

THURSDAY, MARCH 21, 1889.

BAKU PETROLEUM.

The Region of the Eternal Fire. By Charles Marvin.
(London: Allen and Co., 1888.)

THIS book is not, as its title might imply, an eschatological treatise, nor is it a work of fiction after the manner of Mr. Rider Haggard. It is simply a plain, straightforward narrative of a journey to the petroleum region of the Caspian, undertaken with a view of investigating what Mr. Marvin terms "the kerosene factor of the Central Asian problem." It has, however, this connection with eschatology, that the region of which it treats is, or was, holy ground. The peninsula of Apsheron, on which Baku stands, has been famous from time immemorial, and even before the time of Cyrus thousands of the followers of Zoroaster had worshipped on its sacred soil. With the conquest of Persia, first by Heraclius, and twelve years later by the Arabs, the power of the Magi of the Zoroastrian sect was shattered; and the worship of the Eternal Fire in the Surakhani temple for ever passed away, and in its place are now the symbols of a new cult in the shape of greasy derricks and dingy kerosene distilleries.

The story of Baku and its Oil King, Ludwig Nobel, reads like a tale of the "Arabian Nights." Ten years ago the place was a sleepy Persian town: it is now a thriving city, owning more shipping than Cronstadt or Odessa, and the centre of a vast and rapidly increasing trade. But even in the thirteenth century the "sacred element" was so far robbed of its sanctity that the crude petroleum was extensively exported into various parts of Asia. In "The Book of Ser Marco Polo, the Venetian," edited by Colonel Yule, we read that—

"On the confines towards Georgine there is a fountain from which oil springs in great abundance, inasmuch as a hundred shiploads might be taken from it at one time. This oil is not good to use with food, but 'tis good to burn, and is also used to anoint camels that have the mange. People come from vast distances to fetch it, for in all countries round there is no other oil."

Jonas Hanway, to whom Englishmen must be for ever grateful for the introduction of the umbrella to this country, visited Baku about the middle of the eighteenth century in the interest of one of the powerful trading companies of the time; and in 1754 he published a very complete account of the district and of the uses to which its naphtha or petroleum was put. The oil was then, as now, mainly employed for light and fuel, but we are also told that—

"The Russians drink it both as a cordial and medicine; but it does not intoxicate. If taken internally, it is said to be good for the stone as also for disorders of the breast. . . . Externally applied it is of great use in scorbutic pains, gouts, cramps, &c., but it must be put to the part affected only; it penetrates instantaneously into the blood, and is apt for a short time to create pain. It has also the property of spirits of wine to take out greasy spots in silks or woollens, but the remedy is worse than the disease, for it leaves an abominable odour. They say it is carried into India as a great rarity, and being prepared as a Japan is the most beautiful and lasting of any that has yet been found."

Since that time Baku and its wonders have been frequently described, and the importance of the place with respect to the Central Asian question has been repeatedly pointed out by such travellers as Marsh, Valentine Baker, O'Donovan, and Arnold. Up to 1872 the extraction of the oil was a monopoly, but in the following year it was thrown open to the world, and hundreds of wells have since been sunk, mainly by the energy of Swedes and Russians. Geologically speaking, practically nothing is known about this extraordinary district, and even the engineers who bore for the oil and work the wells are ignorant of the conditions which affect the supply of petroleum. At the present time there must be at least five hundred wells and fountains situated close together on less than a thousand acres of ground, but the sources seem to be absolutely independent of each other. The supply is simply (to use Dominic Sampson's word) "prodigious"; and every year, as the borings get deeper, the fountains become more prolific. These borings are nothing like so deep as in America: not a single Baku well has yet approached a depth of 1000 feet. In 1883 two flowing wells each sent out nearly 30,000,000 gallons in less than a month from a depth of 700 feet. In America there are said to be 25,000 drilled petroleum wells, but a single Baku well has thrown up as much oil in a day as nearly the whole of the 25,000 in America put together. Mr. Marvin thus describes one of these "spouting" wells:—

"In Pennsylvania that fountain would have made its owner's fortune; there's £5000 worth of oil flowing out of the well every day. [The actual value was at least £11,200 a day.] Here it has made the owner a bankrupt." These words were addressed to me by an American petroleum engineer, as I stood alongside a well that had burst the previous morning, and out of which the oil was flying twice the height of the Great Geyser in Iceland, with a roar that could be heard several miles round. The fountain was a splendid spectacle—it was the largest ever known at Baku. . . . The derrick itself was 70 feet high, and the oil and sand, after bursting through the roof and sides, flowed fully three times higher, forming a greyish-black fountain, the column clearly defined on the southern side, but merging into a cloud of spray 30 yards broad on the other. . . . The diameter of the tube up which the oil was rushing was 10 inches. On issuing from this the fountain formed a clearly-defined stem, about 18 inches thick, and shot up to the top of the derrick, where, in striking against the beam, which was already worn half through by the friction, it got broadened out a little. Thence, continuing its course more than 200 feet high, it curled over and fell in a dense cloud to the ground on the north side, forming a sand-bank [from the amount of admixed sand], over which the olive-coloured oil ran in innumerable channels towards the lakes of petroleum that had been formed on the surrounding estates. . . . Standing on the top of the sand-shoal, we could see where the oil, after flowing through a score of channels from the ooze, formed in the distance, on lower ground, a whole series of oil lakes, some broad enough and deep enough to row a boat in. Beyond this, the oil could be seen flowing away in a broad channel towards the sea."

Flowing wells yielding from 40,000 to 160,000 gallons of oil daily are common in Baku, and the ordinary yield obtained by pumping is from 10,000 to 25,000 gallons daily; and many of these pumping wells have been worked for years without any diminution in the supply. A well belonging to Gospodin Kokereff had up to the

date of Mr. Marvin's book produced 60,000,000 gallons of oil, and the supply showed no sign of decreasing. The waste occasioned by "spouting" is at times enormous; millions of gallons of oil being lost from the want of any storage accommodation. Occasionally the neighbouring proprietors who happen to have reservoirs empty may thus obtain the oil at a nominal price. On one occasion 2,000,000 gallons were sold at about $7\frac{1}{2}d.$ per ton. When the Droojba fountain "spouted," the crude article, we are told, altogether lost its value for the moment.

"Fedoroff filled his reservoirs with 2,800,000 gallons of oil for 300 roubles, or £30. . . . Thousands of tons were burnt outside the district to get rid of it; thousands were led towards the Caspian; huge lakes of oil were formed near the well, and on one occasion the liquid suddenly flowed into a distant engine-house, and but for the promptness of the engineer in extinguishing his petroleum furnace the whole locality would have been ablaze. Houses were completely buried by the sand cast up by the oil; all efforts to stop the fountain on the part of Baku experts were fruitless."

After great exertions on the part of the well owners of the district, the fountain was eventually gagged, but not before 500,000 tons of oil had "spouted," equal to a loss at the current value of American petroleum of upwards of £1,000,000 sterling. But the record of the Droojba fountain was beaten in 1886, when a single well "spouted" as much as 11,000 tons of petroleum per diem; an amount equal to the aggregate daily yield of the 25,000 wells of America, the thousands of wells in Galicia, Roumania, and Burmah, and the shale oil distilleries of Scotland and New South Wales. As a result the market is now glutted, and the crude oil has been selling at times at the rate of fifty gallons for a penny!

We have not space to indicate all the many points of Mr. Marvin's interesting narrative, or to do justice to his account of the economic results which he thinks must inevitably follow from the prodigious source of wealth which Russia possesses in this wonderful district. It must be remembered that petroleum ton for ton is more potent than coal as a source of power. Hundreds of immense floating cisterns driven by petroleum furnaces are carrying this fuel across the Caspian and up the Volga, to be spread throughout Russia and Germany, and along the Baltic coasts. We learn from a recent Consular Report that pipe lines are being laid from Baku to Batoum: the Caspian and Black Sea Naphtha Conduit Company has now been formed, and the line is to be laid within the next four years. The conduit is to have a forked line on the Black Sea, reaching Batoum and Poti, and the capacity of the line is such as to admit of the daily passage of 1,200,000 gallons of naphtha. In a few years, therefore, this petroleum fuel will be scattered along the Mediterranean coasts and through Southern Europe. Possibly we may have it burning in our own Underground Railway before long. Indeed, as Mr. Marvin tells us, we shall surely see the Parsee back again at Baku, not to worship the Everlasting Fire, but for the purpose of buying lamp oil for the bazaars of India. What the effect of this intercourse will be on the future of India time will show. Meanwhile Russia is steadily making her way towards the gates of India, and Tchernayeff's road to Central Asia will be an accom-

plished fact before many years are past; and since the discovery of the new springs near the Mervi Kultuk Bay, the railway to Khiva will possess its own supply of fuel. A few days ago Mr. G. Curzon read an interesting paper to the Royal Geographical Society on the Transcaspian Railway, which must have opened many people's eyes to the development of Russia's power in Central Asia. In the meantime what are we doing with the sources of wealth in petroleum which we possess in Upper Burmah? Along the valley of the Irrawadi, and within 60 miles of the Rangoon-Prome railway, are enormous deposits of petroleum, probably as copious as those of America, if not so rich as those of Baku, and certainly capable of supplying the whole of India with light and fuel. Perhaps those capitalists who are so eager to rush into the ruby mines of Burmah might more profitably devote their wealth to exploiting the petroleum springs of that country, for it needs not the gift of prophecy to assert that Burmese petroleum in the long run will be certainly more precious than Burmese rubies.

We can heartily commend Mr. Marvin's book to all who are interested in the Central Asian question, for, as he says in the outset, petroleum is bound to become an important factor in that problem. Hannibal was said to have dissolved the Alps by vinegar. It is far more likely that petroleum will dissolve the sort of Chinese wall that our Governments are feebly setting up to keep the Russian trader and the *tchinovnik* out of India.

T. E. THORPE.

A TEXT-BOOK OF ELEMENTARY BIOLOGY.

A Text-book of Elementary Biology. By R. J. Harvey Gibson, M.A., F.R.S.E., Lecturer on Botany, University College, Liverpool. (London: Longmans, Green, and Co., 1889.)

THE above-named work is one of those which, as has been remarked in these pages (vol. xxxviii. p. 52), "the system of examining the whole world on a limited schedule . . . is bound to produce," and the essence of it is devoted to a consideration of those type-organisms which the examining body have set down for study. It contains 345 pages small octavo, and is divided into eight chapters, with an introduction. The first three chapters are devoted to generalities, and the last one to a "history of biology."

The author decries the "evils of the cram system," and proceeds at once to assert that "this must be my apology . . . for the introduction of so many speculations and explanations of casual relationship," while he claims for his treatise the special distinction that it deals "with the relationship of botany to zoology, and of both to the fundamental sciences of physics and chemistry." In fulfilling this determination the author gives, at the outset, a physico-chemical *résumé*. We regard the whole of this as out of place and superfluous, inasmuch as University students (for whom the book is written) will, if properly trained, have received the same information in a more tangible and authoritative form, at the hands of Professors of the special subjects. We strongly deprecate this growing tendency towards usurpation of the functions of others, especially when it

is seen that the sole object in view has here been that of incorporating tall-talk about that modern bogey "anabolism,"¹ with its antithesis, and about other heresies, which neither the pure physicist nor chemist would tolerate. Much that has been written of late under these and similar heads is now, by common consent, tabooed, as a mere garbling with ill-defined terms. As originally presented, it is, to say the least, over-reaching and often childish in its ambiguity: as diluted in the work before us, it bodes mischief whereby it becomes unendurable. It cannot be denied that for many a raw student such phantasies have an especial charm. In this work they are so interwoven with the more solid portions of the text as to bias and distort the intellect.

The "conditions of the environment necessary for the maintenance of life" and the "balance of Nature" are discussed and dismissed before the student is made familiar (in any but misleadingly general terms) with the constitution of the living organism. This we regard as a fatal error, revolting alike to common-sense and to established precedent, and we can only surmise that the adoption of so extraordinary a course has resulted from the influence of a wrong-headedness, at work upon the author's elementary training.

It will be seen that the author has, in our opinion, failed (and that, most probably, from faults not entirely his own) in the mode of treatment of his leading novelty. When first we realized the extent to which he had wandered into subjects not professionally his own, our suspicions were aroused as to whether he might not have erred proportionally within the limits of his recognized domain. The volume abounds in inaccuracies and misstatements. The methods of expression are frequently loose and contradictory: for example, on p. 293 we read that, in the frog, "the air is sucked into the interior of the body to the blood," and on p. 294 that the frog "forces the air into the lungs." On p. 145 a fair description is given of the bulb of the lily, whilst on p. 174 the same plant is "termed an annual." Things are too frequently declared to be "obviously," "naturally," or "clearly" so and so, and the author has yet to realize that with elementary students *nothing* must be taken for granted; while he has, on most points, grossly violated the inductive method (cf. the statements concerning the differentiation and structure of the nervous system, as successively presented on pp. 231, 232, 245).

The author's selection of types is unprecedentedly capricious. On the animal side, the Arthropod and Mollusk are omitted; while on the vegetable side, the description (p. 78) of an imaginary apical cell in *Spirogyra* implies complete ignorance of the type chosen for study. Nor must we disguise the fact that while the author tolerates those types now in vogue, he loses no opportunity of depreciating their educational value (pp. 219, 233, 264). We would remind him that these have served exceedingly well in the past, and that it is the manner of their manipulation by a certain class of teachers, rather than their constitution, which the unsuccessful student has cause to lament.

We deem detailed criticism superfluous, as there are no six pages in this book free from error, and, for a long suc-

cession, no two without inaccuracy. The following extracts will suffice. On pp. 265-66 we read that, in the frog, the alimentary system has become differentiated into "a buccal cavity, where the food is torn in pieces, or masticated; an œsophagus, or tube for the carriage of the triturated food (*sic*)," &c.; on p. 301 we are told that the occipital region of the skull, in the same animal, "consists of a floor and two side walls of bone (the basi- and two ex-occipitals)"; on p. 327, the oviduct of the frog is said to contain, when ready for oviposition, fertilized ova. Now as to the botanical side. *Penicillium* is selected as the type of Fungi, but the descriptions and figures apply throughout to *Eurotium*. In describing *Polytrichum*, his type of the Mosses, the author informs us (p. 103) that the leaves are "composed of almost undifferentiated parenchyma." A ridiculous attempt is made, three pages further on, to show homology between the archegonium of a moss and the conceptacle of *Fucus*; and the diagrammatic figure illustrative of the same can only bewilder the student, and mislead him as to the real structure and mode of development of the organs in question. Under the head of "cell-fusions," the statement is made (p. 149) that "the adjacent walls may have become completely broken down, as in tracheides": no well-tutored beginner needs to be reminded that this is in direct contradiction to the usually accepted definition of these structures. Finally, on p. 152, the *Duckweed* is referred to, and that in the most unfortunate manner conceivable, as a Dicotyledon. Misstatements such as these show the author to be ignorant of some of the most elementary truths dealt with in the most didactic handbooks in contemporary English literature. More the pity that the author should parade his indebtedness to the works of foreign writers.

One of the most conspicuous features of the book is the employment of a new nomenclature. The author was struck, early in his career, with the shortcomings of our conventional terminology; and, bolder than his fellows, he forthwith resolved to revolutionize the same. Order appears to dawn with the correlatives "Protozoa and Protophyta," "Metazoa and Metaphyta," but, when examined in detail, most of the author's substitutes are seen to be no better than their predecessors, and they consequently only complicate matters unnecessarily. We protest against this reckless use of new words. New and comprehensive terms are only to be accepted as landmarks in general advancement. Attempts to uproot a classical and time-honoured nomenclature, which are, like those before us, begotten only of youthful ambition, deserve no encouragement.

There would appear to be something seriously wrong in connection with the system which repeatedly produces books like that before us. Catering, as it does, for a prescribed curriculum, this one, the latest of its kind, will be eagerly sought by the examinees; and in their interests, if in none higher, it is time that something should be done to stem the tide. Similar complaints reach us from other sources, and it has been suggested in the pages of this journal (vol. xxxvii. p. 268) that the difficulty might be met by the establishment of "an Association to prevent the further publication of elementary works other than such as had been carefully revised and

¹ Defined by the author (pp. 336-40) as *consisting*, in the animal, of the processes of mastication, digestion, absorption, circulation, and assimilation.

approved of by a Publication Committee of the Association." No body of men have any such right to interfere with private enterprise; and the remedy proposed is wholly unscientific in principle, inasmuch as it would lay a sure foundation for systems of cliquism and popery, whose issue would be fatal to legitimate progress. Others there are who would seek the solution of the difficulty in an occasional substitution of the types chosen for teaching, and, in fact, such a change is already premeditated. This proposal cannot fail to meet with general approval, but it does not solve the problem; for, while no doubt it may, at the outset, insure to the examinee manuals of the better class, it will only prolong the evil day of publication of yet other inferior ones. The fault appears to us to lie not in systems, but in the individual. We are not yet rid of the old delusion that anybody can keep the children quiet. The infant-class is too often entrusted to the care of a novice, and with what results past systems of training have shown. "*Qu'est-ce qu'une grande vie?*" wrote de Vigny, with the rejoinder, "*Une pensée de la jeunesse exécutée par l'âge mûr.*" No one knows better than the English student that the production of an elementary text-book may constitute a leading feature in a great life. Such a work should be other than a medium in which the author airs his knowledge of fads and phantasies (most of which are sure to be wrong in the end) to the exclusion of fact and common-sense, and we hold its construction to be one of the most arduous of all possible tasks. It is, moreover, one for which a man is not fitted until ripened by long experience and meditation, and to none but the most experienced teacher would we intrust that awakening of the "thought of youth," which, if distorted at the outset, leads to certain failure. Here, to our thinking, lies the clue to the whole position. The matter is one for individual consideration. Upon the mind of the author of this work there has dawned the *pensée de la jeunesse*; in following it up, he has acted prematurely. Had he kept his ideas well in hand, others would have intersected them in the course of time, as his knowledge of (elementary) fact increased and as his experience ripened. He has done otherwise, and, in his eagerness for notoriety, has piled up, upon a flimsy foundation of words, a scant superstructure, the materials of which are ill-chosen and defective, and badly put together. G. B. H.

