired neighbours, the Andamanese. The Nicobarese are very strong, thickly-built men, not much if at all inferior to Europeans in physique, of a reddish-brown colour. They are unconquerably lazy, having no inducement whatever to exertion. They have a wonderful talent for learning languages. Fortunately, Mr. Man, the Settlement Officer at Kamorta, who has done so much for Andaman anthropology, has been carefully studying the Nicobarese, their habits and language, and is now engaged on a book on the subject, which will shortly be published.

MR. C. M. WOODFORD, the successful naturalist explorer of the Solomon Islands, is about to leave England on a third visit to the group. After spending some time in various parts of the islands not previously visited, he will investigate Santa Cruz, Woodlark Island, and other islands lying to the south-east of New Guinea.

ACCORDING to the new Survey Report, triangulation surveys have already been effected over 15,000 square miles in Upper Burma, and the out-turn of reconnaissance surveys amounts to 11,000 square miles on the scale of 4 miles to an inch, in the following States and districts: Northern Shan States and Ruby Mines district, 3000 square miles; Southern Shan States, 3000; Yemethin and Mehtila district, 2000; Yaw country, 1000; Mandalay and Kyaukse districts, 2000.

IN the summary Report of the Geological Survey of Canada for 1887, some of the results are given of the expedition under Dr. G. M. Dawson last summer, of the exploration of British Columbia. Mr. Ogilvie's instrumental survey to the intersection of the Yukon with the 141st meridian will form a sufficiently accurate base-line for future explorations in this region. In addition to this the geographical results include the completion of an instrumental survey of the Sitkine to Telegraph Creek by Mr. McConnell, which is connected with Dease Lake by a carefully placed traverse by Mr. M'Evoy. Thence a detailed running survey was carried by the Dease, Liard, and Pelly Rivers, connecting with Mr. Ogilvie's line at the mouth of the Lewis River, a total distance of 900 miles. Taken in conjunction with Mr. Ogilvie's line, these surveys include an area of over 6000 square miles, the interior of which is still, with the exception of reports received from a few prospectors and from Indians, a *terra incognita*. The same remark may be applied to the whole surrounding region outside the surveyed circuit, but much general information has been obtained respecting the entire district, which will facilitate further explorations. The whole region is more or less mountainous, though intersected by wide areas of flat or valley country. The country, though generally mountainous in character, includes large tracts of flat and slightly broken land, and, according to Dr. Dawson, may eventually support a population as large as that found in corresponding latitudes in Europe.

THE anniversary meeting of the Royal Geographical Society was held on Monday in the hall of the University of London, General R. Strachey presiding. The report, which was read by Mr. Clements R. Markham, having been adopted, General Strachey was for the third consecutive year elected President of the Society. The Founder's Medal for the encouragement of geographical science and discovery was presented to Mr. Clements R. Markham, who retires from the honorary secretaryship after twenty-five years' service, in acknowledgment of the valuable services rendered by him to the Society during that period. Lieut. H. Wissmann was awarded the Patron's Medal in recognition of his great achievements as an explorer in Central Africa; Mr. J. M'Carthy, Superintendent of Surveys in Siam, the Murchison Grant; Major Festing, the Cuthbert Peek Grant, for his services as a cartographer on the Gambia River and the country in the neighbourhood of Sierra Leone. The Gill Memorial for 1888 was secured by Mr. Charles M. Doughty. Various scholarships and prizes to students in training colleges were also distributed. The President then delivered his annual address, passing in review the chief geographical events of the year.

THE LINNEAN SOCIETY.

THE hundredth anniversary meeting of this Society was held on Thursday last, 24th inst., at Burlington House, in the library, the usual meeting-room being inadequate for the reception of the large number of members present on this occasion. The President, Mr. Wm. Carruthers, F.R.S., took the chair at three o'clock, and was supported by the two former Presidents who are happily still with us—Prof. Allman and Sir John Lubbock—the Council of the Society, and many distinguished Fellows, amongst whom we noted Sir Richard Owen, Sir Joseph Hooker, Dr. Günther, Sir Walter Buller, Prof. Duncan, Mr. Romanes, Colonel Grant, and amongst the visitors Dr. Henry Woodward, F.R.S., and Mr. Studley Martin, a nephew of the founder.

After preliminary business, H.M. the King of Sweden was elected an honorary member. The Treasurer, Mr. Frank Crisp, laid the last year's accounts before the meeting, and briefly referred to the financial history of the Society during the century now closed. The senior Secretary, Mr. B. Daydon Jackson, presented an account of the Linnean collections from their formation, their purchase by the founder of the Society, and their possession by the Linnean Society. This was succeeded by the President's annual address, which was largely devoted to a review of the Society's past career. He spoke of the original quarto Transactions, then of the octavo Proceedings, finally of the Journal, of which forty-three volumes are extant. During the past year seven parts of the Transactions and twenty of the Journal had been issued, an amount equal to that published during fifteen years in the early part of the century.