UNITED STATES GEOLOGICAL SURVEY.

Monographs of the United States Geological Survey.
Vol. XII. *Geology and Mining Industry in Leadville, Colorado.* By S. F. Emmons. Pp. 747, with Atlas of 35 folio Plates. (Washington Government Printing Office, 1886.)

THE operations of the United States Geological Survey, under the charge of Mr. S. F. Emmons, in the Leadville mining district, have become known to some extent to many geologists in Europe by personal examination on the ground, and more particularly from the valuable summary of their results which appeared in the Report of the Director of the Survey a few years back. But even those most familiar with the thorough manner in which work is done in the office of Mr. Emmons's division

at Denver can scarcely have been prepared for the mass of information which is presented to them in the present volume. Although the actual productive area of Leadville at the date of the survey was estimated at about one square mile, the study of a considerable part of the adjacent mountain districts was necessary in order to arrive at any general conclusions likely to be of value for practical purposes in regard to the mineral deposits; and therefore a district of about 15 to 20 miles of the western or Musquito Range of the Rocky Mountains has been surveyed, and mapped in very full detail on a scale of 2 inches to a mile. The interior parts of the mining region proper are treated more minutely on a scale of about 6 inches to a mile, and the geology and mine works on the three districts of Iron Hill, Carbonate Hill, and Fryer Hill are given on a scale of 1 to 1920.

From the maps and the sections which accompany each set, and which, in accordance with the excellent custom of the founder of the Geological Survey of Great Britain, the late Sir H. De la Beche, are constructed to the same scale both for heights and distances, it appears that the country described consists essentially of a series of ridges and furrows of sedimentary rocks resting upon an Archæan foundation forming the central mass of the Rocky Mountains. The most important member of this sedimentary series, the blue or metalliferous limestone, is a blue-gray dolomite of Lower Carboniferous age, which, at or near its contact with an overlying igneous sheet, known as the white or Leadville porphyry, is changed over considerable areas, but in an extremely irregular fashion, into a mass of clay and quartz charged with carbonate and sulphide of lead, chloride and bromide of silver, manganese and iron ores, which are obviously of secondary origin, and derived from the alteration of metallic sulphides. The upper surface of the deposit, being formed by the base of the porphyry sheet, is comparatively regular; but below, the boundary is exceedingly ill defined, the metalliferous mass—which in the principal mines resembles a brown garden-mould, mottled with dark-coloured patches in places—shading off into the unchanged limestone; it being, in fact, a pseudomorphous change of the latter rock by infiltration of metalliferous salts from the weathering of the overlying porphyry subsequently to the intrusion of the latter, and before the elevation of the Musquito Range—events which have been placed, as the results of detailed geological study, about the close of the Cretaceous period.

Since the year 1881, when the present Report was substantially completed, the ores of the Leadville district have changed very considerably, the more tractable carbonates and chlorides originally met with having given place to unchanged sulphides, with the result of complicating the processes of reduction. This circumstance detracts a little from the interest of the last section of the work, which is devoted to a very detailed description of the smelting processes as carried on at and near Leadville in 1880. This is due to the labour of M. A. Guyard, of the École des Mines, and for some time an assistant to Messrs. Johnson, Matthey, and Co. Unfortunately, he did not live to see the result of his work in print. Subsequently to the date of the Report, some of the larger smelting establishments were removed to localities closer to the fuel-supplies on the eastern side of the Rocky Mountains, and con-

siderable improvement has been made in the character of the smelting appliances. Some curious points are, however, brought out by M. Guyard's researches, especially as regards the speiss or arsenical regulus formed in the lead furnaces, which he finds collect by preference nickel and molybdenum from the ores, while cobalt, if present, is carried off by the lead, and may be found in the skimmings taken from the bath before casting it into pigs. Another point of interest is the occurrence of chlorine, bromine, and iodine in notable quantities in the furnace fume, which are due to the corresponding silver salts of the ores. The general chemical problems arising in the study of the ores and the containing rocks have been treated in a separate section by Mr. W. F. Hillebrand. The mass of analytical material contained in these sections is very large and important, but in some instances their value is diminished by an unnecessary striving after accuracy. Analyses reported to six decimal places seem to be scarcely suitable for practical purposes. The petrography of the district has been studied by Mr. Whitman Cross, his results being illustrated by heliotype prints of microscopic sections which though good in their way are decidedly inferior to the excellent drawings given by Prof. Irving and others in the earlier volumes of the same series before photographic illustrations were used. In his preface Mr. Emmons very handsomely acknowledges the "continuous and unwearied service" rendered by Mr. Ernest Jacob, an old student of the Royal School of Mines, who, we are sorry to say, has been compelled by reasons of health to retire from a service in which in a comparatively short time he was able to do a large amount of excellent work.

H. B.

OUR BOOK SHELF.

Practical Inorganic Chemistry: the Detection and Properties of some of the more Important Organic Compounds. By Samuel Rideal, D.Sc. (Lond.), F.I.C., F.C.S., F.G.S., Fellow of University College, London. (London: H. K. Lewis, 1889.)

THIS little book, as we learn from the preface, is designed to meet the wants of the medical student in his higher examinations, and we may say at once that it fulfils that purpose admirably. The syllabus of the University of London has been duly considered; all the substances therein mentioned are discussed at length, and their reactions fully given: and not only this, but Dr. Rideal has helpfully distinguished in each case the most characteristic reaction by an asterisk. With the aid of this book, and with ordinary application, the average candidate may fearlessly confront the Sphinx of Burlington Gardens (and *a fortiori* all minor Sphinxes), and attempt her riddles without risk of being torn in pieces.

All this is excellently done, and only one regret crosses the mind of the reviewer. Of course, a medical student is not intended to be an organic chemist, or, necessarily, a specialist of any kind; and it would be absurd to expect from him the knowledge of a specialist. But the training of a medical student is calculated to make him regard himself as the depository of universal scientific knowledge—a belief which he frequently carries with him through life. Would it not be possible to convey the salutary notion that all this testing for organic substances has about as much relation to real practical organic chemistry as, say, the "use of the globes" to practical navigation?

Scottish Moors and Indian Jungles. By Captain J. T. Newall. (London; Hurst and Blackett, 1889.)

MANY years ago, in India, Captain Newall was unfortunate enough to suffer from an accident by which the spine was fractured. To some extent he recovered his health, but he has never since been able to walk or even to stand. Yet he has contrived—by an ingenious device which enables him to be carried about in a chair, in an easy position, by several men—to obtain a good deal of wholesome exercise in the open air. In the year 1880, in conjunction with his brother, he took the little shooting of Scaliscro, in Lewis; and in the first part of this volume he describes the incidents of sport and out-door life there during the seasons of the following four years. The second part of the volume is devoted to a record of more or less exciting sporting experiences in India at a time when the writer had full use of his limbs. The book may be read with pleasure not only by sportsmen but by others, for it is written in a bright and attractive style, and Captain Newall is always careful to give as vivid a picture as possible of the surroundings in the midst of which the incidents of his narrative took place. His account of autumn life in Lewis is particularly fresh and interesting. There are twelve very good illustrations from sketches by the author.

LETTERS TO THE EDITOR.

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The Inheritance of Acquired Characters.

WILL you allow me to say, in reference to Prof. Hartog's interesting letter, that there is no ground for regarding the word "Lamarckism" as a nick-name? There can be no desire to "nick" him or anyone else, should it appear that the views they advocate are to be classified with those of Lamarck. Lamarckism is as reputable a denomination as Darwinism, and no reasonable man can possibly regard with anything but respect and sympathy the attempt to bring forward solid evidence in support of Lamarck's fundamental assumption, viz. that acquired characters are transmitted by heredity.

It is not unusual for children to rest the head on the left forearm or hand when writing, and I doubt whether much value can be attached to the case described by Prof. Hartog. The kind of observation which his letter suggests is, however, likely to lead to results either for or against the hypothesis of transmission of acquired characters. An old friend of mine lost his right arm when a school-boy, and has ever since written with his left. He has a large family and grandchildren, but I have not heard of any of them showing a disposition to left-handedness.

E. RAY LANKESTER.

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It would be difficult to overrate the importance of the instance given by my friend Prof. Hartog in the last number of NATURE (p. 462) of the inheritance of a character acquired by habit; but the explanation which he offers of the non-inheritance of characters produced by mutilation, so far from being flat Lamarckism, appears to me to flavour of ultra-Darwinism, and the following hypothesis, resting more directly on mechanical principles, might be suggested. It is well known that many of the lower animals possess a remarkable power of regenerating lost parts. The garden snail offers a familiar instance: if the eyes be snipped off from their tentacles, they are in a short time reproduced, usually with a structure as perfect as that of their predecessors, as may be proved by a histological examination of thin slices. This power appears to be possessed to an unlimited extent, for one of my former pupils, Mr. Trevor Evans, performed the experiment twenty times in succession on the same snail, and the last eye was as perfect as the first; he then relinquished the research, being persuaded that the power of regeneration would

only terminate with the life of the unfortunate subject. This power of growing afresh so complex and specialized an organ as an eye is certainly at first sight not a little astonishing, but it appears to be capable of a very simple explanation: the cells terminating the cut stump of the tentacle are the ancestors of those which were removed; a fresh series of descendants are derived from them, similarly related to the ancestral cells as their predecessors which they replace; the first generation of descendants become in turn ancestors to a second generation, similarly related to them as were the second tier of extirpated cells; and this process of descent being repeated, the completed organ will at length be rebuilt. The possibility of this arises from the fact that in the snail the embryological course of development is capable of being repeated by the adult structure. In higher organisms this possibility does not as a rule exist, and mutilation is not followed by regeneration; but even in their case the ancestral cells remain, and when the embryological development is repeated their representatives in the embryo are present to give rise to descendants of the normal type in the normal fashion. It follows from this view, which leaves pan-genesis out of account, that mutilations cannot possibly be inherited, and this for the reason that the cells forming the organism at each stage of its development must be regarded as the ancestors of those of the next stage; thus finally we are brought round to something which looks very like Weismannism.

W. J. SOLLAS.

Trinity College, Dublin, March 15.

P.S.—The foregoing completely accounts for the non-inheritance so often referred to of the character produced by circumcision. In the case of a snail it might be presumed that circumcision could not produce any persistent result; in the human subject what is remarkable is not the reappearance of the prepuce in the descendant, but that no regrowth beyond healing takes place in the subject.

MR. MARCUS M. HARTOG's letter of March 6 inserted in last week's number (p. 462), is a very valuable contribution to the growing evidence that acquired characters may be inherited. I have long held the view that such is often the case, and that I have myself observed several instances of the, at least I may say, apparent fact.

Many years ago there was a very fine male of the *Capra megaceros* in the gardens of the Zoological Society. To restrain this animal from jumping over the fence of the inclosure in which he was confined, a long and heavy chain was attached to a collar round his neck. He was constantly in the habit of taking this chain up by his horns and moving it from one side to another over his back; in doing this he threw his head very much back, his horns being placed in a line with the back: the habit had become quite chronic with him, and was very tiresome to look at. I was very much astonished to observe that his offspring inherited the habit; and although it was not necessary to attach a chain to their necks, I have often seen a young male throwing his horns over his back and shifting from side to side an imaginary chain. The action was exactly the same as that of his ancestor. The case of the kid of this goat appears to me to be parallel to that of child and parent given by Mr. Hartog. I think at the time I made this observation I informed the late Mr. Darwin of the fact by letter, and he did not accuse me of "flat Lamarckism."

J. JENNER-WEIR.

Chirbury, Beckenham, Kent, March 16.

Hertz's Equations in the Field of a Rectilinear Vibrator.

IN Dr. Oliver Lodge's valuable communication to NATURE of the 21st ult. (p. 402), giving Hertz's equations for the field of a rectilinear vibrator, may I suggest the following very slight change, in order to bring the formulæ into complete accord with those of the Maxwellian theory.

Hertz has, with $A^2 = \mu K$,

$$A \frac{dL}{dt} = \frac{dZ}{dy} - \frac{dY}{dz}, \quad A \frac{dM}{dt} = \frac{dX}{dz} - \frac{dZ}{dx}, \quad A \frac{dN}{dt} = \frac{dY}{dx} - \frac{dX}{dy},$$

$$A^2 \frac{d^2 X}{dt^2} = \frac{dM}{dz} - \frac{dN}{dy}, \text{ \&c.,}$$

whence he obtains the suitable solutions—

$$X = - \frac{d^2 \Pi}{dx dz}, \quad Y = - \frac{d^2 \Pi}{dy dz}, \quad Z = \nabla^2 \Pi - \frac{d^2 \Pi}{dz^2},$$

$$L = A \frac{d^2 \Pi}{dy dt}, \quad M = - A \frac{d^2 \Pi}{dz dt}, \quad N = 0,$$

where Π satisfies the equation—

$$\nabla^2 \Pi = A^2 \frac{d^2 \Pi}{dt^2}.$$

The corresponding Maxwellian equations would be—

$$\frac{dL}{dt} = \frac{dZ}{dy} - \frac{dY}{dz}, \quad \frac{dM}{dt} = \frac{dX}{dz} - \frac{dZ}{dx}, \quad \frac{dN}{dt} = \frac{dY}{dx} - \frac{dX}{dy},$$

$$A^2 \frac{d^2 X}{dt^2} = \frac{dM}{dz} - \frac{dN}{dy}, \text{ \&c.,}$$

with the solutions, X, Y, Z, as before, and

$$L = A^2 \frac{d^2 \Pi}{dy dt}, \quad M = - A^2 \frac{d^2 \Pi}{dz dt}, \quad N = 0.$$

The more general solutions of the field equations would be—

$$X = \frac{d}{dy} \left(\mu \frac{d}{dx} - \lambda \frac{d}{dy} \right) \Pi + \frac{d}{dz} \left(\nu \frac{d}{dx} - \lambda \frac{d}{dz} \right) \Pi;$$

$$L = A^2 \frac{d}{dt} \left(\nu \frac{d}{dy} - \mu \frac{d}{dz} \right) \Pi;$$

with corresponding expressions, *mutatis mutandis*, for Y, Z, M, N; where λ, μ, ν , are arbitrary constants, coinciding with Hertz's results when $\lambda = 0, \mu = 0, \nu = -1$.

H. W. WATSON.

Alternative Path Leyden Jar Experiments.

IN your issue of Feb. 14 (p. 380) there is an "Electrical Note" which is very misleading. You will perhaps allow me to say, therefore, that Mr. Acheson's photographs show no evidence of oscillation whatever; that his experiments are aimed at practical questions connected with lightning protectors, and confessedly were not made in such a way as to have much theoretical importance; that Mr. Acheson is not expounding a new theory by calling self-induction "extra currents"; and finally, that the author of the note, in speaking about "the errors due to charging which vitiated Prof. Lodge's early experiments," is talking about something which has no existence.

OLIVER J. LODGE.

The Celluloid Slide-Rule.

CELLULOID has been applied to so many purposes, that one is never surprised to see one or other of its many valuable properties turned to account in some new way. A slide-rule is now made, in which the surfaces on which the divisions are engraved consist of thin sheets or veneers of dead white celluloid. The divisions are beautifully sharp and distinct. If these veneers do not come unfastened, and the rule does not lose its dead white surface with use and exposure, this new application of celluloid will be found a most valuable one. The rule examined is one almost identical in pattern with the well-known Gravet instrument, and, if one may judge by the scale, the accuracy of the divisions, and the smoothness of the motions, it is made by the same machinery. The differences are mere differences of detail. Mahogany takes the place of boxwood. The cursor runs on an improved form of slide. Chisel-edges, instead of cross-lines, on the cursor are used to transfer readings. There is only one opening at the back, so tangents cannot be read without reversing the slide. The millimetre scales at the two edges are replaced by scales of inches. It is a pity that one of the scales of millimetres has not been left. The agents are John Davis and Son, of Derby and 118 Newgate Street, and the price is rather less than that at which the ordinary Gravet can be obtained in this country.

C. V. BOYS.

The Philosophical Transactions.

YOUR correspondent "S." seems to be unaware that what he asks for has been already done. The abridgment of the Philosophical Transactions, which was brought down to the year 1800 by Charles Hutton, George Shaw, and Richard Pearson, was continued in octavo form, by order of the President and Council of the Royal Society, under the title of "Abstracts of the Papers printed in the Philosophical Transactions of the Royal Society of London." This series extended to six volumes, bringing the abridgment down to the year 1854. At the seventh volume the title was changed to "Proceedings of the Royal Society of London," a publication which still exists, and which contains abstracts of all the papers in the Philosophical Transactions and a good deal besides.

H. R.

Japanese "Koji."

IN the current number of NATURE (p. 469) is a note upon the preparation of Japanese *koji*, taken from the American Consular Reports.

In NATURE, vol. xxiv. p. 468, will be found a report of a paper read before the British Association on this subject, supplemented in the following number (p. 509) by a letter from the author giving more details. The whole subject was exhaustively treated in a paper on "The Diastase of Koji," read before the Royal Society in 1881, and also in a memoir on "Sake-brewing," published by the University of Tokio in the same year. Further, an abstract of the latter appeared in the *Chemical News*, November 11, 1881, p. 230.

I shall feel obliged if you will insert this letter, as most people, on reading the note in NATURE, would be led to think that Prof. Georgeson had made observations which were previously unknown. This is not the case.