A novel feature was then introduced, one of those intended to mark the centenary of the Society. Prof. Thöre Fries, the present occupant of Linnæus's Botanical Chair at Upsala, had been invited to pronounce a eulogium on his illustrious predecessor. As he was detained by his professorial duties in his University, his essay was read by the President. In it he spoke of the profound sleep of natural science during the Middle Ages, and the hard struggle which had to be fought before men of science could liberate themselves from a narrow orthodoxy, or the fetters they had themselves forged by attaching infallibility to Aristotle and classic authors. Linnæus bore an honourable part in placing the study of natural science on a logical basis by his clear definitions, and admirable nomenclature, and by the enthusiasm he was able to rouse in his disciples for the same methods. England, unluckily for Sweden, became his heir; many consequently are the ties which unite the memory of Linnæus with this country, the strongest perhaps being the Linnean spirit, the genuine spirit of freshness and enterprise in which scientific research is carried on in England.

Sir Joseph Hooker then pronounced a eulogy on Robert Brown, the greatest botanist of the present century. He specially dwelt on the evidence afforded by the "Prodromus" of his untiring industry, accuracy of observation and exposition, together with sagacity, caution, and soundness of judgment, in which he has not been surpassed. Where others have advanced beyond the goal he reached, it has been by working on the foundations he laid, aided by modern appliances of optics and physics. His memory was wonderful, he seemed never to forget a plant he had examined; and the same with his books—he could turn to descriptions for a statement or a figure without needing a reference. The noble title conferred upon him by Humboldt has been confirmed by acclamation by botanists of every country, "Botanicorum facile princeps."

Prof. Flower, C.B., F.R.S., delivered an address on Charles Darwin, who, he said, had special claims on their consideration, inasmuch as a large and very important portion of his work was communicated to the world by papers read before the Society and published in the Journal. His life was one long battle against our ignorance of the mysteries of living Nature, and he sought to penetrate the shroud which conceals the causes of all the variety and wonders round us. His main victory was the destruction of the conception of species as being fixed and unchangeable beyond certain narrow limits, a view which prevailed universally before his time. That other factors had operated besides natural selection in bringing about the present condition of the organic world was admitted even by Darwin himself. His work, and the discussions which had sprung from it, had marvellously stimulated research, and he had shown by his life and labours the true methods by which alone the secrets of Nature may be won.

Prof. W. T. Thiselton Dyer spoke on George Bentham, who presided over the Society from 1863 to 1874. A nephew of Jeremy Bentham, and trained to some extent under him, he was early imbued with a taste for method and analysis, and through his mother's fondness for plants he was led to study them, with marvellous results. The records of his life-work are astonishing. Whilst President he delivered a series of masterly addresses, and the latter part of his career witnessed the preparation of the "Flora Australiensis" and a full share of the "Genera Plantarum." He stood in the footsteps of Linnæus, and although the descent was oblique he inherited the mantle of the master whose memory was that day commemorated.

The President stated that the Council had decided to establish a Linnean Gold Medal, to be presented to a botanist and a zoologist in alternate years, but on this occasion it would be awarded in duplicate. The medal bore on the obverse a profile of Linnæus, modelled from the bust in the library; on the reverse, the arms of the Society and the name of the recipient. The President made the first presentation to Sir Richard Owen, recounting the chief services he had rendered to zoology. Sir Richard, with some emotion, expressed his high sense of the honour conferred, and thanked the Fellows for their cordial reception of him. The President then presented a similar medal to Sir Joseph Hooker, with a like recapitulation of the splendid services he had bestowed on botany. Sir Joseph suitably replied, returning his cordial thanks for the distinction.

The remaining formal business included the announcement of the newly-elected Councillors, and the re-election of the officers—Mr. Wm. Carruthers, President; Mr. Frank Crisp, Treasurer; and Messrs. B. Daydon Jackson, and W. Percy Sladen, Secretaries.

The annual dinner was held at the Hotel Victoria, Northumberland Avenue, at seven o'clock. The President took the chair, about sixty of the Fellows being present. In addition to the usual toasts, that of "The Medallists" was given, and replied to by Sir Joseph Hooker, who alluded to the fact that he had personally known eight of the Presidents of the Society, and that the founder himself induced his father, Sir William Hooker, to take up the study of botany. As a proof of his close connection with the Linnean Society, he added that his father, grandfather, father-in-law, and uncle had all been Fellows.

The final portion of the centenary celebration took place the following evening, when the President and officers held a reception at Burlington House. A special feature was made of the Linnean manuscripts and memorials, which were displayed in glass cases with descriptions, a catalogue of them being also distributed. Memorials of other distinguished naturalists were also shown, conspicuously those of Robert Brown and George Bentham, lent by Sir Joseph Hooker and M. Alphonse de Candolle, of Geneva, a foreign member of the Society.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Rede Lecture on June 8, by Sir F. A. Abel, will be upon applications of science to the protection of human life. It will be illustrated by experiments and the exhibition of appliances.