R. W. ATKINSON.

44 Loudoun Square, Cardiff,
March 18.

"The absence of lines from the corona spectrum shows a great reduction in the temperature of the sun, and such a marked change in the sun should produce a corresponding change on the earth, so that the associated

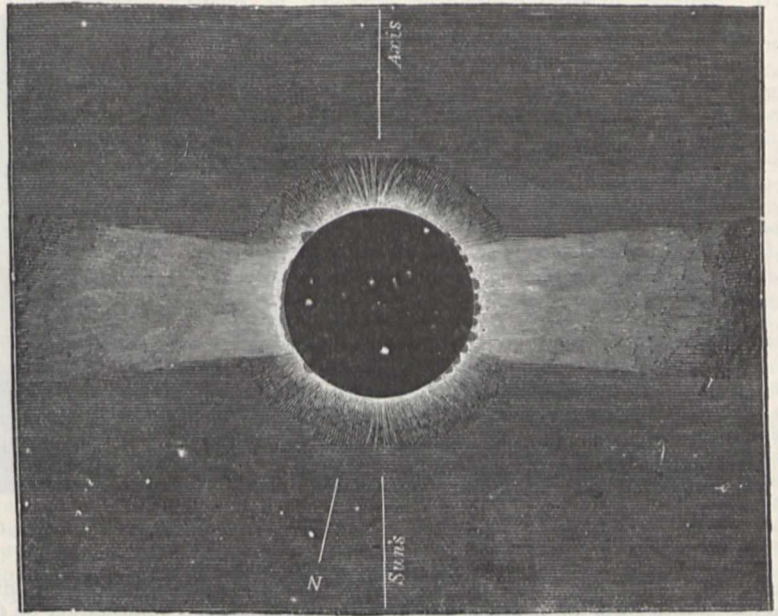


FIG. 1.—The equatorial extension and Polar tracery observed at the minimum of 1867.

THE TOTAL SOLAR ECLIPSE OF JANUARY 1.

BY the kindness of Mr. Todd we are enabled to give a drawing summarizing in a general way the phenomena observed during the last total eclipse. A comparison of this with the records at the two preceding sun-spot minima indicates very clearly that we have now very definite information concerning the corona of the sun as observed at the minimum period of sun-spots.

Everything written relating to the form of the corona in 1878 is now strengthened by still another critical observation at the succeeding minimum. It remains to be seen whether the same marked absence of bright lines in the coronal spectrum has been noted.

Here is an extract from what I wrote in 1878:—

"The utter disappearance of the large bright red corona of former years in favour of a smaller and white one in this year of minimum, struck everybody. Indeed it is a remarkable thing that after all our past study of eclipses, this last one should have exhibited phenomena the least anticipated. It isolates the matter that gives us a continuous spectrum from the other known gaseous constituents. The present eclipse has accomplished, if nothing else, the excellent result of intensifying our knowledge concerning the running down of the solar energy. With the reduction of the number of spots or prominences for the last four years, the terrestrial magnetism has been less energetic than it has been for the preceding forty years, while at both ends of this period we have had famines in India and China.

"As the sun is the great prime mover of earth, and as every air current depends upon it, its present quiet condition is worthy of the most minute study.

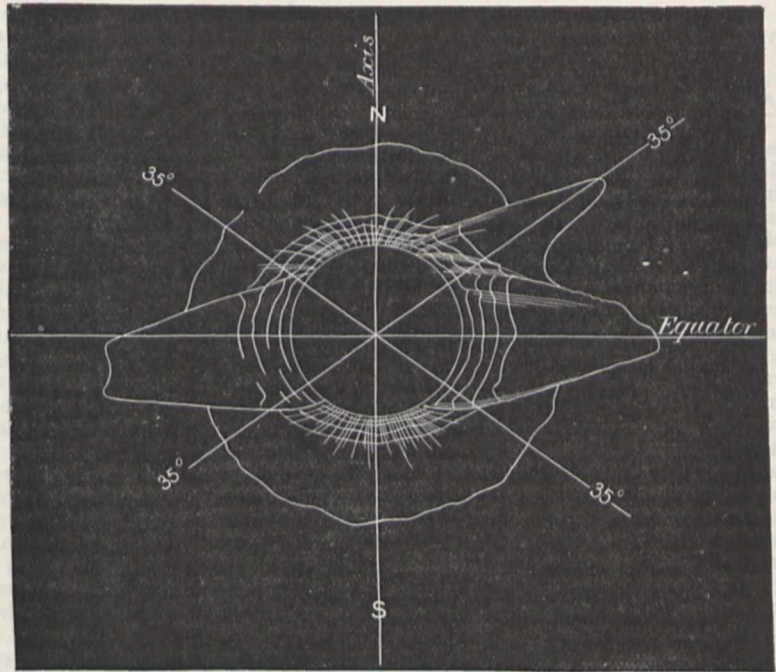


FIG. 2.—Tracing of the results obtained by the cameras in 1878, showing inner portion of equatorial extension, and how the surfaces of it cut the concentric atmosphere in lat. 35° N. and S., or thereabouts.

terrestrial phenomena should be carefully observed. Hence I regard this eclipse as the most important that has been observed for many years, as it throws much

needed light on many points hitherto obscured in doubt."

The similarity of the coronas of 1867 and 1878 was one of the points relied upon when I subsequently discussed

(see "Chemistry of the Sun") the possible meteoric origin of many solar phenomena, and pointed out that if this were so, there must be an equatorial ring to produce them. The recent development of the meteoric theory suggests that

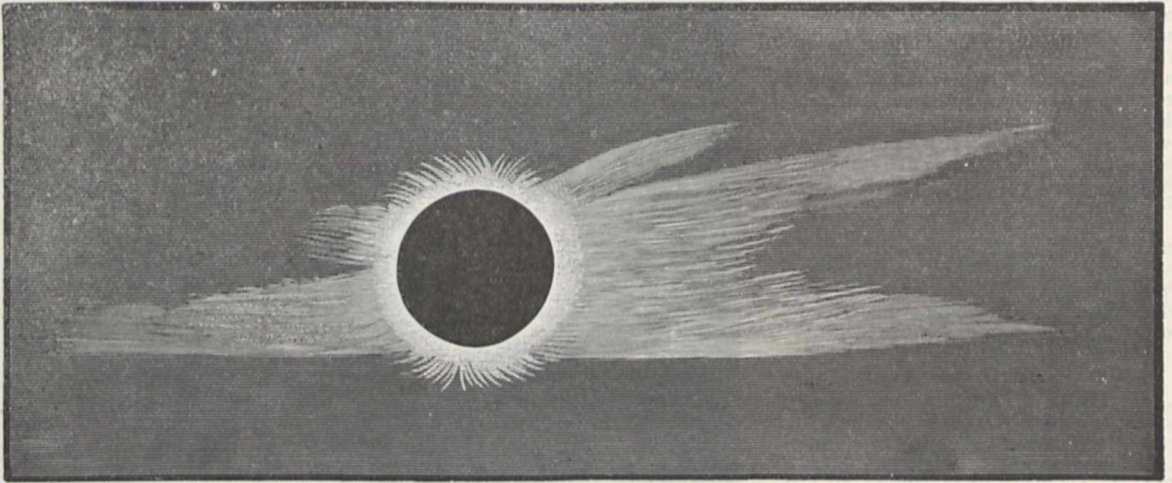


FIG. 3.—Phenomena observed during the total solar eclipse of January 1, 1889 (see NATURE, March 7, p. 436). †

among the most important observations to be made at future eclipses will be a direct comparison of the spectrum of the corona with the low temperature spectrum of meteoritic dust. It may be that some of the photo-

graphs taken during the last eclipse may give us some information on this point, but so far nothing is known.

J. NORMAN LOCKYER.

ON THE GRADUAL RISING OF THE LAND IN SWEDEN.

ALTHOUGH we find in a work by Urban Hjärne, printed in 1702, some remarks on the level of the sea in the Baltic, and the old shore-lines of the island of Gothland, the honour of having for the first time raised this question seriously, and of having subjected it to scientific investigation, belongs to Emanuel Swedenborg, who, in 1719, published a work entitled "On Proofs from Sweden of the Level of the Sea, and the Past World's Strong Flood and Ebb." From the condition of the rocks in West Gothia; from fossils in horizontal chalk and marl beds; from shell-banks situated high above the actual level of the sea; from skeletons of whales and wrecks of ships found far inland; from the structure of the sand-hills and from the round stones found therein; from erratic blocks (or, as Swedenborg calls them, "stones that are spread all over the world"); from giants' bowls; from the shore-lines on Halle and Hunneberg (mountains in West Gothia); from the species of fishes existing in lakes at great elevations; and, finally, from the many proofs of the fall of the sea-level in the Baltic,—from all this, Swedenborg drew the conclusion that the former level of the sea in Sweden was some 400 feet above the present one. These changes he attributed in part to an alteration in the velocity of the earth's rotation and the period of rotation of the moon, whereby the water at the Pole is forced towards the equator. He also assumed that as the Baltic lies at a higher level than the Western Sea, the water therein gradually decreases.

Swedenborg's work, which suggested many points respecting the history of the world that have been hotly debated to the present day, was at first not understood, and continued to be almost ignored by the scientific world. But it was the immediate cause of analogous

researches begun by Prof. Anders Celsius, in 1724, along the coast of the Baltic, the results of which he embodied in a paper published, in 1743, in the Proceedings of the Royal Academy of Sciences, entitled "Remarks on the Decrease of the Water in the Baltic, as well as in the Western Sea."

Setting aside all other periods dealt with by Swedenborg, Celsius devotes himself exclusively to the changes in the sea-level which have taken place in historical times. He adduces several examples, tending to show that harbours and roadsteads on our shores have become shallow, and that rocks have gradually risen above sea-level; that ample depth for seine-fishing existed where there is now a shallow; that the appellations "island" and "holm" are frequently used on the coast for uplands surrounded by lowlands, the name "sound" for bights or dry land; that flat rocks at the level of the sea, formerly valuable on account of seals gathering therein, have become valueless by having risen too high above the sea; and that anchors and wrecks have been found in inland peat-bogs. He further compares measurements of the rising of the land extending over 168 years, and comes to the conclusion that at Gefle (on the Baltic), during 100 years, the land rose from 41 to 47½ inches, and, on the opposite side of the Bothnia Sea, from 41 to 50 inches, being an average of 45 inches. Celsius also proves a similar rising on the west coast, and from these facts he infers that the entire Scandinavian peninsula is gradually rising. Celsius further calculates the area of the land thus won from the sea since the days of Pytheas, and finally, for the benefit and instruction of coming generations, has a rock at Löfgrundet, off Gefle, carefully marked, this being the first scientific water-marking of the rising of the land in Sweden. As regards the fall of the sea, Celsius is of opinion that it is partly due to the transformation of water into earth through plants, and partly to the flowing

of water into "abysses" in the earth. It may be pointed out that the former theory could hardly be considered absurd at a time when most physicists believed that water could be transformed into earth; and as to the latter, we are still discussing the possibility of water being "absorbed by underlying strata."

Celsius found an ardent supporter in Linnæus, who, returning to Swedenborg's theory, connected the decrease of water with the presence of mussel-shells and *petrificata marina* in strata now situated high above the sea. Linnæus wholly rejected the theory that their presence was due to the Flood. He also held that "endless ages" must have elapsed since the earth began to be inhabited by plants and animals.

The views of these two great naturalists were at first accepted and defended by a number of distinguished scholars. But from 1755 they met with the warmest opposition, especially from the Bishop Johan Browallius, who, from the theological point of view, in a celebrated and learned work refuted and condemned the theories of Swedenborg, Celsius, and Linnæus. When some years later Colonel Carl Fredrik Nordenskiöld presented a paper to the Academy further elucidating the question, four years elapsed before it was published, and even then a "note of apology" for its appearance was appended.

But with the opening of the present century a new controversy arose. The theory of the structure and history of the earth had, during the preceding era, not only become developed into a special science, but students had already, by different opinions on certain fundamental scientific points, become divided into two schools, the followers of which, under a fierce, but to science beneficial, contest, each attempted to prove their views by searching old and collecting new records. Hardly had this strife begun when it became evident of what importance the old question of the rising of the land or the fall of the sea would be for the determination of the matters in dispute. One of the founders of the plutonic school, John Playfair, in 1802 advanced the theory of a connection between the rising of the land in Sweden and the volcanic forces in the interior of the earth, and some years later this view was further developed by the most ardent and gifted champion of plutonism, Leopold von Buch, who himself had had the opportunity during a journey in Scandinavia, 1805-6, by personal observations and by intercourse with Swedish men of science, of learning that at all events most of the observations on which the assumption of a change in the sea-level of the Baltic were founded had been carried out with the greatest care and conscientiousness.

Some of the opposite views, on the contrary, were revived, after a careful study of the literature appertaining thereto, by K. E. A. von Hoff, in an excellent work printed in 1822, entitled "Geschichte der durch Ueberlieferung nachgewiesenen natürlichen Veränderungen der Erdoberfläche"; but it should be added that the views defended in this work were retracted, twelve years later, after a careful discussion of the researches respecting the land rising carried out in 1820-21 by Herr N. Bruncrona, Director of the Swedish Pilot Service, and the observations of Lieut.-Colonel C. P. Hällström, recorded in the Proceedings of the Academy in 1822. Hoff then acknowledged that the theory of the rising of the land formed one of the most important and instructive parts of modern geological science. Hällström, by the way, demonstrated that a considerable rising of the land takes place on the east as well as the west coast of Sweden, that the rising differs in magnitude in various localities, and that no rising exists on the coasts of Halland and Scania in the extreme south.

At this stage of the discussion, the closing word was spoken by the famous English geologist Lyell. He had at first doubted the assertion of the rising of the Scandinavian peninsula, but having, in the summer of 1834,

paid a visit to Sweden for the purpose of investigating the question, having examined many of the statements bearing upon it, and having obtained valuable information from Berzelius and others, he published, in the following year, a paper in the Transactions of the Philosophical Society, entitled "On the Proofs of the Gradual Rising of the Land in Certain Parts of Sweden." In this paper Lyell accepts unhesitatingly the views held by the Swedish men of science. He especially points out the theoretically important and instructive fact (already, however, demonstrated by Hällström) that the rising varies much in different localities, and even that in some places in Southern Sweden no rise has taken place within historical times. Lyell's paper remained the final word upon this question for a long time, during which no opposition was raised to the fundamental principle. Efforts, however, were made by fresh measurements on the Swedish coast, to obtain fuller material for research, valuable contributions being rendered by Sven Nilson, P. A. Siljeström, A. Erdmann, Sven Lovén, J. G. Forshammar, G. Lindström, Lord Selkirk, A. G. Nathorst, and others. From these new researches it became evident that it was often difficult to establish harmony between observations made in places very close to each other, a circumstance which indicated that the phenomenon was far more complicated than at first supposed, and which again threw some doubt upon the matter, and caused fresh opposition. Even Lyell himself, in the eleventh edition of his "Principles of Geology," published in 1872, speaks with far less confidence of the land rising; and in a newly published important work the celebrated Austrian Professor, Suess, wholly denies the rising as well as local changes of the shore-lines. The old view of Urban Hjärke is adopted, viz. that the Baltic may be considered a lake, in which the height of the water chiefly depends upon the proportion between the water conveyed into it and the water lost by evaporation and outflow. Space does not permit me to enter further into the ingenious arguments of the eminent Austrian geologist. Hardly had his work left the press before the views advanced were refuted by Dr. Holmström in an elaborate paper, published in the Transactions of the Royal Swedish Academy.

Holmström's researches were begun in 1867 at the instigation of Prof. Otto Torell, so that his paper is founded upon studies extending over a period of thirty years. During that time Dr. Holmström, partly at the expense of the Pilot Service, visited and re-measured most of the old water-marks along the coast of Sweden. New ones have also been cut in the rocks, and for the guidance of future researches the old as well as the new markings have been carefully drawn and described.

The following important synopsis is the result of Dr. Holmström's prolonged studies.

The twenty-four hydrographical rock-marks along the west coast of Sweden show that the land in that part has risen about 0.5 centimetre during the last half-century. The rising is incontestable, but varies in different localities, amounting, for instance, at Nordkoster, to almost nothing, but at the Väderö to more than 1 metre in the century.

This result of the west coast researches is very important, inasmuch as no doubt can be entertained that the average water-level there corresponds with that of the North Sea, and that the rising of the land thus demonstrated cannot possibly be caused by a gradual fall of the water in the Baltic.

The two rock-marks on the south coast also indicate a rising during recent years, but as the time between the registration and the cutting of the marks is hardly twenty years, this proof cannot be accepted with certainty.

On the east coast of Sweden, as far as Stockholm, some twenty water-marks have been examined, and here, too, a rising is perceptible in most places, but at Säfsvö

and Rödskär, and some other places, a *sinking* has taken place during the last twenty years, amounting to 0·7 centimetre a year. This sinking is, however, at all events at Säfvö, as far as can be ascertained from personal observation, of a quite local nature. At Calmar, on the other hand, as already shown by Dr. Siljeström, no change whatever has taken place since the beginning of the century.

From Stockholm northwards there are about thirty water-marks, and here, too, the rising predominates, although it varies often in localities very near each other; but a careful discussion of the observations seems to have established that the rising has been on the decrease during the last century. During the last period it amounted at Stockholm to 0·5 centimetre a year; at Celsius's old water-mark, at Löfgrundet, off Gefle, to 0·9 centimetre; at Chydenius's mark at Ratan to nearly 1 centimetre; at Bergö, on the Finnish side of the Gulf, to 1 centimetre; and at the mark cut by Augustin Ehrensward, August 21, 1754, on a rock at Hangö (Finland), to 0·6 centimetre. Therefore, a considerable rising, varying from 0·5 to 1·1 metre per century has taken place in this part of the Baltic.

The above facts, gathered by Dr. Holmström, form the last contribution to our practical knowledge of the old water decrease problem, and many decades must now elapse before fresh data can be obtained for further observations upon these changes in the earth's crust—changes which appear to us to take a long time, but which, geologically reckoned, are very rapid.

If the problem of the land-rising is taken in the same extent in which it was first raised by Swedenborg, it may be divided in two problems, certainly related, but widely separated, and both of pre-eminent importance to the geological history of the earth, viz. (1) the question of the changes of level to which the sea or the hydrosphere of the earth has been subjected in historical times; (2) the question of changes in the level of the sea during the immense length of the geological ages.

As regards the first, it must be considered fully demonstrated, to the student free from preconceived opinions, (1) that in several places along the coast of Sweden, during the lapse of a few generations, a considerable rising of the land has taken place, not only in the Baltic, but also on the west coast; (2) that this rising varies in different localities, and is in some places entirely wanting.

These facts cannot possibly be explained, as some students have attempted, simply by maintaining that the sea-level of the Baltic lies above that of the seas beyond, and that a gradual levelling takes place; as in that case no rising could take place on the west coast. If we, therefore, as is always advisable in natural researches, take the actual observations as basis for our theories, we are compelled to assume that in some places on the Swedish coast a gradual upheaval of the solid fundamental rock really takes place, although some portion of the apparent rising may no doubt be ascribed to a decrease of the water in the Baltic. That such a decrease does occur is probable, but when the student of science refers to it, he should bear in mind that it is only an hypothesis, as yet far from being proved.

Several circumstances seem certainly to speak against the trustworthiness of the observations founded on the water-marks. Prof. P. A. Gadd, for instance, remarks that often there have been found, close to a mark indicating a rising of the land from 3 to 4 feet in a century, trees 300 years old standing close by the water's edge—*i.e.* in places which, when the tree was only a shoot, would have been several feet under water, and this argument has been repeated without contradiction by Lyell, Erdmann, Suess, and others. But it is forgotten, when this is used as an argument against the land-rising theory, that the tree during a period comprising centuries may

have sunk through its own weight and through the washing away by rain of the earth at its roots, peculiarities which cannot be unknown to the horticulturist who has planted trees on earthy eminences in parks. Indeed it is self-evident that among the thousands of trees by our shores there must be some which could strike their roots and thrive just in such a spot. Viking mounds, memorial stones, and buildings by the shore might be subjected to similar sinking, the water-marks carved in the solid crystalline rock only being trustworthy as evidence in questions about secular changes in the earth's strata.

Another argument against these observations on the coasts of Scandinavia is that these changes of level, if they do really take place, cannot possibly be confined to this country alone, but must be observable in other parts of the world. But any certain counterpart to the land-rising in Sweden is not known anywhere, not even on the North Sea coast of Norway, nor along the Atlantic border, where foundations of monuments dating from the time of Cæsar still remain intact. The weight of the latter argument is, however, greatly reduced when we bear in mind that observations such as those made in Sweden could not possibly be effected on a coast exposed to the ocean, where, in consequence of the tide, the level of the sea varies diurnally and alters with the direction and force of the wind—changes which so far exceed the land-rising here referred to that they would entirely obscure it. Besides, as regards old buildings, only those built carefully of granite and resting on the solid rock can be taken into account in this discussion. It is, moreover, possible that such an elevation of the land as that in Scandinavia takes place only in districts where the rocks consist of granite or crystalline schist. The Mediterranean being a sea with a mouth far more narrow than that of the Baltic, is unsuitable for the settlement of such questions. On the west coast of Europe, again, the tide is so great that similar observations there would be very difficult. Neither are the sandy shores of Holland and Germany suited for such observations, and the east coast of America has hardly a history long enough for such researches. This applies in a still greater degree to the west coast of America and the coast of Australasia. The volcanic shores of the Pacific Ocean are but little suited for the observation of such changes of the level of the sea. That no rising of the land along the coasts of the oceans has been observed is therefore capable of explanation.

But even accepting the theory that a slow secular disturbance of the level of the shore-line does take place in some localities we are obliged to confess that the geologists at present cannot advance any certain proof of a general change in the level of the sea having occurred in historical times. Any general decrease or increase of the volume of water in the sea in historical times has not been proved. The case is, however, different when it is a question of changes during ages not measured by those of man, but by those of the earth, *i.e.* by the measure of time, which no doubt bears the same proportion to our years and centuries as our terrestrial measures bear to astronomical distances. For in all parts of the globe, as well at the equator as near the Poles, we find rocks which incontestably have, during former geological ages, been formed below the sea, although now lying above it. There is not a shade of doubt about this. And one of the reasons why the geologist has with such great interest studied the question of land-rising in Sweden is that he hopes to derive from the small changes that take place before our eyes an insight into the causes of the great ones. With regret, however, we must confess that our success has yet been very slight. There does not yet exist any satisfactory theory of the origin of the beds of chalk and clay, a thousand feet in thickness, containing fossils of unmistakable sea animals, which are found high

up on the slopes of the Alps and far in the interior of high continents.

The marine deposits which are encountered all over the globe high above the present sea-level are stratigraphically of two very different kinds: viz. marine layers which have been greatly disturbed from their original horizontal position, upheaved and thrust up by the side rocks; and marine layers which, lying perfectly horizontally, form the upper strata of the high plateaus, or of the table-mountains.

That the former, after having been deposited as mud below the level of the sea, and afterwards hardened into more or less solid rock, have been dislocated from their original position by mechanical forces, and raised high above the level at which they were formed, pressed together, and thrown above each other,—about this all geologists agree. Formerly the opinion prevailed that the volcanic forces in the interior of the earth had accomplished all this, but we may assume that most geologists are now inclined to seek the cause of the changes indicated in *side pressure*, dependent upon various causes—a theory advocated by me twenty years ago, but then little heeded.

However, this explanation is no longer applicable to marine layers which have not been disturbed in the least degree from their original horizontal position, although they at present form high plateaus several thousand feet in depth and several thousand square kilometres in area. Such formations are, as is generally known, found in all parts of the globe, and from all geological ages. On the west coast of Norway, where no such rising of the land in historical time as in Sweden has been observed, one finds in many places, particularly in the north, terraces or ledges which run perfectly horizontally, irrespective of the geological structure of the coast, for miles along the shore. Since attention was first drawn to these terraces by Urban Hjärne in Sweden, and by Keilhau and Bravais in Norway, they have been the subject of careful study, and of a literature as voluminous as that relating to the land-rising question. No geologist will now venture to deny that we have here before us old shore-lines, indicating that the sea even during the very last geological epoch, but still long before, very long before, historical times, stood far above its present level; whilst the horizontal position observed everywhere, apart from purely local exceptions, appears to contradict the view that this is due to local upheavals. Similar formations are also found in other parts of the world, as for instance at the Cape and the southern part of South America, proving that even there great changes in the level of the sea have taken place since the beginning or middle of the last geological epoch.

Of layers from the Tertiary period we have, in consequence of the erosion during the Glacial age, only traces in Scandinavia; but further north, in Spitzbergen, we find Tertiary strata thousands of feet in thickness. Near the west coast they are much disturbed, but further inland they form almost horizontal strata of sand and clay, here and there containing small coal-seams and schists, rich in splendid fossil remains, bearing witness not only to a magnificent vegetation having once existed in these parts, now ice-covered, but to the fact that the sea at Spitzbergen when they began to form hardly stood higher than at present. When therefore Prof. Nathorst, during one of his expeditions to Spitzbergen, on the highest plateaus of one of these high but horizontal Tertiary beds, found a mighty layer of marine fossils, we obtained proof that during the Tertiary period, geologically speaking so near us, the level of the sea had varied to the extent of several thousand feet. Even here the perfect horizontal position of the strata from Advent Bay by the Ice Fjord across the Storfjord to Franz Joseph's Land, excludes the possibility of these Tertiary marine beds being raised to their present level by volcanic forces. And if we proceed

from the Tertiary beds of the Arctic regions to those on which Paris rests, or to those of the United States or of Patagonia, we encounter everywhere proof that the level of the sea has changed many times during the Tertiary period. Analogous observations may be made about the strata from the Trias, the Jura, and the Chalk periods in different parts of the globe. Again, the geologist finds that the level of the sea for some reason or another during those epochs has changed by many thousands of feet, in most places without its being possible to connect this change with the oft-adduced reaction on the earth's crust of the supposed red-hot interior; and the same applies also to layers from the Palaeozoic period, from the period during which the rocks of West Gothia, referred to by Swedenborg, were formed.

Independent of all observations on the land-rising in Sweden, and independent of all theories, the fact remains that since the earth became an abode for animals and plants, the level of the sea has changed many times.

But we must confess that up to the present no acceptable theory explaining the *cause* of these changes has been proposed. Some have re-adopted Swedenborg's ancient idea that a change in the rotation of the earth caused a change in the form of the hydrosphere; others have discussed the great influence exercised by heavy mountains on the water-level of the adjacent seas, calculating that under favourable conditions this may amount to a great deal, *i.e.* that the sea-level on coasts that are engirdled by great mountain ridges is several hundred metres above the main level of the ocean in the same latitude; others, again, have sought the explanation in the hypothetical, and to those who are familiar with the Arctic regions wholly arbitrary, assumption, that huge masses of ice are periodically heaped up at one or another of the Poles, and by their attraction cause notable changes in the sea-level; and, finally, some maintain that the rising of the level depends on dust and *débris* being either blown or washed into the sea, and that the sinking depends on water being absorbed by strata in the interior. But to the student reckoning with figures, and who bases his researches on actual observations and not on assumptions, none of these causes explains fully and satisfactorily the great and probably simultaneous changes of the sea-level. To my mind the simplest explanation, and nearest at hand, has never been duly considered.

No doubt this neglect in some degree springs from the still prevailing belief in the quantitative unchangeableness of the heavenly bodies, which with the Aristotelian philosophy has penetrated the intellect of natural philosophers. Kepler, on account of the sun being obscured during three consecutive days in April 1547, most probably by cosmic dust, opposed this principle, declaring expressly, *Cæli materiam esse alterabilem*; but the belief in the old dogma was so little shaken thereby that the scientific ban went forth from more than one quarter against Chladni when he attempted to demonstrate that cosmic matter does really fall upon the earth. Now Chladni's doctrine is everywhere accepted, but even at the present day few geologists will assign to the cosmic matter that falls on the earth an important influence in the formation of new strata. Only a few quantitative studies of the phenomenon itself, and an unprejudiced estimation of the length of the geological epochs, are needed to convince anyone how unjustifiable this is. To my mind it seems fully proved that solid matter, as well as gaseous, and fluid at a temperature above 0°, is daily in great quantities brought to the earth, and that through this fall, and by the masses of *débris* carried by rivers and wind into the sea, the latter must during geological ages have become filled, and its level raised in a manner which would be totally opposed to actual facts, if there were not other causes to counteract it.

Such a cause might be found in the circumstance that,

just as fresh matter is hourly brought to the earth by meteors, it steadily loses during its orbit in the solar system some of its gaseous constituents; and the near maintenance of a *status quo* during ages partly depends upon the circumstance that gain and loss balance each other, and partly also upon the gain and loss, during the record of mankind, being so infinitesimally small in proportion to the gaseous and fluid matter surrounding the lithosphere of the earth. But during the geological ages even this "little" may be appreciable: long periods may have passed when the gain has been in excess, which has caused a rise in the volume of the sea; whilst at others the loss has predominated, whereby a gradual fall of the sea-level has taken place.

That the atmosphere sometimes decreases through loss in space it is of course impossible to demonstrate by direct observation; but as we at present know fairly well the forces acting upon a gas or dust molecule in the outer strata of the atmosphere, it seems that we may, from a theoretical point of view, be able to obtain an answer to the question raised here. However, we must, to avoid erroneous and hasty conclusions, here take into consideration so many factors difficult to estimate that the definite answer probably for a long time will give rise to much controversy.

Therefore, although the problem of the rising of the land on the coasts of Sweden and Finland may now be said to have, in the main, been decided, the old question about the diminishing of the sea-level, and that just in the general form in which it was presented by Swedenborg and Linnæus, still remains an unsolved riddle of immense importance to the history of our earth.

A. E. NORDENSKJÖLD.

VARIABLE STARS AND THE CONSTITUTION OF THE SUN.

VARIABLE STARS.—The theory of variable stars set forth by Dr. Brester in a recent essay¹ somewhat resembles those suggested by Zöllner in 1865,² and by Dr. Lohse in 1877.³ Briefly, Zöllner's theory regards variability as being due to the formation of scoriæ on the photospheres of the stars and their subsequent dispersion by the heat due to chemical combinations which take place in virtue of reduced temperature. Dr. Lohse substitutes absorption by the cooled atmospheres of the stars for the reduction of light by scoriæ as in Zöllner's theory, although both agree as to the cause of the removal of the light-obstructing agencies. The theory suggested by Dr. Brester is a little more ambitious than either of these, and, to give a translation of his own statement, "All the phenomena that variable stars present to us are the varied effects of one cause—the intermittent chemical combination at the cool external layers of that which had previously been dissociated by heat" (p. 1). All the explanations are based on the assumption that the stars are stratified spherical agglomerations of gaseous matter, the different layers having different compositions according to their distances from the centre.

Most stars are too hot to allow of the formation of compounds as we know them, but the stars most subject to variability (the red stars) are sufficiently cool, in their outer layers at least, for the formation of such compounds as hydrocarbons. It is in the obstruction of light by these compound vapours that Dr. Brester finds his explanation of variability. He aptly compares the cooling of a star to the running down of a clock-spring, and the intermittent chemical combination to the escapement which regulates it. These changes pass unnoticed in the hottest stars, because the periods elapsing between the coolings is very

great, and the combinations formed exert no very great absorbing influence; but in the cooler stars only small changes of temperature are necessary, and the periods are correspondingly short.

Again, although the temperature may be low enough for a combination to take place, the combining substances may be so diluted by other matter that the combination is impossible, just as a mixture of oxygen and hydrogen will not explode if admixed with more than $7\frac{1}{2}$ volumes of air (Bunsen). This condition Dr. Brester describes as a state of *surdissofiation*. This state does not last long, because, as the combining molecules get nearer the centre, they get more concentrated, while the substances which prevent their union diminish in proportion. When the combination does take place, there is an "eruption of heat" and the clouds in the outer cool layers are dispersed, the brightness of the star consequently increasing.

So much for the general theory, which Dr. Brester believes to be competent to explain every description of variable star, even such diverse ones as Algol and β Lyrae. He rejects the eclipse explanation of the Algol type on the ground that it is impossible to conceive such large-obscure bodies to travel at such an enormous rate, and that it is in contradiction to the recent work of Chandler and Sawyer, showing irregularities in the periods, especially in the case of U Ophiuchi.

Secondary maxima, such as occur in β Lyrae, he believes to be due to double combinations: the first substances which combine by the fall of temperature do not produce sufficient heat to reproduce the first maximum, whereas the next combination does, and these taking place alternately, the β Lyrae type receives explanation. Irregularities in the variability are, according to this theory, due to disturbances brought about by very rapid rotations.

"New stars" are believed by Dr. Brester to be produced by the sudden dispersion of the obscuring clouds which formerly surrounded the star, by heat due to a new chemical combination. On this supposition they must be at a very low temperature before they burst out. It is not easy to understand, however, how any such action as this could raise a star from the ninth to the second magnitude, as was the case with T Coronæ. The spectroscopic difficulty is a still greater one. How the spectrum of a new star just before its disappearance could, on Dr. Brester's view, be like that of a planetary nebula, is not easy to explain. For the present it seems more consistent with the facts to regard "new stars" as being due to the clashing together of two meteor-swarms in space.

In this theory Dr. Brester has attempted too much. Most astronomers are agreed that more than one cause of variability is at work, and it is certainly too much to expect one theory to explain all the various types. Dr. Brester does not seem to be aware that Algol is one of the hottest stars in the heavens, and that a recent photograph by Prof. Pickering shows the spectrum to be the same at maximum as at minimum. If one hot star be variable, why not all? Again, if variability is only manifest in the cooler stars, why does not every cool star give indications of variability? Further, the theory assumes that all variable stars are cooling, whereas Mr. Lockyer's recent work has shown that those of the Mira type are increasing in temperature. Dr. Brester's only objection to Mr. Lockyer's theory of variability is its limited application, but it was not set forth as being universally applicable. If Dr. Brester's theory had been limited to the variables of Group VI. (Vogel's Class III θ), it would be more reasonable, but even then it would not be easy to understand why all the stars of the group do not exhibit variability.

The Sun.—The second part of the essay attempts to explain the various phenomena presented to us by the

¹ "Essai d'une Théorie du Soleil et des Étoiles variables," par A. Brester, D.Sc. (J. Waltman, 1889).

² "Photometrische Untersuchungen," p. 252.

³ *Monatsber. der Akad. der Wissenschaften*, p. 826.

sun. The first great departure from prevailing opinions is the view that the sun is in a tranquil state, and is in no way subject to the violent storms which are commonly believed to disturb it. The stratified character of the solar atmosphere is set forth as evidence of this tranquil state. Dr. Brester believes that the apparent motions of the protuberances are not real, but simply indicate the displacement of the luminous condition brought about by chemical combinations in tranquil matter. This he believes to be quite consistent with the observed displacements of the prominence lines, and we see no reason to differ with him.

The next important divergence from prevailing ideas is the suggestion that pores, spots, and faculæ are all at exactly the same temperature because they are at the same level. The experiments of Spoerer and Langley have shown that the spots emit less heat than the other parts of the photosphere; but Dr. Brester states that this is not due to a difference in temperature, but to a difference of emissive power. He believes that spots are formed by the vaporization of the photospheric matter in the regions where they are formed, the luminosity being reduced, whilst the temperature remains the same. On this supposition, the photosphere bears the same thermal relation to the spot that ice does to the water formed as it melts.