Mr. Percy Groom, B.A., late of Trinity College, has been elected to the Frank Smart Studentship in Botany at Gonville and Caius College.

The fittings of the new Chemical Laboratory are costing £1000 more than was originally estimated (from rough drawings only) by Mr. Lyon, Superintendent of the University workshops. Some of this is due to the fact that the fixing of the tables on a bottom independent of the floors of the rooms, and making the cupboard doors fairly dust-proof, originally recommended, was not adopted till after the tables had been fixed, and much cutting of the floors had to be done. Also much of the iron and steel work was not particularized at first.

The Council are taking steps to carry out the appropriation of the old Chemical Laboratory to the department of pathology.

Prof. Darwin will lecture during the long vacation on the theory of the potential, and on attractions, commencing on Tuesday, July 10. The lectures will treat principally of gravitational problems, including attraction of ellipsoids, Gauss's paper, heat of tin, Jacobi's and Dedekind's ellipsoids, oscillations of a fluid sphere, the foundation of the theory of tides, atmospheres of planets, &c.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 3.—"Effect of Chlorine on the Electromotive Force of a Voltaic Couple." By Dr. G. Gore, F.R.S.

If the electromotive force of a small voltaic couple of unamalgamated magnesium and platinum in distilled water, is balanced through the coil of a moderately sensitive galvanometer of about 100 ohms resistance, by means of that of a small Daniell's cell, plus that of a sufficient number of couples of iron and German silver of a suitable thermo-electric pile (see Proc. Birm. Philos. Soc., vol. iv. p. 130), the degree of potential being noted; and sufficiently minute quantities of very dilute chlorine water are then added in succession to the distilled water, the degree of electromotive force of the couple is not affected until a certain definite proportion of chlorine has been added; the potential then suddenly commences to increase, and continues to do so with each further addition within a certain limit. Instead of making the experiment by adding chlorine water, it may be made by gradually diluting a very weak aqueous solution of chlorine.

The minimum proportion of chlorine necessary to cause this sudden change of electromotive force is extremely small; in my experiments it has been 1 part in 17,000 million parts of water,[1] or less than 1/7000 part of that required to yield a barely perceptible opacity in ten times the bulk of a solution of sal-ammoniac by means of nitrate of silver. The quantity of liquid required for acting upon the couple is small, and it would be easy to detect the effect of the above proportion, or of less than one ten-thousand-millionth part of a grain of chlorine, in one-tenth of a cubic centimetre of distilled water by this process. The same kind of action occurs with other electrolytes, but requires larger proportions of dissolved substance.

As the degree of sensitiveness of the method appears extreme, I add the following remarks. The original solution of washed chlorine in distilled water was prepared in a dark place by the usual method from hydrochloric acid and manganic oxide, and was kept in an opaque well-stoppered bottle in the dark. The strength of this liquid was found by means of volumetric analysis with a standard solution of argentic nitrate in the usual manner, the accuracy of the silver solution being proved by means of a known weight of pure chloride of sodium. The chlorine liquid contained 2·3 milligrammes or 0·03565 grain of chlorine per cubic centimetre, and was just about three-fourths saturated.

One-tenth of a cubic centimetre of this solution ("No. 1"), or 0·003565 grain of chlorine, was added to 9·9 c.c. of distilled water and mixed. One cubic centimetre of this second liquid ("No. 2"), or 0·0003565 grain of chlorine was added to 99 c.c. of water and mixed; the resulting liquid ("No. 3") contained 0·0000003565 grain of chlorine per cubic centimetre. To make the solutions ("No. 4") for exciting the voltaic couple, successive portions of $\frac{1}{10}$ or $\frac{3}{10}$ c.c. of ("No. 3") liquid were added to 900 cubic centimetres of distilled water and mixed.

[1] As 1 part of chlorine in 17612 million parts of water had no visible effect, and 1 in 17000 millions had a distinct effect, the influence of the difference, or of 1 part in 500,000 millions, has been detected.

I have employed the foregoing method for examining the states and degrees of combination of dissolved substances in electrolytes, and am also investigating its various relations.

May 17.—"Magnetic Qualities of Nickel." By J. A. Ewing, F.R.S., Professor of Engineering, University College, Dundee, and G. C. Cowan.