The forms of the spots he believes to be due to the increase of pressure caused by the volatilization of the photospheric matter, the conical form being due to the fact that the nearer the centre the greater the resistance to the expansion.

That faculæ should precede spots Dr. Brester states to be essential to his hypothesis. They indicate the places where increased condensations are taking place prior to the "eruptions of heat" which will produce spots.

For an explanation of the periodical phenomena, and the increased angular velocities of spots near the equator, Dr. Brester assumes that, while the photospheric surface which we see is spherical, the different layers of the atmosphere must be ellipsoidal, owing to the rotation of the sun. He admits that this state of things is not easy to explain, but states that it is sufficient to know that the fact exists. This being taken for granted, the varying periods of rotation in different latitudes is not difficult to explain. For since the photospheric matter is formed by the condensation of the vapours of the ellipsoidal layers, the particles in equatorial regions have to descend a greater distance towards the centre than those in the same layers near the Polar regions; and since the linear velocity remains the same during the descent, the angular velocity is increased, and is increased more at the equator than away from it. Since the spots lie in the photosphere, they thus indicate an increased angular velocity in equatorial regions. It will be seen that this explanation is much akin to that suggested by Mr. Lockyer,¹ differing from it mainly in giving the whole photosphere the additional velocity, whereas, according to Mr. Lockyer's view, only the spot-forming material partakes of the added angular velocity.

The relation of spot spectra to the eleven-yearly period observed by Mr. Lockyer is also partially explained. According to Dr. Brester's view of the solar economy, the photosphere must have a special composition in each latitude, and since the latitudes of the spots vary with the period, the spectra would also vary with the period. The exact nature of the change—namely, from lines of iron and other known substances at minimum to unknown lines at maximum—is not explained.

The similarity of the spot zones on both sides of the equator, according to Dr. Brester's view, is due to the fact that the same atmospheric layer meets the photosphere in equal latitudes on opposite sides of the equator.

The slight differences which do exist are regarded as simply the effect of chance, since an "eruption of heat" may either produce one large spot or several smaller ones.

Dr. Brester also attempts to explain the cause of the eleven-yearly period, but his explanation is difficult to follow. Broadly speaking, his idea is that during eleven years the integrated effects of the various chemical combinations which have taken place are such as to very nearly restore the conditions which had existed at the commencement of the period. Slight differences would be produced each time, so that after a long interval, well-marked differences might be expected.

Although the theory explains many of the phenomena observed, an explanation of many more is still required. Thus, although it is not difficult to understand the absence of spots at the equator, the cooler layers there being at the greatest distance from the photosphere, we should be led to expect the greatest number of spots in polar regions, where the atmosphere in the neighbourhood of the photosphere is coolest, and where, therefore, chemical combinations would be most likely to take place. The question of the corona is reserved for a future essay, but Dr. Brester is confident that it will present no great difficulty. He also hopes to satisfactorily explain the phenomena of comets' tails, the zodiacal light, and the variability of Jupiter and his satellites.

In conclusion, Dr. Brester states that his theory, so far from being at variance with the laws of chemistry and physics, really strengthens them, and that it is not discordant with the observed facts. At the same time he admits that the difficulty of comprehending it in detail will prove a great drawback to its acceptance.

A. FOWLER.

THE RABBIT PEST.

MR. W. RODIER, of Tambua, Cobar, New South Wales, has forwarded to this Society a printed sheet, containing, as it appears to me, by far the best suggestion yet made for the extermination of rabbits—a subject to which my attention has been repeatedly called by various correspondents in the Australian colonies, where, as is well known, the damage done by these animals is enormous. Mr. Rodier states that his plan has been in operation at his station in New South Wales for about eight months "with the utmost possible success," and has cleared the country of rabbits. It is a very simple plan. Ferrets and nets are used in the usual way to capture the rabbits, but while all the females taken are destroyed, the males are turned out again uninjured.

The results of this mode of operation are that the male rabbits, as soon as they begin to predominate in numbers, persecute the females with their attentions, and prevent them from breeding. They also kill the young rabbits that happen to be born; and even, as Mr. Rodier asserts, when they largely predominate in numbers, "worry the remaining does to death."

This is all strictly in accordance with what we know takes place under similar circumstances in the case of other animals, so that we can readily believe it to be likely to happen.

The ordinary mode of trapping, as Mr. Rodier points out, is more likely to increase the number of rabbits than to diminish them. For reasons which he clearly explains, more buck rabbits are always killed by the trappers than does. Thus the does predominate in numbers, and, a few bucks being sufficient for a large number of does, are perpetually breeding and increasing the stock.

The plan advocated by Mr. Rodier is so simple and easy that I cannot doubt it will be widely followed when known. No disease that might otherwise cause injury is introduced, no other noxious animal is proposed to be

¹ "Chemistry of the Sun," p. 424.

imported, but advantage is taken of the well-known natural laws which regulate the increase of life to effect in this instance a salutary decrease.

P. L. SCLATER.

Zoological Society of London,
3, Hanover Square, W., March 18, 1889.

NOTES.

THE number of candidates for the Fellowship of the Royal Society this year is seventy-one, being about a dozen above the average number.

THE contributions hitherto paid or promised in this country towards the intended statue of G. S. Ohm amount to £95 14s. 6d. from ninety-four subscribers. It is proposed that the subscription-list shall be closed at the end of the present month, and we are desired by the Committee to ask intending subscribers to send their contributions as early as convenient to the Treasurer, Dr. Hugo Müller, F.R.S., 13 Park Square, N.W.

A COMMITTEE was formed some time ago at Limoges for the purpose of securing the erection of a statue of the great French physicist and chemist, Gay-Lussac. The preliminary arrangements have now been made, and the task of preparing the statue has been intrusted to M. Millet, who expects to be able to exhibit it at the *Salon* next year.

WE have to congratulate the Fishery Board for Scotland upon the acquirement of the services of Dr. J. Beard, who for some years has been working on the Continent. Dr. Beard's researches into the development of fishes take rank among the leading recent contributions to the subject, and they augur well for the future work of the Board. We are pleased to see that the members of this body are now issuing their scientific Bulletins independently of their official Reports.

MR. W. E. HOYLE, late of the *Challenger* Office, has been appointed to the Curatorship of the Manchester Museum in the Owens College. The Museum Committee is fortunate in having secured the services of so competent a man.

A VALUABLE collection of photographs, representing Alpine and Caucasian scenery, taken by the late Mr. W. F. Donkin, is now being exhibited at the Gainsborough Gallery, 25 Old Bond Street.

WE regret to have to record the death, at a very early age, of Mr. J. Reynolds Vaizey, a promising member of the younger school of botanists at Cambridge. His best-known contributions to botanical science are his papers in the first volume of the *Annals of Botany*, on "The Transpiration of the Sporophore of the Musci," and on "The Absorption of Water, and its Relation to the Constitution of the Cell-wall in Mosses." Mr. Vaizey was subject to epileptic fits, and, during one of these, received fatal injuries from falling into the fire.

THE oldest botanical journal of Germany, *Flora*, hitherto published at Regensburg, under the auspices of the Bavarian Botanical Society, appears now, in its seventy-second year, under a new form, issued at Marburg, under the editorship of Prof. K. Goebel. In addition to original papers, it will contain a *résumé* of botanical work during the year in different departments. The first part under the new *régime*, for March, contains important papers by Goebel, Pfeffer, Ludwig, J. Müller, and others.

IN the March number of the *Kew Bulletin* there are papers on fibre industry at the Bahamas, hardy species of Eucalyptus, yam bean, West African rubbers, Phylloxera in Asia Minor, botanical station at Lagos, and Chiga bread.

AT the meeting of the Scientific Committee of the Royal Horticultural Society on March 12, corroborative information was received from Mr. Plowright, of Lynn, regarding the occurrence, described at the previous meeting, of boughs of various trees being broken off by the extraordinary growth of crystals of rime upon them. As no snow had fallen during the period, it was impossible to attribute the results to such a cause. There had been excessive fog before January 7; the rime forming upon the telephone wires was so great that they were broken down. The ice was deposited unilaterally like flat sheets of glass, 1½ to 2 inches in width on the south side. On the 8th was a thaw. The result of the frost was that a birch had a branch amounting to one-third of the tree broken off; the smaller branches particularly suffered. The elms were most injured, branches of all sizes being broken off, even large arms, one measuring 5 feet 6 inches in circumference and 1 foot 10 inches in diameter. To such an extent was the roadway covered with *débris*, that the market carts were greatly impeded. Oaks, willows, and poplars also suffered; but ashes and Scotch firs escaped. Mr. Plowright noticed that fracture without falling was a distinct feature of rime-injuries to trees, excepting to willows and poplars, the vast majority of whose branches fell to the ground.

THE Society established some months ago under the name of the Gesellschaft Urania has already issued the sixth monthly number of its excellent magazine, *Himmel und Erde*, which is edited by Dr. W. M. Meyer. The main object of the Society is to popularize the accurate knowledge of scientific matters, by practical demonstrations at the head-quarters in Berlin, and through the medium of its magazine. Astronomy, as it always did and always must, leads the way in this attempt to interest the general public in science. Since it is expounded by such authorities as Prof. Schiaparelli, whose illustrated article on Mars runs through the first three numbers, it is evident that the Society does not mean to sacrifice genuineness for the sake of popularity. Dr. Scheiner, of the Potsdam Observatory, contributed an admirable article to the January number, on the principles of spectrum analysis and their application to celestial physics. Astronomical articles have also been contributed by Prof. Foerster, Prof. Seeliger, F. K. Ginzler, and others. Other subjects, however, have not been neglected. A clear exposition of the proofs of subsidence and elevation afforded by the pillars of the Temple of Jupiter Serapis was given by Dr. Brauns in the November number. The January number also contains an excellent article on the aurora, by Dr. Weinstein. The magazine is got up in an attractive style, and is admirably illustrated. The Society has purchased a 13-inch refractor, several microscopes, and other apparatus for the demonstrations; and it is their intention to have models constructed to illustrate eclipses and other phenomena.

THE Educational Society of Japan has, says the *Japan Weekly Mail*, published and circulated a little volume containing its programme, organization, and a list of its members. It is worthy of note that, in the artistic device on the cover, women are conspicuous, and the fact that women are carrying on their studies side by side with men would seem to indicate that the Society is desirous of recognizing the equality of the sexes. No fewer than 5000 members have joined the ranks of the Association, and a kind of committee or parliament is elected by these for purposes of discussion and deliberation, consisting of 200 deliberative members, seven councillors, seven sectional presidents, and one president.

AN interesting step has been taken in Japan by the organization of a branch of the Anthropological Society of Tokio, to be called the "Maine Club," after the late Sir Henry S. Maine, having for its object the investigation of the ancient laws and

customs of Japan, and all matters connected with the development and progress of civilization in that country. Its members are chiefly members of the parent Society, but membership is not confined to these. It is proposed that there shall be monthly meetings at which papers will be read, and discussions held. Well-known scholars are to be invited to attend the meetings, and contribute to the discussions. Essays or speeches which are considered to be of sufficient importance will be printed either separately or in the volume of Transactions of the Anthropological Society.

AT the meeting of the French Meteorological Society on February 5, M. Lemoine communicated the information he had collected upon the rising of the Upper Rhone from the 3rd to the 5th of October last. The maximum rise was on the 5th at Lyons, where it reached 14 feet. The cause of the rise was a severe thunderstorm which broke out at 2 a.m. on October 2, with incessant rain over a large area lasting until the evening of the 5th.

THE Pilot Chart of the North Atlantic Ocean, issued by the Washington Hydrographic Office, for March, shows that gales were experienced in the western part of the Atlantic during the first three weeks of February. The most noteworthy was one which originated on the 10th, just north of the Bahamas; on the 12th its influence was felt, noticeably from Newfoundland to the West Indies, and from the American coast to the 45th meridian. More fog was experienced than is usual during February. The southward movement of ice was very backward, no field ice or bergs having been reported till February 6, in lat. $45^{\circ} 35' N.$, and long. $48^{\circ} W.$ The chart contains brief rules for the use of oil at sea.

THE "Administration Report" of the Surveyor-General of Ceylon, for the year 1887, contains meteorological summaries for sixteen observatories, and monthly rainfall values for seventy-one stations. The mean temperature of the year was below the average at almost every station, and a comparison of the records since 1882 proves that there has been a fall of temperature throughout the island up to the present time. A map is given, showing the mean annual rainfall of the various districts, and a table showing the monthly means during different periods. The returns from Ceylon have been regularly published since 1869.

Two shocks of earthquake occurred at Bologna on March 9, but no damage was done. A severe shock was noticed at Aquila on March 10.

THE vapour-density of aluminium methide, $[Al(CH_3)_3]_n$, has formed the subject of an important series of experiments by Dr. Quincke, of Göttingen, with the view of further elucidating the question of the valency of aluminium. A few months ago, Messrs. Louise and Roux published an account of their experiments upon the same substance, from which they conclude that molecules of the constitution $Al_2(CH_3)_6$ are capable of existence. This result was in direct contradiction to the earlier observations of Messrs. Buckton and Odling, who showed that, even at the boiling-point itself, $130^{\circ} C.$, the density was considerably lower than that required for this double formula; from the boiling-point upwards the density gradually diminished, until, at the temperature at which this organo-metallic body unfortunately commences to decompose, it had almost reached that required for $Al(CH_3)_3$. Hence a revision of the subject has been undertaken by Dr. Quincke at the request of Prof. Victor Meyer. The aluminium methide employed was a very pure specimen, of constant boiling-point, and solidifying, on cooling, in the form of magnificent tabular crystals. Analyses gave practically theoretical numbers. The vapour-density was determined in a Victor Meyer apparatus in an atmosphere of hydrogen. Of

course, the all-important point to decide was the nature of molecular grouping just above the boiling-point, and, if such molecules were found to exist at all, to ascertain whether the value required for $Al_2(CH_3)_6$ remained constant for a sufficient interval of temperature. The experiments were therefore performed at the temperature of boiling xylene (140°), only 10° higher than the boiling-point of the methide. The mean value for the density, obtained from ten consecutive determinations, was 3.92 ; $Al_2(CH_3)_6$ requires 4.98 , and $Al(CH_3)_3$ corresponds to 2.49 . Hence it can no longer be doubted that molecules of the double formula are incapable of existence. Aluminium methide must therefore be represented by $Al(CH_3)_3$. Readers of NATURE will remember that only a fortnight ago an account was given in these columns (p. 417) of an analogous series of experiments by M. Alphonse Combes, upon a new organic aluminium compound, $Al(C_6H_7O_2)_3$, aluminium acetyl acetonate. It is supremely satisfactory that in this case the density, at a temperature only 45° above the boiling-point, was found to actually correspond precisely with that required by the triad formula, precluding again the possibility of the existence of molecules of the type Al_2R_6 . Taking the mass of evidence now before us, it may fairly be granted that the stable molecules of aluminium salts are constructed upon the type AlR_3 ; and aluminium in this respect thus completely resembles iron, chromium, indium, and gallium.

A REPORT of Mr. D. Hooper, the Government Quinologist in the Nilgiris, says that efflorescent salts occur in nearly every district of India. When the salt is alkaline in its nature, the surface of the soil on which it collects is known as dhobies' earth, which has for ages been used in various manufactures, and for washing and dyeing. A large quantity of the efflorescence of Northern India, which is sold in the bazaars as *sajji mati*, is a mixture of salts, where the sulphate and chloride of sodium preponderate over the carbonate. Dhobies' earth consists principally of sodium carbonate and sand; the other ingredients are organic matters and sodium chloride, with traces of sulphate of clay, oxide of iron, and lime.

IN the Report on the Blue-book of 1887, the Colonial Secretary for Ceylon says that the operations of the Survey Department during the year were most important and varied. Not only was the ordinary work of surveying Crown land for sale carried on, but a large amount of surveying was undertaken in connection with irrigation schemes and forest reservation. The minor triangulation of the island was continued, and thirty new stations were established. The great triangulation of the northern part of the island, for the purpose of connecting the Ceylon system with the Madras coast series of the great Trigonometrical Survey of India, was completed, as described in these columns some time ago. Considerable advance was also made with the surveys of roads, streams, and lakes in all the provinces; and a vast amount of other work, including surveys of the coast-line, surveys of villages for forest reservation purposes, &c., was satisfactorily completed.

A RECENT American Consular Report contains a long account of the industrial school at Reichenberg, which was founded by the Imperial and Royal Ministry of Public Instruction as a technical school of the middle grade, with the object of educating young men for important industrial and manufacturing positions. The institution is divided into a high school and a workmaster's school, and each of these is subdivided into branches for architecture, mechanical arts, and chemistry. In the high school a very high standard of general education is maintained, and the students are prepared, by systematic courses of lectures, for practical work. The workmasters' school is open to persons who have already worked in architecture, or in some mechanical art, or in chemistry. Besides these

schools there is one at night for the benefit of persons who are compelled to work during the day, the instruction given relating chiefly to drawing and modelling. This institution is now being taken as a model for other schools which are in course of establishment by the Russian Government.

IN the report, to the Foreign Office, of Sir A. Nicholson on the agriculture of Hungary during the past year, it is said that in November last a new agricultural school was opened in the Torontáler country, and at the end of the year there existed an academy of forestry at Chemnitz, a veterinary school at Buda-Pesth, an agricultural school in Hungarian Altenburg, four other agricultural academies in various parts of the country, and six schools. There were eight institutions for giving instruction in viticulture, three of which were in receipt of a fixed subvention. A proposal made to establish a high school for forestry and agriculture at Buda-Pesth has, for the present, fallen through. A Director-General has been appointed for all the agricultural schools; and a staff of travelling teachers for certain branches of agriculture has been formed. This staff, however, needs organization similar to that in Austria and France. Up to the present the members of the staff seem to have devoted themselves chiefly to instructing in agriculture and viticulture. Some years ago a body of engineers was formed under the control of the Ministry for Agriculture, with the object of assisting proprietors and farmers in irrigation, drainage, and other similar works, and of watching over water rights and fisheries. At present the number of these engineers is too small for the needs of the country.

A NEW stalactite cave has lately been discovered by accident near the little village of Erlach, in Lower Austria. It is about 60 metres long, and contains a shaft filled with water. The floor and walls are covered with stalactites and stalagmites picturesquely grouped, varying in colour from brown and green to white.

AT the annual general meeting of the Linnean Society of New South Wales, on January 30, Prof. W. J. Stephens, in his Presidential Address, took occasion to discuss Dr. Waagen's ideas as to the supposed Upper Carboniferous glacial period, and its assumed bearing upon the correlation of various Upper Palæozoic and Mesozoic formations in India, South Africa, and Australia. Prof. Stephens's object was to show that no general glaciation had ever taken place in the temperate regions of the southern hemisphere, and that evidences of local glaciation, as of glaciers, floating ice, whether of icebergs or river ice-rafts, cannot be regarded as of any value in the determination of the question of the relative ages of members of geographically distant formations.

THE new number of the *Mineralogical Magazine* contains, besides Mr. L. Fletcher's address on the renaissance of British mineralogy, the following papers: a manganese-magnesian magnetite, by Prof. A. H. Chester; on the zeolites of Rye Water, Ayrshire, and the minerals of the Treshinish Islands, by Prof. M. F. Heddle; elaterite, a mineral-tar in Old Red Sandstone, Ross-shire, by Mr. W. Morrison; analyses of various mineral substances, by Prof. I. Macadam; on the supposed fall of a meteoric stone at Chartres, Eure-et-Loir, France, in September 1810, by Mr. L. Fletcher; calcites from the neighbourhood of Egremont, Cumberland, by Mr. H. A. Miers; on the large porphyritic crystals of fels-par in certain basalts of the Isle of Mull, by Mr. T. H. Holland. Mr. Allan Dick has a paper in which he describes a new form of microscope.

THE United States Geological Survey has published the fifth volume of the series entitled "Mineral Resources of the United States," by David T. Hay, Chief of Division of Mining Statistics and Technology. This volume contains a summary

statement of the mineral substances produced in the United States in the year 1887, and chapters showing the features of the principal mining industries during that period.

SEVERAL valuable Bulletins of the United States Geological Survey (Nos. 40-47) have just been issued. One of them (No. 44) consists of a bibliography of North American geology for 1886.

VOL. III., Part I, of the *Folk-Lore Journal* contains, amongst other interesting matter, papers on African folk-lore, by Edward Clodd; on Wexford folk-lore; and on superstitions of Scottish fishermen, by E. E. Guthrie. This volume also contains the Annual Report of the Council of the Folk-Lore Society, in which it is said that many new members have joined the Society. Amongst the losses by death during the past year have been Sir H. S. Maine, Mr. J. C. Morison, Mr. R. Proctor, and Mr. Gifford Palgrave.

THE Geneva Society of Physics and Natural History has issued the first part of vol. xxx. of its Memoirs. It opens with an address by the President, M. Victor Fatio, giving an account of the work done by the members of the Society in the course of the year 1887.

MR. JOHN ANDERSON has compiled an interesting "History of the Belfast Library and Society for promoting Knowledge, commonly known as the Linen Hall Library" (Belfast: M'Caw, Stevenson, and Orr). It has been published in connection with the hundredth anniversary of the institution. Some valuable old maps of Belfast are reproduced in the volume.

PART 5 of Cassell's excellent "New Popular Educator" has been issued. Like the preceding parts, it is carefully illustrated.

DR. A. B. GRIFFITHS'S "Treatise on Manures" will be published, in a few days, by Messrs. Whittaker and Co., of Paternoster Square.

MESSRS. WILLIAM WESLEY AND SON have issued No. 94 of their "Natural History and Scientific Book Circular." It contains a catalogue of works relating to the various branches of physical science.

THE additions to the Zoological Society's Gardens during the past week include a Fruit Bat (*Cynonycteris*, sp. inc.) from India, presented by Mr. W. Jamrach; two Pine Grosbeaks (*Pinicola enucleator*), two Waxwings (*Ampelis garrulus*), a Nightingale (*Daulias luscinia*), British, presented by Mr. J. Young; a Great Eagle Owl (*Bubo maximus*), European, presented by Mrs. Morant; a Cactus Conure (*Conurus cactorum*) from Brazil, presented by Mr. W. H. St. Quintin; a Common Moorhen (*Gallinula chloropus*), British, presented by Mr. G. Hayward; a Rhesus Monkey (*Macacus rhesus* ♀) from India, two Nicobar Pigeons (*Caloenas nicobarica*) from the Indian Archipelago, deposited; a Buffon's Touracou (*Corythaix buffoni*) from West Africa, purchased.

OUR ASTRONOMICAL COLUMN.

ROWLAND'S PHOTOGRAPHIC MAP OF THE NORMAL SOLAR SPECTRUM.—Prof. Rowland has been engaged since the publication in 1886 of his first photograph of the spectrum, in endeavouring to perfect it, and has now completed a new map, which he considers much superior to the former. The entire work has been gone over again; a new dividing-engine has been constructed, and several concave gratings ruled by its means, some of which give especially fine definition. Much greater attention has been paid to the photographic manipulation, and the prints are, it is said, much finer and more perfect than those of the first series, which, however admirable as representations of the spectrum, as photographic works of art

left much to be desired. The present issue comprises ten plates, each 3 feet by 2 feet, and includes the entire spectrum, from λ 6950 in the B group up to the extreme limit of the ultra-violet. Of these, all but the first plate, which contains the most refrangible portion of the ultra-violet, are now ready, though plate *i*, λ 6050 to λ 6550, is not quite satisfactory, and may have to be replaced. The original negatives for this new edition show as distinct doubles, not only E, but even finer lines, such as those at λ 5276.1 and 5914.3, but it has not been found possible to exhibit all these as divided on the map.

THE CLINTON CATALOGUE.—We learn that the ownership of this most important work, which embraces the positions of over 35,000 stars, is in dispute; Mr. Borst, who with his sisters performed the principal part of the reductions, and prepared the manuscript of the completed Catalogue, having laid claim to it, whilst Dr. C. H. F. Peters, the Director of the Litchfield Observatory, of Hamilton College, Clinton, New York, at which Observatory Mr. Borst was an assistant, has instituted an action against him in order to regain possession of the Catalogue. The manuscript in question contains 3572 pages, 900 of which are of nearly double folio size, and shows more than 7,000,000 of figures.

SATURN'S RING.—Prof. Krueger telegraphs from Kiel that Dr. Terby, of Louvain, announces the appearance of "a white region on Saturn's ring, opposite the shadow of the globe" (*Dun Echt Circular*, No. 169).

THE O'GYALLA OBSERVATORY.—The tenth volume of the observations of Dr. N. de Konkoly's private observatory has just been published, in which he gives the results of the work done during the year 1887. The principal observations made were those of the sun, and of meteor-showers. In the former department, 137 drawings were made, showing 187 groups of spots. The relative spot number for the year was deduced as $R = 10.35$. The meteor-showers watched were those of the Aquarids principally, on July 25-27, the Perseids on August 8-12, and the Leonids on November 17. Some experiments with hydroxylamine as a developer, and the trial of a couple of object-glass prisms, with two or three observations of comets, complete the volume.

MOON-CULMINATING STARS, 1889.—M. Lœwy has prepared a comprehensive Catalogue of moon-culminating stars for 1889, which has recently been issued by the Bureau des Longitudes. Stars down to the seventh magnitude, 366 in number, have been taken and arranged in the order of their right ascensions. The R.A. of each star is given for every ten days during its period of visibility, the mean declination and sec D and tan D being also given. The Catalogue forms a valuable supplement to the tables already published in the *Connaissance des Temps* and the *Nautical Almanac*.

The ephemerides of eight Polar stars for 1889, all within 9° of the Pole, and none below the sixth magnitude, are given in the first part of the memoir.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1889 MARCH 24-30.

(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 March 24

Sun rises, 5h. 54m.; souths, 12h. 6m. 16.5s.; sets, 18h. 18m.; right asc. on meridian, oh. 14.9m.; decl. 1° 37' N. Sidereal Time at Sunset, 6h. 28m.
Moon (at Last Quarter on March 24, 7h.) rises, 2h. 3m.; souths, 6h. 7m.; sets, 10h. 9m.; right asc. on meridian, 18h. 14.6m.; decl. 22° 8' S.

Planet.	Rises.		Souths.		Sets.		Right asc. and declination on meridian.	
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	
Mercury..	5 25	10 36	15 47	22 44.4	10 15	S.		
Venus ...	6 30	14 32	22 34	2 41.3	21 22	N.		
Mars ...	6 34	13 30	20 26	1 38.7	10 7	N.		
Jupiter ...	2 26	6 22	10 18	18 29.3	22 58	S.		
Saturn ...	13 17	20 56	4 35*	9 6.5	17 49	N.		
Uranus... 19 45*	1 11	6 37	13 17.3	7 28	S.			
Neptune..	8 0	15 44	23 28	3 53.0	18 35	N.		

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

Mar.	h.	
24 ...	12 ...	Jupiter in conjunction with and 0° 41' south of the Moon.
25 ...	— ...	Venus at period of greatest evening brilliancy.
29 ...	12 ...	Mercury in conjunction with and 2° 2' north of the Moon.

Variable Stars.

Star.	R.A.		Decl.	h. m.
	h. m.	h. m.		
U Cephei ...	3 52.5	81 17	N. ...	Mar. 27, 4 36 m
Algol ...	3 1.0	40 32	N. ...	" 26, 1 12 m
ζ Geminorum ...	6 57.5	20 44	N. ...	" 28, 22 1 m
R Canis Majoris ...	7 14.5	16 11	S. ...	" 30, 1 0 m
U Cancri ...	8 29.4	19 17	N. ...	" 28, 20 56 m
U Coronæ ...	15 13.7	32 3	N. ...	" 30, 0 12 m
S Sagittæ ...	19 51.0	16 20	N. ...	" 24, M
R Sagittæ ...	20 9.0	16 23	N. ...	" 24, 19 57 m
T Delphini ...	20 40.2	16 0	N. ...	" 26, 0 0 M
T Vulpeculæ ...	20 46.8	27 50	N. ...	" 28, m
δ Cephei ...	22 25.0	57 51	N. ...	" 27, M
				" 24, 4 0 M
				" 25, 6 0 M
				" 26, 23 0 m

M signifies maximum; m minimum.

Meteor-Showers.

R.A. Decl.

Near δ Bootis ...	228	33 N.	March 27.	Very swift.
" γ Libræ ...	233	15 S.	Swift; long paths.	
Between ξ and ζ Draconis.	263	62 N.	March 28.	Rather slow.

GEOGRAPHICAL NOTES.

AT the last meeting of the Paris Geographical Society, M. Ed. Blanc made a communication giving the results of his four years' researches among the oases on the south of Tunis. Referring to the question of the desiccation of the Sahara, and to the obliteration of formerly existing oases by the sand, M. Blanc said he did not believe it was due to the destruction of the irrigation works which had been established by the Romans, nor to any alternation of periods of drought with periods of humidity. Nor did he attribute it to the deforestation or the depasturage of the country; forests, he believes, have very little if any influence on rainfall. The desiccation of the Sahara M. Blanc attributes to general geographical causes, resulting from modifications in the contour of the continents, such as the emersion of the steppes of Central Asia, the gradual disappearance of the snows which existed during the Glacial period in certain mountain masses of Europe and even of Africa, and perhaps also the elevation of a part of the depressions of the Western Sahara. These various causes, according to M. Blanc, have led to a deficiency of moisture in the air-currents which prevail over that part of Africa, and the equilibrium once broken between rainfall and evaporation, there results a progressive desiccation, more and more marked, and irremediable with the means at present at our disposal. The spread of the sand is a natural result of the exhaustion of the desiccated soil under the action of the winds. It is therefore a consequence of the above conditions, and could only be arrested by an alteration in the rainfall. Still, M. Blanc thinks that though one cannot alter existing conditions it is quite possible to palliate them, and especially by tapping underground supplies increase the number of oases, and restore to fertility others which have existed in former times, but are now overrun with sand.

MR. F. ARNOT, the young missionary who has spent seven years in South Central Africa, returns to Loanda in a few days. Mr. Arnot intends to proceed again to the Garanganze country to resume his labours. He means, however, to travel about the region of which Lake Bangweolo is the centre. The contour and position of that lake he will endeavour to settle, and also lay down as far as possible the courses of the various rivers that contribute their waters to the Congo. Mr. Arnot has during his stay at home been qualifying himself for taking exact observations, so that we may expect important contributions from him to the geography of Central Africa.

THE immense terrestrial globe which is being constructed for the forthcoming Paris Exhibition will have many points of

interest. It will be one-millionth the size of the earth; a millimetre on the globe will represent a kilometre on the surface of the earth. The globe will be about 30 metres (nearly 100 feet) in diameter. On this scale it will be possible in most cases to give geographical details their true dimensions; Paris will occupy just about 1 centimetre, and may serve as a unit with which to compare the dimensions of other features. All the great lines of communication by land or by sea can be shown in detail. In the enormous cupola under which the globe will be placed, it will be possible by means of a clock-work arrangement to turn the globe on its axis and convey a precise notion of the diurnal rotation of the earth. A point on the equator will move at the rate of half a millimetre per second. The many educational uses to which such a globe could be put are evident. The globe, we understand, is well advanced towards completion.

In the most recent number of the *Bulletin de la Société de Géographie*, M. Jules Marcou continues and concludes an account of his investigations into the origin of the name America. He rejects, for very many reasons, which will be found in the contribution in question, the ordinary derivation—that is, from the Christian name of Vespucci, the Italian navigator. Vespucci, he says, never took the name Amerigo, or Amerigo, till after America was discovered, and, through vanity, he kept up the proud title. The name is an indigenous one, M. Marcou thinks, and means the country of the wind, or the land rich in gold. Four-fifths of the storms which are met with in the Atlantic come from America, and the gold put in circulation by Columbus's discovery explains the second meaning of the term. Between Lake Nicaragua and the Mosquito Coast is a range of mountains called the American Mountains, inhabited by a tribe of Indians, now very few in numbers, who bear the name, "Los Ameriques," and who have been, according to the President of the Nicaraguan Republic, who supports this view, continually in communication with the whole of the Mosquito Coast. Columbus, and not Vespucci, was the discoverer of America, and the country was named from this place and these people, and not from Vespucci, who was a man of no importance, until he either took the name of Amerigo, or until it was given him.

CAPTAIN CECCHI, Italian Consul at Aden, sends to the *Bollettino* of the Italian Geographical Society some further particulars of Count Teleki's expedition to the north of Masai Land, and his discovery of the two lakes Samburu (Upper and Lower Narok) in that region. The explorer, who was accompanied by Lieut. L. von Höhnel, of the Austrian Navy, after ascending Mount Kenia, reached the Niems territory on November 21, 1887, and was detained there till the following February. On the 10th of that month the party continued their journey in a northerly direction, and on March 6 arrived on the southern shore of the large lake Samburu (Upper Narok), to which Count Teleki gave the name of his intimate friend, the late Crown Prince Rudolph. The much smaller basin of the Lower Narok, which was also re-named Stephania, in honour of the Crown Princess, was reached on April 4, after which the Expedition returned to the coast at Mombasa. At the northernmost point to which they penetrated (nearly 6° N. lat.) they were within about seventy miles of the Kafia country, and they describe the two rivers flowing thence southward to the northern extremity of Lake Rudolph as "very important streams." This agrees with the results of Sig. Borelli's explorations in the region south of Shoa, and makes it highly probable that one of these two rivers is the Omo (Ghibieh), which in that case would be an affluent, not of the Juba or of the White Nile, but of the inland Samburn basin, lying between those two water-systems. To the same basin belongs Lake Stephania, which communicates with the northern extremity of Lake Rudolph, about lat. 4° 20' N. The expenses of this important expedition were entirely borne by Count Teleki, who is a wealthy Hungarian nobleman. Captain Cecchi's letter is accompanied by a map of the two new lakes prepared from Lieut. von Höhnel's original sketch.

SIXTH ANNUAL REPORT OF THE FISHERY BOARD FOR SCOTLAND.

THE Report for 1887 is published in three separate parts—a plan which will be found convenient in many ways. Part I. contains the General Report; Part II., Report on Salmon Fish-

eries; and Part III., the Scientific Investigations. The product of the sea-fisheries of Scotland continues to be very large, but in 1887 the prices of most kinds of fish were much lower than they had been for a great many years previously; the fishermen only received a very small return for their capital and labour, and many of them were reduced to a state of extreme poverty. Of the different fisheries of Scotland, that of the herring continues to be by far the most productive and valuable. The fishing of 1887 was less so than that of 1886, but, owing to the great depression in the herring trade, it was not entered into nor carried on with the spirit and industry of more prosperous times. The summer's catches of herring were, speaking generally, much inferior to those of 1886, but the winter herring fishery was the most productive ever known. With yearly fluctuations, the yield of the herring fishery on the Scottish coast has, since the beginning of the century, gone on increasing in an extraordinary degree. The total quantity of white fish landed and sold for consumption fresh showed a large increase compared with 1886, being the largest landed in any year during which returns have been collected; whilst the shell-fish showed a considerable decrease. The total gross value of the sea-fisheries of Scotland for 1887 was £1,915,602 10s. The Board are much impressed with the beneficial results to fishermen and curers arising from increased telegraphic communication, which, when further developed, will be of immense value for the promotion of the fishing industry. It is satisfactory that thirteen new telegraph stations are to be opened in remote districts; also that a number of harbours are being improved or constructed. The marine police and fishery superintendence was carried on by H.M.SS. *Jackal*, *Vigilant*, *Firm*, and *Active*.