The experiments described in the paper were made with the view of extending to nickel the same lines of inquiry as had been pursued by one of the authors in regard to iron (Phil. Trans., 1885, p. 523). Cyclic processes of magnetization have been studied, in which a magnetizing force of about 100 C.G.S. units was applied, removed, reversed, again removed, and re-applied, for the purpose of determining the form of the magnetization curve, the magnetic susceptibility, the ratio of residual to induced magnetism, and the energy dissipated in consequence of hysteresis in the relation of magnetic induction to magnetizing force. Curves are given, to show the character of such cycles for nickel wire in three conditions: the original hard-drawn state, annealed, and hardened by stretching after being annealed. The effects of stress have also been examined (1) by loading and unloading magnetized nickel wire with weights which produced cyclic variations of longitudinal pull, and (2) by magnetizing while the wire was subjected to a steady pull of greater or less amount. The results confirm and extend Sir William Thomson's observation that longitudinal pull diminishes magnetism in nickel. This diminution is surprisingly great: it occurs with respect to the induced magnetism under both large and small magnetic forces, and also with respect to residual magnetism. The effects of stress are much less complex than in iron, and cyclic variations of stress are attended by much less hysteresis. Curves are given to show the induced and residual magnetism produced by various magnetic forces when the metal was maintained in one or other of certain assigned states of stress; also the variations of induced and residual magnetism which were caused by loading and unloading without alteration of the magnetic field. Values of the initial magnetic susceptibility, for very feeble magnetizing forces, are stated, and are compared with the values determined by Lord Rayleigh for iron, and the relation of the initial susceptibility to the stress present is investigated. The paper consists mainly of diagrams in which the results are graphically exhibited by means of curves.

Chemical Society, May 3.—Mr. W. Crookes, F.R.S., in the chair.—The following papers were read:—The determination of the molecular weights of the carbo-hydrates, by Mr. H. T. Brown and Dr. G. H. Morris. The law established by Blagden in 1788, that the lowering of the freezing-point of aqueous solutions of inorganic salts is proportional to the weight of substance dissolved in a constant weight of water, was extended by de Coppet in 1871–72, who pointed out that when the lowering of the freezing-point is calculated for a given weight of the substance in 100 grammes of water, the result, which he termed the coefficient of depression, is constant for the same substance, and that the coefficients for different substances bear a simple relation to their molecular weights. Raoult extended the law to organic substances and to other solvents than water, and showed that when certain quantities of the same substance are successively dissolved in a solvent upon which it has no chemical action, there is a progressive lowering of the point of congelation of the solution, and that this lowering is proportional to the weight of the substance dissolved in a constant weight of water. The "coefficient of depression," A—that is, the depression of the point of congelation produced by 1 gramme of the substance in 100 grammes of the solvent—is given by the formula $\frac{C \times y}{x \times 100} = A$, where C is the observed depression produced by x grammes of the substance dissolved in y grammes of the solvent, and from this value the "molecular depression," T, is calculated by the formula $M \times A = T$, where M is the molecular weight of the substance in question. T is a value varying with the nature of the solvent, but remaining constant with the same solvent for numerous groups of compounds, whence it follows that A and T being known, the molecular weight of the substance in question may be determined from the equation $M = T/A$. This method of Raoult's, which is of value in cases where a vapour density determination is not possible, has been employed by the authors to determine the molecular weights of the following carbo-hydrates: dextrose, cane-sugar, maltose, milk-sugar, arabinose, and raffinose, and also that of mannitol (the solvent being water), with results which lead to formulæ

identical with those ordinarily adopted for these substances.—The molecular weights of nitric peroxide and nitrous anhydride, by Prof. Ramsay. The molecular weight of nitric peroxide as determined by Raoult's method in acetic acid solution, accords with the formula N_2O_4. No definite results could be obtained with nitrous anhydride since dissociation occurred at the temperature of experiment (16°).—In the discussion which followed the reading of these papers, and in which Prof. Debus, F.R.S., Dr. Perkin, F.R.S., and others took part, Mr. Wynne remarked that most results hitherto obtained by Raoult's method pointed to a complete dissociation of the complex molecules present in solids and liquids, and would seem to show that the dissociation is not dependent on the particular solvent employed; Mr. Crompton referred to the great irregularities noticeable on comparing the molecular depressions of various substances as determined by Raoult, and thought that until more was known of the cause of such irregularities, and of the mechanism of the changes under discussion, such results as those brought forward by Messrs. Brown and Morris should be accepted with great reservation; and Prof. Armstrong, F.R.S., observed that, apart from the information as to the comparative molecular weights of dissolved substances which Raoult's method promised to afford, it appeared that, in order to gain as complete an insight as possible into the molecular composition of solids and liquids it was important to vary in every way the proportions of substance dissolved as well as the solvent.—The action of heat on the salts of tetramethylammonium, by Dr. A. T. Lawson and Dr. N. Collie. In the majority of cases, the salts examined decompose in a simple manner, yielding trimethylamine and a salt of methyl.—The action of heat on the salts of tetramethylphosphonium, by Dr. N. Collie. The salts of tetramethylphosphonium with the oxy-acids, when heated, undergo as a rule two changes: the first and most important is the production of trimethylphosphine oxide and a ketone, and the second, which occurs only to a very limited extent, results in the formation of trimethylphosphine and a salt of methyl.