The inference from Mr. Young's Report on the oyster and mussel fisheries on the south-west coast of Scotland is that there are many places where the cultivation of these mollusks might be renewed or established, but that, to make this of any permanent use, such nurseries should be the property of someone whose interest it would be to make the concern profitable to the public and himself, of course under proper legislation. In the salmon fisheries, owing to the dryness of the season, the angling was very poor, but the nets, especially those in the tide-ways, were very successful. The total value was £282,523 10s.

The third part of the Report, consisting of 400 pages and 17 plates, contains the results of the scientific work. The text is divided into three sections, and is preceded by a general statement, which touches upon the scientific work done in 1887, and draws attention to the matters requiring special attention in the immediate future—viz. (1) how adequate supplies of bait for the line fishermen may be best provided. (2) What measures should be taken to improve certain exhausted fisheries of the shores and in-shore waters, such as mussels, lobsters, oysters, &c., by artificial cultivation, or otherwise. (3) The collection of all possible information bearing upon the influence of different modes of fishing, especially in the territorial waters, and in relation to the destruction of young fish. (4) The study, by means of the *Garland* and otherwise, of the distribution, migrations, and spawning periods of the edible fishes, and of the distribution and movements of the floating organisms which form a large portion of their food. (5) The extension of our knowledge regarding the physical conditions of the fishing-grounds and of the waters around the coast. (6) The collection of special statistics in relation to the fisheries of particular districts. The value and utility of such investigations and inquiries is manifest. It is very desirable that some measures should be taken with the object of providing a plentiful supply of bait for the line fishermen. The condition of certain of the shore fisheries is also a subject of considerable gravity. The oyster, as an article of commerce, is becoming slowly but surely extinct in Scotland, the total value of the yield for 1887 being only £965. The diminution in the numbers and in the size of the lobster has been referred to, and it will be an unfortunate circumstance if, for the want of active steps being taken, this important branch of the Scottish fisheries, now rapidly falling off, is allowed to follow the oyster in the process of practical extinction.

Section A of the appendixes contains the general scientific reports, the longest of which is that on "The Trawling Experiments of the *Garland*, and the Statistics of the East Coast Fisheries," Part 2, by Prof. Cossar Ewart and Sir J. R. G. Maitland, illustrated by three admirable charts, a map showing the chief areas investigated by the *Garland*, and about 130 pages of elaborate and accurate statistical tables. The influence of

excessive beam-trawling in the in-shore waters has formed the subject of several Parliamentary inquiries; but from want of trustworthy statistics or scientific evidence the conclusions arrived at have not always been in agreement. The result of the *Garland* experiments and the statistics collected shows that in those areas where trawling is prohibited, the fish, especially the flat-fish, have largely increased and the number of young fish is greater than formerly. The results of the *Garland's* investigations as to the distribution of edible fishes, their numerical variations at different seasons, and the proportional abundance of young and adults are also given, and the scientific statistics collected are discussed in detail. It is evident that by the systematic collection of scientific statistics regarding the productiveness of the fisheries and the relative influence of special modes of fishing, the migration, the spawning processes, and the general life-history of the fishes themselves, a great deal will be accomplished for the promotion of the fishery industries of Scotland. In this connection it will be seen that the investigations carried on by the *Garland* are calculated to have a high value, since the data thus collected are wide in their scope, systematic, and trustworthy. Without the use of a vessel specially adapted for the purpose such investigations would be impossible.

Section B contains the biological investigations. The paper on "The Scottish Lobster Fishery," by Prof. Ewart and T. Wemyss Fulton, M.B., discusses at due length the interesting question as to the best means of restoring this fishery to its old place in our seas and in our markets. Slowly but surely lobsters have been diminishing in size and number and rising in price; and our once famous home lobster market has to be supplemented by supplanting foreign supplies, simply because Scotch lobsters cannot be got in sufficient numbers of a marketable size. The older and most valuable lobsters have been cleared out, and the less mature forms are being drawn upon. Unfortunately also, the female lobster being much more valuable for cooking purposes, the "coral" is sometimes collected alone, and so, by the systematic destruction of its ova, the lobster is seriously handicapped in the struggle for existence. The use of "creels" or "pots," instead of the older-fashioned "rings," has been also an important factor in bringing about the "over-fishing." The legislation of lobster-fisheries is a very difficult matter, and in Canada, where the restrictions are very severe, they have failed in their aim. It is impossible to set one fixed close-time all over Scotland, as there is no general agreement among fishermen as to which time would be most serviceable. The institution of a minimum legal size is a regulation generally adopted, and it is proposed that the gauge of 8 inches should be raised to 9 inches. Further, that, as in Norway and the United States, artificial culture should be resorted to. By artificially hatching the eggs and rearing the young through the larval stages till they have reached a certain size, they are protected from their natural enemies, and if then transferred to the sea would be better able to take care of themselves. That the process is feasible has been shown both in Norway and the United States. A complete lobster-hatchery could be established for a comparatively small sum at some suitable point on the west coast. Unless some steps be taken, the lobster fishery of Scotland is likely to become the memory of a pleasant and profitable past. Mr. Thomas Scott gives in interesting detail, a "Revised List of the Crustacea of the Firth of Forth," which records 230 species, including 41 of Ostracoda, 42 of Copepoda, and 13 Schizopods. Of these species many are new to the district, and two Copepods—*Astroirogus papillatus* and *Cyclops ewarti*—new to science. This list is a valuable addition to our knowledge of the Crustacean fauna of this region, previously studied by Leslie, Herdman, Henderson, and others. Mr. Scott also supplies notes on the contents of the stomachs of herring and haddock, and on interesting fishes, &c., sent to the University of Edinburgh. The nature of "red cod," a fungoid condition sometimes met with in the preserved fish, is described by Prof. Ewart; Dr. Edington furnishing and figuring the results of a bacteriological investigation as to the nature of the organisms present, and the cause of the red coloration. Red cod was first noticed in America, but has since been observed in various places, including two as far apart as Algiers and the Hebrides. Used as food in this state, the results may be disagreeable or even dangerous. It was generally referred to the presence of a minute Fungus (*Clathrocystis roseo-persicina*), but Dr. Edington ascribes it to a special Bacillus (*Bacillus rubescens*), which also existed in the salt used for curing, and thus infected the fish. Mr. W. L. Hoyle reports on biological investigations in the sea to

the west of Lewis during July and August 1887, and gives a list of the various forms obtained. Prof. McIntosh, F.R.S., gives Reports from the Marine Station at St. Andrews. These deal chiefly with the stages of development in several of the food-fishes, and with the Annelids and other forms used as bait. Mr. Calderwood furnishes notes on an intra-uterine specimen of the porbeagle (*Lamna cornubica*); and Mr. J. Murray on the fishing-grounds of the Stonehaven district, of which he is officer. A new and edifying feature of the Report is furnished by Dr. Wemyss Fulton's account of contemporary work relating to the scientific and economic aspects of the fisheries. The contemporary work carried on in England and Ireland, United States, Germany, Norway, Denmark, Holland, Italy, and Japan is also summarized.

Section C, which is devoted to the physical investigations, contains three papers: on the apparatus required for carrying on physical observations in connection with the fisheries, and on a physical and chemical examination of the water in the Moray Firth and the Firths of Inverness, Cromarty, and Dornoch, by Dr. John Gibson and Dr. H. R. Mills, the latter also reporting on the physical observations on the sea to the west of Lewis, taken during the cruise of the *Jackal*, as described previously by Mr. Hoyle. These papers are illustrated by ten graphic plates, with tables, charts, &c.

As may be seen from the foregoing abstract of the Report, the Scottish Fishery Board is doing good and trustworthy work in many directions, and, from a scientific and commercial point of view, it deserves every encouragement by the Government and the public. It would be an important aid if, by interchange of [publications, the Board could be kept in touch with the important fishery organizations abroad. Unfortunately, at present the number of copies of the Report placed at the disposal of the Board renders this impossible. This should be remedied speedily, as, from an economical point of view, there should be the freest circulation of knowledge on questions touching such an important industry.

SCIENTIFIC SERIALS.

Revue d'Anthropologie, troisième série, tome iv. (Paris, 1889).—The Hottentots in the Paris Garden of Acclimatization, by M. Deniker. As the group consists of only six men, five women, and two children, the observations and anthropometric measurements made by the author cannot be regarded as contributing any very important facts to general ethnological inquiry. To French readers the subject has, however, the interest of novelty, since it would appear that the physical conformation of these South Africans has not hitherto been often made the subject of careful study among French ethnologists owing to their lack of opportunity for examining the living subject or measuring the cranial remains of the people, since the Museums of France contain scarcely more than thirty skulls in all, including both Hottentots and Bushmen. The observations of M. Deniker agree generally with those of Profs. Flower, Virchow, and Davis; and like them he believes that we must regard the Hottentot as belonging to the dolichocephalic type, while the Bushmen must be included under the mesocephalic group, the cephalic index being, however, nearly the same, 73, for both. The women of the party all presented the well-developed steatopygia, which is generally admitted to be a national characteristic of the sex, this condition being specially marked even in one of the elder women whose body was almost emaciated in all its other parts. A curious abnormality was noted in two of the men, and in one woman, who presented an interdigital membrane between the second and third toes, affecting both feet in one case.—M. S. Reinach in an article on the museum of the Emperor Augustus, whose collection of bones and arms is referred to by Suetonius, points out that owing to inexact interpretations the precise meaning of the writer has gradually been more and more distorted. M. Reinach thinks that we must seek for the site of this so-called museum at Capri, and not on the Roman Palatine, as M. Nadaillac supposes; while he believes that the "*gigantum ossa*" spoken of by Suetonius were fossil bones, popularly characterized as "*arma heroum*." This opinion, the author thinks, derives support from the story of Samson slaying the Philistines with a jaw-bone; animal bones having been found by primitive peoples to be more readily available as weapons than implements of stone, which required labour for their fabrication. There is no doubt, moreover, from a reference in the Vedic

hymns to the weapons of Indra, that animal bones were used among the early peoples of the East for purposes of offence and defence.—Continuation of Dr. Seeland's notes on Kashgaria and the passes of the Tian-shan. The author's description of the city of Kashgar, which lies on an extensive elevated plateau 3750 feet above the level of the sea, shows that the spot described in such glowing terms by Marco Polo is now nothing more than a confused network of foul, narrow, and tortuous streets, the houses of which lack every requirement of comfort, and almost of decency, as judged by our notions. The dwellings of the richer people have indeed large gardens filled with luxuriant fruit-trees, but the modern traveller would seek in vain for the shady groves, sparkling fountains, splendid mosques, spacious baths, rich bazaars, and lovely women, spoken of by the old Venetian writer. The ethnic type of the Kashgarians is clearly that of a deteriorated mixed race, in which the original Aryan or Turkish character has been nearly obliterated by repeated admixture with different Mongol races. The Chinese officials, under whose rule the people have long languished, effectually prevent all improvement in the country or the people, as is sufficiently shown by Dr. Seeland's account of the mode in which they govern this once fertile region. Indeed, nothing can be more deplorable than the account given of the personal appearance, character, and sociology of the Kashgarians, who exhibit the most marked slovenliness and incapacity, with a melancholy and passive temperament; and whose only pleasures are derived from an excessive abuse of narcotics, accompanied by a marked degree of sexual depravity, which they have possibly acquired through their intimate association with the Chinese. It fact, honesty seems to be the only virtue left to the Kashgarian. The account given by the author of the effect of Chinese rule in this part of Asia Minor agrees with the views of the late M. Prjevalsky, and certainly seems to warrant the conviction cherished by these travellers that the only apparent chance of ameliorating the condition of the people would depend upon the annexation of Kashgaria to the Russian Empire.—The race of Lagoa Santa of Brazil, by Dr. Soren Hansen. The bones found by M. Lund in the caves of Lagoa Santa were mostly deposited in one of these numerous recesses. These human remains were not associated with any animal bones, from which it could be determined with absolute certainty whether they were contemporaneous with a Tertiary or a Quaternary fauna, while the absence of every kind of implement left the antiquity of the race equally uncertain. These remains, which include fifteen more or less entire skulls, besides a very large number of bone fragments belonging to persons of all ages, are preserved in the Zoological Museum of Copenhagen. All the crania present remarkable uniformity with two skulls, respectively preserved in the British Museum and at Rio, which have been referred by M. Quatrefages to a Papuan type, and they appear to give support to his opinion of the existence over the greater part of South America of a primitive dolichocephalic race, which was subsequently intermingled with peoples presenting a brachycephalic character.

Notes from the Leyden Museum, vol. xi. No. 1, January 1889, contains twenty articles, chiefly descriptions of new genera and species of insects. The more important entomological papers are: Dytiscidæ et Gyrinidæ nouveaux ou rares, par M. Régimbar; Neue Coleopteren, beschrieben von E. Reitter; and a note on *Macronota apicalis*, G. and P., by J. R. H. Neervoort van de Poll.—There are two interesting papers by Dr. R. Horst, on a remarkable Syllis bud, with extrudible segmental organs (plate 1); and contributions towards a knowledge of the Annelida Polychæta (plate 2). This latter note, treats about the species of the genus *Arenicola* found at Naples: these are *A. claparedi*, Levensen, possibly peculiar to the Mediterranean, but should be looked for on our southern coasts; *A. cristata*, Stimpson, originally described from South Carolina, but now found at Naples; *A. grubii*, Claparède, very common in the Gulf of Naples.—Dr. F. A. Jentink gives notes on a collection of mammals from East Sumatra, based on the collections made by Dr. B. Hagen. The orang-utan is to be found along the coasts of the northern half of East and West Sumatra, and among the other mammals, hitherto not recorded from Sumatra, though known to occur in Borneo, are *Arctogale stigmatica*, *Hemigalea derbyana*, *Herpestes brachyurus*, *Cynogale bennetti*, *Ptilocercus lowii*, and *Rhizomys dekan*.—Mr. J. Büttikofer gives notes on a new collection of birds from South-Western Africa (plate 4). The collection was made at Gambos, in the Upper Cunene region; it contained 267 skins, representing 103 species, of which

number 49 were not mentioned in Mr. Büttikofer's previous list; two species are new, *Lophocercs alboterminatus* and *Francolinus jugularis*.

THE longer papers in the *Nuovo Giornale Botanico Italiano* for January are almost entirely floristic, relating to the phanerogamic or cryptogamic flora of particular districts of Italy.—Signor G. Arcangeli describes a remarkable monstrosity of *Narcissus Tazetta*, in which the "corona" is divided into six petaloid leaves.—In the Reports of the meetings of the Società Botanica Italiana, the same botanist follows up his account of the structure of the seed of *Euryale ferox* by a description of those of our common water-lilies, *Nymphaea alba* and *Nuphar luteum*. They all agree in the occurrence of a scanty endosperm, consisting from one to four layers of cells, and a very copious perisperm.—Signor R. Pirota describes the mode of fertilization of *Amorphophallus Rivièri*, which is effected almost entirely by a number of different species of Coleoptera.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 15, 1888.—"Observations upon the Electromotive Changes in the Mammalian Spinal Cord following Electrical Excitation of the Cortex Cerebri. Preliminary Notice." By Francis Gotch, Hon. M.A. Oxon., B.A., B.Sc. Lond., and Victor Horsley, B.S., F.R.S., Professor of Pathology, University College, London. (From the Physiological Laboratory of the University of Oxford.)

Hitherto pathologists have attempted the analysis of the epileptic convulsion by the graphic method—that is, by recording the spasmodic contractions of the muscles involved. Recent investigations of this kind have shown that the excitation of the cortex cerebri, whether by electrical or chemical means, or by the presence of certain pathological states, neoplasms, inflammation, &c., is invariably followed in the higher mammals by a definite and characteristic sequence of movements in the muscles. It is, however, obvious that such investigations have up to the present succeeded in determining the characters of the neural disturbance only when this has reached the peripheral terminations of the efferent nerves. Now since the excitatory processes originating in the cortex are conducted by the efferent channels in the spinal cord, presumably the pyramidal tracts, the problem of their relationship to the centres of the bulbo-spinal system cannot be determined by experiments which record the mechanical changes in the muscles. In order to ascertain what share respectively the centres in the cortex and those in the spinal cord have in the production of the characteristic epileptic sequence, the action of the latter must be eliminated. This can be done by investigating the nature of the excitatory processes in the cord when the efferent channels in the dorsal region for the lower limbs are made the subject of observation.

For this purpose we determined to obtain, if possible, evidence as to the nature of the excitatory processes of the epileptic convulsion in the spinal cord, as shown by "tapping" the cord and noting the electromotive changes which, as is well known, accompany functional activity in nerves. The results we have already obtained are so harmonious and demonstrative, that we venture to make this preliminary communication, reserving full details for a subsequent account.