Geological Society, May 9.—Mr. W. T. Blanford, F.R.S. President, in the chair.—The following communications were read:—The Stockdale Shales, by J. E. Marr, and Prof. H. A. Nicholson. The Stockdale Shales extend in an east-north-east to west-south-west direction across the main part of the Lake District, parallel with the underlying Coniston Limestone Series and the overlying Coniston Flags, with both of which they are conformable. They also occur in the neighbourhood of Appleby, and in the Sedbergh district. They are divisible into a lower group of black and dark gray and blue Graptolite-bearing shales, interstratified with hard bluish-gray mudstones, containing Trilobites and other organisms, and an upper group of pale greenish-gray shales, with thin bands of dark Graptolitic shales. The lower group (Skelgill Beds) are well seen in the stream which runs past Skelgill Farm, and enters Windermere near Low Wood; while the upper group (Browgill Beds) occurs fully developed in the Long Sleddale Valley, and its beds are very fossiliferous in Browgill. The authors divided these into a series of fossil-zones, and the beds were compared with the corresponding beds in Sweden, Bohemia, Bavaria, &c. The fossils other than Graptolites were shown to occur elsewhere in strata of Llandovery-Tarannon age, from which it was concluded that the Stockdale Shales occupy that horizon. A fault occurs everywhere between the Middle and Lower Skelgill Beds, except perhaps in the Sedbergh district; but it does not seem to cut out a great thickness of rock, and the authors gave reasons for supposing that it was produced by one set of beds sliding over the other along a plane of stratification. The beds are found to thicken out in an easterly direction, and the possibility of the existence of land in that direction was suggested. The authors directed attention to the importance of Graptolitoidea as a means of advancing the comparative study of the stratified deposits of Lower Palæozoic age. A description was given of the following new species and varieties:—*Phacops elegans*, Boeck and Stars, var. *glabr*, *Cheirurus bimucronatus*, Murch., var. *acanthodes*, *Cheirurus moroides*, *Acidaspis erinaceus*, *Harpes judex*, *H. angustus*, *Amoyx aloniensis*, *Proëtus brachypygus*, and *Atrypa flexuosa*.—On the eruptive rocks in the neighbourhood of Sarn, Caernarvonshire, by Alfred Harker.

Zoological Society, May 1.—Prof. Flower, F.R.S., President, in the chair.—Colonel Irby exhibited (on behalf of Lord Lilford) a specimen of *Aquila rapax* from Southern Spain, believed to be the first authentic specimen of this species known from the Peninsula.—Prof. Flower exhibited and made remarks on a specimen of the Japanese Domestic Fowl with the tail-coverts enormously elongated, the longest attaining a length of 9 feet. The specimen had been presented to the British Museum by Mr. F. D. Parker.—Mr. C. M. Woodford made some general remarks on the zoology of the Solomon Islands, and read some notes on the nesting-habits of Brenchley's Megapode, which lays its eggs in the sands on the sea-shore of these islands.—Mr. G. A. Boulenger read the description of a new Land-Tortoise of the genus *Homopus* from South Africa, based on specimens living in the Society's Gardens, which had been presented to the Society by the Rev. G. H. R. Fisk. The author proposed to name the species *H. femoralis*.—Mr. F. E. Beddard read the second of his series of notes on the visceral anatomy of birds. The present paper treated on the air-sacs in certain diving birds.—Mr. Francis Day read the first of a proposed series of observations on Indian fishes.

Royal Meteorological Society, April 18.—Dr. W. Marcet, F.R.S., President, in the chair.—The following papers were read:—Jordan's new pattern photographic sunshine recorder, by Mr. J. B. Jordan. The improvement in this instrument over the previous pattern of sunshine recorder consists in using two semi-cylindrical or D-shaped boxes, one to contain the morning, and the other the afternoon chart. An aperture for admitting the beam of sunlight is placed in the centre of the rectangular side of each box so that the length of the beam within the chamber is the radius of the cylindrical surface on which it is projected; its path therefore follows a straight line on the chart at all seasons of the year. The semi-cylinders are placed with their faces at an angle of 60° to each other. They are fixed on a flat triangular plate which is hinged to a suitable stand having levelling screws attached, and fitted with a graduated arc as a means of readily adjusting and fixing the cylinders to the proper vertical angle agreeing with the latitude of the station where used.—On the meteorology of South-Eastern China in 1886, by Dr. W. Doberck. This paper gives the results of observations made at the Custom-houses and lighthouses by officers of the Imperial Chinese Maritime Customs. In summer there is very little change of temperature with latitude. The temperature depends upon the distance from the nearest sea coast, and is greatest at stations farthest inland. The highest mean temperature occurred in July, and the lowest in January. The north-east monsoon blows from September to June, and the south monsoon during July and August; the latter does not blow with half the force of the former. Rainfall is greatest in Northern Formosa, and least in Northern China. Along the east coasts of Formosa and Luzon the winter is the wet season, while in China July seems to be the wettest month of the year.—Lightning in snowstorms, by Prof. A. S. Herschel, F.R.S.—Insolation, by Mr. Rupert T. Smith.

EDINBURGH.

Royal Society, May 7.—Lord Maclaren, Vice-President, in the chair.—Dr. G. Sims Woodhead communicated a paper written by Mr. Robert Irvine and himself, on the secretion of carbonate of lime by animals.—A paper by Mr. Irvine and Mr. George Young, on the solubility of carbonate of lime under different forms in sea-water, was also read.—Dr. Alexander Bruce described a case of absence of the *corpus callosum*, in the human brain.—Dr. J. Murray discussed the distribution of some marine animals on the west coast of Scotland.—Mr. W. E. Hoyle described some larvæ of certain Schizopodous Crustacea from the Firth of Clyde.

May 21.—The Rev. Prof. Flint, Vice-President, in the chair.—A series of photographs of the Nice Observatory, presented by M. Bischoffsheim through the Astronomer-Royal for Scotland, were exhibited.—A note by Prof. Cayley, on the hydrodynamical equations, was communicated. The author discusses the result of the elimination of the symbol denoting the pressure by differentiation of the three fundamental hydrokinetical equations.—Dr. Archibald Geikie treated fully the history of volcanic action during Tertiary time in the British Islands.

PARIS.

Academy of Sciences, May 22.—M. Janssen, President, in the chair.—Obituary notice of M. Hervé Mangon, member of the Section for Rural Economy, and Vice-President of the Academy for the year 1888, by the President. M. Mangon, who was born in Paris on July 31, 1821, and died there on

May 15, 1888, may be regarded as the founder of agronomic science, to which he devoted many years of assiduous labour. To him France is indebted for the introduction of all the more useful agricultural processes. He also gave a great stimulus to the associated science of meteorology, and rendered important services to ballooning, especially in connection with military tactics.—On the part played by atmospheric nitrogen in vegetable economy, by M. E. Chevreul. A few summary observations are made in reference to the memoir recently presented to the Academy by MM. Gautier and Drouin. These observers having announced as a result of their personal experiments and as something new to science that the gaseous nitrogen of the atmosphere is absorbed by plants, it is pointed out that the Commission appointed in 1854 to investigate the question decided in favour of M. Georges Ville's theory and against that of M. Boussingault. Since then the part played by atmospheric nitrogen in the vegetative process has been carefully studied both in France and Germany, and hitherto the results, such as those of MM. Gautier and Drouin, have tended to confirm the conclusions first arrived at by M. Georges Ville.—The sardine on the Marseilles coast, by M. A. F. Marion. The sardine appears yearly in these waters, where a total of 409,055 kilogrammes were taken during the period between March 1887 and the end of February 1888. Details are given regarding the food, migrations, and breeding-season of this fish.—Study of the planet Mars, by M. F. Terby. Three small round spots, white and brilliant, are visible on the continuation of *Erebus* (left or west side), when the *Trivium Charontis* is midway from the central meridian in the eastern half of the disk. These spots, at first scarcely perceptible, become brighter and whiter as they approach the limb, where they become diffused by irradiation like the polar spot. The black line, which seems to divide the north polar spot, has been perfectly visible since May 12. Facing it on the outer side is a small hyperborean tract, white or snowy, but less brilliant and white than the true polar spot, of which it seems at first sight to form an integral part. It is evidently the same phenomenon as that which has recently been simultaneously observed by M. Perrotin, as well as by M. Schiaparelli.—On an electro-chemical actinometer, by MM. Gouy and H. Rigollot. Copper oxidized or covered with basic salts, and plunged into water or into a solution of sulphate of copper, is known to undergo variations of electromotor force under the action of light, effects which can be clearly indicated only with intensely luminous means. But the authors find that the oxidized copper plunged into a solution of metallic chloride, bromide, or iodide becomes, on the contrary, extremely sensitive to luminous rays even of slight intensity, and may consequently be employed as an actinometer. Details are given of the process by which they have constructed the apparatus based on this phenomenon.—Determination of the heat of combustion of a new solid substance isomerous with benzine, by M. W. Louguinine. Five experiments with a beautiful specimen of this substance, discovered by M. Grimer, give a mean of 10,863·9 calories for the heat liberated in the combustion of 1 grain. The heat of combustion of benzine is much less (776,000 cal.), corresponding to a body whose constitution is absolutely different from that of the isomerous substance.—On the Pliocene formations of the Montpellier district, by M. Viguier. In this paper the conclusions are summed up of an extensive investigation of this geological area. Three distinct groups are determined: (1) Arnusian, fresh-water deposits, puddings and gravels, with remains of *Elephas meridionalis*; (2) Astian, also fresh-water, clays and marls, with remains of *Semnopithecus monspessulanus*, *Helix quadrifasciata*, *Triptychia sinistrorsa*, &c.; (3) Plaisancian, marine deposits, sandy and other marls, with remains of *Potamides basteroti*, *Melampus myotis*, *Rhinoceros leptorhinus*, *Mastodon brevirostris*, &c.

BERLIN.

Meteorological Society, May 1.—Dr. Vettin, President, in the chair.—Dr. Perlewitz spoke on aperiodic variations of temperature. He based his researches on the observations made at Berlin during the forty years 1848–87, and during ninety-three years, 1791–1883, at Breslau. If a year is divided into halves, the first half is characterized by a normal curve of rising temperature, the second half by a similarly normal curve of falling temperature. Both curves, however, show negative irregularities, whose number may be very considerable in any one month: thus in May these irregularities (fall of temperature) occurred on more than thirteen days as against seventeen days on which the curve rose regularly; and similarly, in October, there were more than twelve days on which an irregularity (rise of temperature) was observed as against nineteen days with a normally falling temperature. On the whole the number of these irregularities is greater in the first half of the year than in the second, so that the heat of the second half is greater than that of the first. A whole series of interesting details exists in connection with the number, magnitude, and periodic duration of the changes of temperature during both the normal and abnormal times; these cannot however be considered here.—Dr. Vettin communicated the results of his observations on the daily periodicity in the velocity of the wind, extending over a period of two years. From direct determination of the movement of smoke coming from a chimney, and from observations with a home-made anemometer, he found that in addition to the well-known maximum velocity of the wind which occurs at midday, there is a second maximum just after midnight. This latter maximum is very small in summer, but in winter, on the other hand, it is much greater and even exceeds that maximum which occurs at midday. This second maximum is not very marked as an average on the whole year. The speaker then gave a detailed description of the construction of his anemometer, which he exhibited to the Society. He further described a spring vane which he had made, which he has erected at the window of his house in a moderately wide street; this vane indicates accurately not only the direction of the wind which is blowing up or down the street, but also of any wind which may be blowing over the houses at right angles to this. Experiments made with tobacco-smoke in a glass-covered chamber have shown that the wind which blows over the houses gives rise to ascending and descending currents of air along their walls, causing an elevation or depression of the vane. The vane also records accurately the direction of a wind which blows at any angle other than at right angles to the axis of the street. Suitable as this spring vane is for observers who live in narrow streets, it is specially adapted for observations in narrow mountain valleys, in which the direction of the wind cannot be ascertained by any other means.

Physical Society, May 4.—Prof. von Bezold, President, in the chair.—Prof. Schwalbe gave expression to the loss which the Society had sustained through the death of Prof. Hoh, for many years an active collaborator with the "Fortschritte der Physik."—In the election which then followed, Prof. Kundt, the new Director of the Physical Institute, was chosen as first Vice-President in the place of the late Prof. Kirchhoff.—Dr. Koenig spoke on the instantaneous photographs made by Ottomar Anschütz, of Lissa, accompanied by demonstrations and examples of the photographs. Anschütz began taking instantaneous photographs in 1882, operating at first upon bodies of troops during the manœuvres. Later on, at the instance of the Minister of War, he photographed horses and riders moving at every sort of pace. In addition, up to 1885, he busied himself with photographing many animals in the different and frequently very bizarre positions in which they place themselves during their movements. Some of the most interesting photographs taken at this time are those of storks. From 1885 onwards he has been taking serial-photographs of men and animals in motion, obtaining pictures of the consecutive stages of each movement. From these serial-photographs it is possible to draw many scientific deductions, by following the course of the centre of gravity of the object in the successive pictures of horses and men when running and jumping. A complete knowledge of the mechanics of motion can, however, only be arrived at from these series of photographs when the interval of time between each consecutive member of the series is equal and extremely small, a result which Anschütz has nearly obtained. Latterly he has taken pictures of large masses in motion, such as processions, &c. The numerous photographs which the speaker exhibited and briefly explained, testified completely to the technical excellence at which Anschütz has already arrived. The apparatus used for instantaneous photography was exhibited at the same time.

Physiological Society, May 11.—Prof. du Bois-Reymond, President, in the chair.—Dr. Koenig spoke on his measurement of the intensities of light in the spectrum. The method employed was as follows. A circular field of vision was divided into two halves, of which one was illuminated with some colour of the spectrum of fixed intensity, usually with red; the colour to be compared with this was then applied to the other half, and made to vary until it produced the sensation of a light-intensity equal to that of the red. The first measurements were made on Dr. Broddahn, whose eyes are dichromatic (green colour-blind).

By taking the mean of the separate determinations for different parts of the prismatic spectrum, Dr. Koenig had constructed a curve for the light-intensity of all the colours of the spectrum; there was a difference of at most 2 per cent. between the values of the separate measurements and the mean. The speaker then made similar measurements with his own normal trichromatic eyes; in this case he obtained a greater difference between the value of the separate determinations and the mean (up to 5 per cent.) but the curve of light-intensity for the whole range of the spectrum was found to be identical with that obtained from Dr. Broddahn. By reducing the prismatic spectrum used in these experiments to one produced by diffraction, he was able to calculate the curve of light-intensity for a normal spectrum. Comparing this curve with those which he had obtained, in conjunction with Dr. Dieterici, for the sensations of the three primary colours, red, green, and blue (as determined for each point in a normal spectrum), he found that the curve of light-intensity of the spectrum was identical with that for the sensation of red. From this it must be concluded that the sensation of luminous intensity for each separate light is simply dependent on the amount of red contained in it, or, to state this more accurately, the brightness of each kind of light is determined by the extent to which it stimulates the red-perceiving fibres of the retina. Dr. Koenig had some time ago given expression to the conjecture that in the dichromatic eye it is not the fibres for the perception of the third colour which are wanting (the red-perceiving for red colour-blindness and green-perceiving for green), but that they are, so to say, differently tuned; tuned down in those who are colour-blind to green, so that they can only perceive the sensation due to light as red, tuned up to a higher pitch in those who are red colour-blind, so that when they are stimulated by rays of greater wave-length they only perceive green. It is now possible to verify the above conjecture experimentally as follows. The measurements of luminous intensities throughout the spectrum were made upon the eye of another person who was colour-blind, and this time on one who was red colour-blind; in this case the curve obtained was identical with that of the sensation of green. The phenomena observed by Dove, that the relative luminous intensities of red and blue vary according to the intensity of the illumination, were verified by Dr. Koenig, but only up to a certain limit; beyond this limit, the *relative* luminosities of these two colours underwent no further alteration in the brightness of the illumination.—Prof. Gad discussed Prof. Fick's views on blood-pressure in the capillaries, which the latter believed he had placed on an experimental basis by means of an artificial vascular scheme; according to this the pressure in the capillaries could not be much less than in the arteries, and only sinks appreciably as the capillaries are passing over into the veins. Prof. Gad showed that the conditions existing in the above scheme cannot be applied to the blood-capillaries; he further pointed out that the requisite data for calculating the true blood-pressure in the capillaries can be obtained from a theoretical consideration of the rate of flow in, and sectional area of, these vessels, and from this the pressure would appear to be about half of that which exists in the aorta. A true basis for any theory of capillary blood-pressure can only be obtained from such experimental investigation as admits of being applied to various parts of the purely theoretical consideration.

STOCKHOLM.

Royal Academy of Sciences, April 11.—Prof. W. C. Williamson, of Manchester, was elected a foreign member of the Academy.—Critical remarks on the researches of Foeppl on the electrical conductibility of the vacuum, by Prof. Edlund.—A theory of isohydric solutions, by Dr. Arrhenius.—Remarks on the fossils of the Cretaceous formation of Sweden, by Prof. B. Lundgren.

May 9.—On *Triglaps pingelii*, an Arctic fish, found for the first time off the shores of Sweden, and on some specimens of *Syrrhaptes paradoxus* lately shot in Sweden, by Prof. F. A. Smitt.—The whale of Swedenborg (*Balæna svedenborgii*, Liljeborg) found in the diluvial strata of Sweden, described by Dr. Carl Aurivillius.—On the anazotic, stored up nutriments of the Gramineæ, by Dr. C. J. Johanson.—A generalization of the researches of Laplace on the libration in the orbits of the planets, by Dr. K. Bohlin.—On the points of approximation in the theory of perturbation, by the same.—Some extracts from the report of the French scientific expedition to Spitzbergen and other places in the years 1838, 1839, and 1840, by C. B. Lilliehöök, R.N.—Contributions to the theory of the undulatory movement in a gaseous medium (conclusion), by Dr. A. W. Bäcklund.—Derivates of the δ-amido-naphthaline-sulpho-acid, by Prof. P. T. Cleve.—Derivates of the γ-amido-naphthaline-sulpho-acid, by the same.—On naphthol acids, by Dr. Å. G. Ekstrand.—On abnormal forms of the first abdominal appendices of some female cray-fishes, by Dr. D. G. Bergendahl.—On two new Lamellibranchiates from the Arctic post-glacial beds of Scania, by Herr G. Clessin, of Ochsenfurth, Bavaria.

AMSTERDAM.

Royal Academy of Sciences, April 27.—Mr. J. A. C. Oudemans spoke of Airy's double-image micrometer, and stated the result of his efforts to discover the conditions to which this apparatus must be made to conform, in order that the value of one screw-turn may be independent of the adjustment of the eye. He had found that the distance from the first to the second lens must be equal to the focal length of the first lens—a condition already fulfilled in the micrometer for another purpose.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

British Petrography: J. J. Harris Teall (Dulau).—A Manual of Orchidaceous Plants, Part 3 (Veitch).—Longmans' Commercial Mathematics (Longmans).—A Wanderer's Notes, 2 vols.: W. Beatty-Kingston (Chapman and Hall).—Principles of Agricultural Practice: J. Wrightson (Chapman and Hall).—Discromatopsia, Enrico dal Pozzo di Mombello (Scariglia, Foligno).—Soaps and Candles: J. Cameron (Churchill).—Die Regenverhältnisse der Iberischen Halbinrel: G. Hellmann (Pormetter, Berlin).—Proceedings of the Geologists' Association, February (Stanford).

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