PART I. *The Electromotive Change following a Single Excitation of the Mammalian Nerve.*

Our first experiments were made for the purpose of ascertaining to what extent we could detect an electromotive change following a single excitation of a mammalian nerve. Since the discovery by du Bois-Reymond of the fact that the excitatory process in nerve is accompanied by an electromotive change, the characters and time relations of this change have been investigated by various observers, notably by Bernstein, Hermann, Hering, and Head. The general result of their observations is to show that the change following a single stimulus is of very short duration, so short that the galvanometer gives little evidence of its presence, and the observers referred to were compelled to adopt the device first employed by Bernstein, which involves repeated excitation and consequent summation of effect, a method well known to physiologists as that of the repeating differential rheotome. For our purpose it was essential to obtain evidence of the effect following one stimulus only, and this we were fortunately able to do by using a sensitive Lippmann's capillary electrometer of quick reaction, made by Mr. G. F. Burch, and

belonging to Dr. Burdon Sanderson, who kindly placed it at our disposal. This instrument, when the capillary was magnified 400 times by the observing microscope, gave a perceptible response when connected through a resistance of 10,000 ohms for one-thousandth of a second with an electromotive difference of only 0.003 D. The amount of movement of the mercury was estimated by the divisions of a micrometer eye-piece, one division of which indicated an actual movement of $\frac{1}{100}$ of a millimetre. After we had found that the electrometer, when connected with the transverse and longitudinal surfaces of the sciatic nerve of the toad, showed a response of one division following the application of a single stimulus, whether electrical or mechanical, we proceeded to the examination of the sciatic nerve in the rabbit, cat, and monkey. For these experiments the animal was in every case kept under the influence of ether, which was maintained throughout the whole experiment, and the animal was killed before recovery. The sciatic nerve seemed for many reasons the most suitable of the mammalian nerves. It can be quickly prepared for 7 or 8 cm. of its length, its nutrition is well preserved, since the *arteria comes nervi ischiadici* can be left uninjured, and its diameter lessens the dangers of drying.

The nerve, having been rapidly prepared and bathed in warm saline solution, 0.6 per cent., was ligatured low down in the thigh, the ligature including the popliteal trunks. It was then divided on the peripheral side of the knot, and raised in air so as to be at right angles to the limb. One kaolin pad of a non-polarizable electrode was applied to the cut end, and another to the longitudinal surface at a distance of 1.5 cm. A pair of sheathed exciting platinum electrodes, 2 mm. apart, was then applied to the trunk of the nerve 6 cm. centrally from the nearest leading-off electrode, *i.e.* opposite the sciatic notch. The exciting stimulus was obtained by the break of the current of a single Callaud cell supplying the primary coil of a du Bois-Reymond inductorium graduated by Kronecker. The break shock produced in the secondary coil by this means was so feeble as to be barely perceptible on the tip of the tongue when the secondary coil completely covered the primary. The break was effected by the spring rheotome, which opened a fixed key at a definite point in its course. The electrometer was connected with the non-polarizable electrodes by a circuit which included the usual compensator. By means of a switch the electrometer could be cut out, and the circuit made to include a high resistance galvanometer, which also revealed the single variation. The two instruments could be thus readily compared. The excursion of the mercury of the electrometer was ascertained both by direct observation in terms of the divisions of the micrometer eye-piece, and by photographing the projected capillary upon a moving sensitive plate; in the latter case the capillary was magnified 100 times. The results of our observations are briefly as follows:—

The mammalian nerve showed a well-marked difference or demarcation current—that is to say, the electrode upon the longitudinal surface was notably positive to that on the cut end. The movement of the mercury corresponding to this difference amounted in some cases to 60 divisions of the micrometer, and was produced by an electromotive force which was estimated as from about 0.01 to 0.015 D. The passage of the single break induction shock through the platinum electrodes in either direction was followed by a small quick movement of the mercury, which was invariably in the opposite direction to that produced by the demarcation current. Its amount varied in different animals from 1 to 2.5 divisions of the micrometer eye-piece, and was photographed. After severing the nerve from the bulbo-spinal system above the exciting electrodes, the same effect was obtained; its character, as shown by the movement of the mercury, was, however, different, being as we believe much shorter in duration and less in amount. But, our experiments not being directed to the elucidation of this point, we will not speak positively with regard to it. After a time, varying in different cases from twenty minutes to three-quarters of an hour, the effect was no longer visible. We convinced ourselves that the movement we obtained and photographed was due to the electromotive change which accompanies the propagation of an excitatory state along the mammalian nerve when this state is evoked by the application of a single stimulus.

PART II. *Excitation of the Cortex Cerebri.*

A. *Mixed Spinal Nerve connected with the Electrometer.*—In two cases we have connected in the manner described in Part I. the sciatic nerve with the electrometer, and have then exposed

by a small trephine opening the so-called motor cortical centre for the lower limb. This we then excited by a very weak but adequate faradic current. So far, however, we have not been able to detect any movement in the mercury, although the muscles of the investigated limb supplied by the anterior crural nerve were thrown into a state of active convulsion. It is probable that the character of the neural disturbances in the mixed nerve may be best studied by investigations which we shall shortly undertake upon the electromotive changes in the muscles.

B. *The Spinal Cord connected with the Electrometer.*—The experiments, the results of which are now to be briefly detailed, were made in the following manner:—

The spinal cord of the etherized animal (cat and monkey) was exposed in the lower dorsal region for about 4 cm., and as low down as the upper end of the lumbar enlargement. Great care was taken by bathing with warm saline to guard as much as possible against the dangers of error due to cooling and drying. The dura mater having been split longitudinally, a strong thread was passed round the spinal cord at the lower limit of the part exposed. It was tied firmly and the cord divided below the knot. By successive division of the two or three roots exposed in the intervertebral foramina, the cord was easily raised from the neural canal and suspended in the air without any great interference with the circulation in the longitudinal vessels.

One of the non-polarizable electrodes was then brought into contact with the cut end of the cord and the knotted ligature, while the other was connected with the longitudinal surface of the cord 2 cm. from the cut end by means of soft thread cables soaked in saline solution and tied loosely round the cord. In one experiment the connection was with one lateral column only. Mass movements of the electrodes upon the spinal cord were suitably guarded against, though it was found that the cord might be shaken without producing any effect in the electrometer.

On connecting these electrodes with the electrometer a considerable electromotive difference was found to exist between the contacts, the excursion of the mercury being so great, *i.e.* beyond the field of the microscope, that its amount could not be estimated in terms of the micrometer eye-piece. The cut surface was always negative to the longitudinal surface, and the amount of the difference as estimated by the compensation method was about 0.02 D. It appeared to be highest when the section passed through the dorsal region without involving the lumbar enlargement. A difference between the surfaces of the cord has been previously observed by du Bois-Reymond.

The cortex cerebri was now exposed and the exciting circuit prepared. The inductorium previously employed was again used with one Daniell cell in connection with the interrupter of primary coil and the Helmholtz side wire. The exciting electrodes had platinum points 2 mm. apart.

The demarcation current having been compensated, and the electrometer placed in connection with the non-polarizable electrodes, the motor area for the lower limb was excited. The results of the observations made upon four monkeys and several cats may be summed up as follows:—

(1) The application of the exciting electrodes to the cortex was without exception only followed by a movement in the electrometer when the area of representation of the lower limb was touched, and this even when owing to prolonged excitation of the arm area the upper limb was in violent epileptic convulsion. We found that when the exciting electrodes were moved over the surface of the brain the observer at the electrometer only gave notice of a movement in the instrument when the person exciting had crossed the margin of representation of the limbs. This shows that electromotive changes in the cord sufficient to affect our instrument occurred only when the motor area of the lower limb was excited. All error due to escape is thus set on one side, while at the same time this remarkable fact confirms the localization of function.

(2) The excitation of the motor area for the lower limb was accompanied and followed by characteristic movements of the mercury. The excitation by means of the interrupted current usually lasted for three seconds—that is, about 300 equal and alternately directed induction currents passed through the excited tissue. During this period the mercury showed an excursion opposed in direction to that of the difference between the longitudinal surface and cut end of the cord. This excursion persisted as long as the excitation lasted, and ceased when this was left off. Then after an interval of from one to three seconds there ensued a rhythmical succession of excursions each opposed

in direction to the resting difference, some apparently single and others multiple. These lasted from twenty to thirty seconds and suddenly ceased.

We have repeated this observation thirty or forty times, and feel ourselves justified in concluding that we have obtained evidence that during a cortical epileptiform discharge the electro-motive changes in the spinal cord are exactly parallel as regards the character of their sequence to the convulsions of the muscles as recorded by the graphic method. It remains to be stated that after removal of the cortex we have obtained an effect in the electrometer when the corona radiata was stimulated. This effect was only present during the period of excitation, no rhythmical after effect ever being observed. Its character was prolonged, and resembled the first persistent stage referred to above.

In conclusion, we consider that, since by the method we have adopted the influence of the lumbar bulbo-spinal centres is excluded, the existence of the epileptic rhythm in the dorsal regions of the spinal cord points to its being almost entirely of cortical origin.

Physical Society, February 23.—Prof. Reinold, President, in the chair.—Dr. J. W. Waghorne read a note on the measurement of electrical resistance, showing that two resistances may be compared by joining them in series with a battery, and observing the deflections of a galvanometer connected successively with their terminals. The resistances are proportional to the currents which pass through the galvanometer in the two cases, provided they are large compared with that of the battery, or are not very different from each other. By using a rocking key, the method is rendered expeditious, and the galvanometer resistance need not be known.—On a new polarimeter, by Prof. S. P. Thompson. The author gave a *résumé* of the ordinary methods of determining the position of the plane of polarization, pointing out their advantages and disadvantages; and exhibited his new polarimeter, in which two black glass mirrors, placed at a small angle (about $2\frac{1}{2}^\circ$), are used to polarize the light in two different planes. By using a modified Nicol as analyzer, the plane can be determined to one-tenth of a degree, when the substance examined does not absorb much light; but, for dark-coloured liquids, the author prefers to use one of his "twin prisms," described before the British Association in 1887, as polarizer, in which the planes of polarization are 90° apart. A method of dividing a polarized beam into two parts inclined at a variable angle, by means of a combination of quarter-wave plates of mica, was described, in which the two halves of the field are similarly coloured. Mr. Glazebrook considered Poynting's glass cell, with different thicknesses of active solution, a very convenient means of obtaining two beams polarized at a small angle, as, by altering the strength of the solution, the angle may be varied at will.—Prof. Thompson also read a note on the formation of a cross in certain crystal structures. Several specimens (including benzoic acid, stalactite, Eno's salt, &c.), which exhibit a radial structure, and show a cross when examined by polarized light, were thrown upon the screen, and the fact that the cross remains stationary when the specimens are rotated demonstrated. Similar effects were produced by mica sectors arranged radially, thus showing the stationary cross to be caused by the light not being analyzed in those directions.—On electrical measurement, by Prof. W. E. Ayrton, F.R.S., and Prof. J. Perry, F.R.S. In a paper on winding voltmeters, read before the Society in 1885, the authors showed, on the assumption that the thickness of insulating covering on wires was proportional to their diameter, that instruments wound with copper wire gave a less heating error than similar ones wound with German silver. Since then, platinoid has been introduced, and the electrical constants of phosphor-bronze determined. Further, a remarkably simple relation between the volts corresponding to a given deflection on a given type of instrument, and the resistance per unit length of the wire used in winding it, has been suggested by Mr. Crawley. Suppose F = number of ampere turns required to produce the deflection P , and U the half area of section and volume of the coil respectively, and d and D the diameters of the bare and covered wires, then—

$$A = \frac{F}{n}, \quad n = \frac{P}{D^2}, \quad r = \frac{4\rho}{\pi d^2}, \quad \text{and } l = \frac{U}{D^2};$$

from these we get—

$$V = Ar = \frac{FU}{P} \cdot \frac{4\rho}{\pi d^2} = K \cdot \frac{4\rho}{\pi d^2},$$

(say) where K is a constant depending on the type of instrument.

Since $\frac{4\rho}{\pi d^2}$ is the resistance per unit length, the volts required to

produce a given deflection are proportional to the resistance per unit length of the wire used, whatever be the material of the wire or thickness of the insulation. Taking this into account, and using a more accurate value for the thickness of the covering, it is shown that the four metals above referred to arrange themselves in the following order of merit when used for high-reading voltmeters—platinoid, phosphor bronze, german silver, and copper; and for comparatively low-reading instruments, the last two change places. As a standard ammeter of great range, a circuit containing a Depretz D'Arsonval galvanometer is shunted by a wide sheet of thin platinoid, and by altering the resistance in the galvanometer circuit, the sensibility may be varied in known proportions. An instrument on this plan has been arranged to measure any current from 0.1 to 800 amperes to one-quarter per cent., and the same galvanometer in series with various resistance coils is used as a standard voltmeter of practically unlimited range. Whilst arranging these standards it has been found that the deflections are not generally proportional to the currents, and the discrepancy traced to the centre of gravity of the swinging coil not being in the line of suspension. By replacing the bottom torsion wire by a long thin spring the defect may be remedied. As relating to calibration curves of instruments, it was mentioned that in "Siemens's dynamometer" the "square law" is not correct, probably owing to distortion of the spring. Referring to "hot wire voltmeters," in which the sag of a wire heated by the current is measured by a magnifying spring, the authors remark that, in their original paper on the subject, they neglected the change of length due to change of stress in the wire, and subsequently their assistant, Mr. Bourne, found that maximum sensibility was never co-existent with minimum sag. The sag which gives maximum sensibility depends on the initial stress in the wire, and by altering the initial sag the instruments may be compensated for changes of temperature of the room. In the present paper the mathematical treatment is more rigorous, and the results are in accordance with experiment. A voltmeter intended for use with "electric welders," which deflects about 300° for 2 volts (direct or alternating), and is graduated to 1/100 of a volt, was exhibited, and used to measure the resistance of a storage cell. Dr. Thompson suggested that the want of proportionality of D'Arsonval galvanometers might be due to lateral displacement of the coil caused by the current in the torsion wires crossing a magnetic field, but from experiments with pivoted coils the authors thought this improbable.—Prof. Rücker read a note on the dimensions of electro-magnetic units, by Prof. G. F. Fitzgerald, F.R.S., which suggests that specific inductive capacity and permeability be assumed to be of dimensions $\left[\frac{T}{L}\right]$ (slowness); if this be done the dimensions of quantities expressed in electrostatic and electro-magnetic measure become identical. The author also states that it seems most likely that inductive capacities are related to the reciprocal of the square root of the mean energy of turbulence of the ether. Prof. Rücker remarked that in his recent paper on the subject he considered it important to retain K and μ as secondary fundamental units, and Mr. Blakesley did not concur with Prof. Fitzgerald's suggestion.—A photograph of crystal models, by Mr. R. T. Anderson, of Belfast, was exhibited at the meeting.

Chemical Society, February 21.—Mr. W. Crookes, F.R.S., in the chair.—The following papers were read:—Note on the decomposition of potassic chlorate by heat in the presence of manganic peroxide, by Prof. H. McLeod, F.R.S. The author concludes from his experiments that the reaction which ensues when potassic chlorate is heated with manganic peroxide most probably consists in the formation of potassium permanganate, chlorine, and oxygen in the first instance; that the permanganate as rapidly as it is produced is decomposed by the heat into potassic manganate, manganic peroxide, and oxygen; and that the resulting potassic manganate is acted on by chlorine generated by the action of the peroxide on some fresh chlorate, forming potassic chloride, manganic peroxide, and oxygen, so that the peroxide is being continually reproduced. The quantity of chlorine evolved corresponds to only a very small proportion of the manganic peroxide present, so, if the first action really takes place, the chlorine must be absorbed and employed in converting the potassium into chloride.—The vapour-density of hydrogen

fluoride, by Prof. T. E. Thorpe, F.R.S., and Mr. F. J. Hambly. Gaseous hydrogen fluoride, on being heated from a few degrees above the boiling-point of the liquid, shows a rapid decrease in density, owing to the dissociation of H_2F_2 molecules ultimately into HF molecules, the course of the dissociation being similar to that observed in the case of nitrogen peroxide and acetic acid. The density of the gas at about 32° corresponds with that required for a molecule H_2F_2 , but a careful study of the molecular breaking down of the vapour as it is effected by changes of temperature and pressure shows that there is no evidence for the existence of such a molecule. At a temperature of $26^\circ.4$, the lowest temperature observed, the density of the gas corresponds with a molecular weight of 51.2 ($\text{H}_2\text{F}_2 = 60$), and from this point the process of dissociation is perfectly continuous until the temperature increases to about 60° , when the density corresponds with that of a vapour consisting wholly of HF molecules. In the discussion which followed the reading of the paper, Prof. Ramsay said that Prof. Thorpe, in speaking of the analogy of the results obtained in the case of hydrogen fluoride with those of the brothers Natanson for nitric peroxide, had pointed out that these latter afforded insufficient proof of the higher limiting value of n in the formula N_nO_{2n} ; and that this limiting value was also unknown in the case of acetic acid, of which the vapour-density also increased with fall of temperature. Now there were three separate lines of argument leading to a knowledge of the higher limiting formulæ of these bodies which had been pointed out by himself and Dr. Young, and of which the data were to be found in papers published in the Philosophical Transactions, in the *Philosophical Magazine*, and in the Chemical Society's Transactions. The first of these has reference to the alteration of density of the saturated vapour with fall of temperature and corresponding fall of pressure. It is argued that the density of the vapour of a substance must necessarily, at any given temperature, be higher when the vapour is on the point of condensation than when it is unsaturated. Hence, if it can be proved that the density of the saturated vapour of bodies like nitric peroxide and acetic acid shows no signs of increasing beyond those required for the respective formulæ N_2O_4 and $\text{C}_4\text{H}_8\text{O}_4$, such formulæ must denote the limit of complexity of the molecules, in the gaseous state at least. To ascertain such a limit, Dr. Young and the speaker constructed from the Natansons' data for the relations of volume, pressure, and temperature of nitric peroxide, and their own data for the vapour-pressure of that body, isothermal curves in which pressures formed ordinates and vapour-densities abscissæ. The terminal points of such curves are characterized by rapid increase of density without rise of pressure, and, in fact, denote that the substance is no longer in the gaseous state, the vapour-pressure of the liquid having been reached. The densities of the saturated vapour therefore will correspond with the angles of union of the isothermal curves with horizontal straight lines representing condensation to liquid under vapour-pressures constant for each temperature. By joining with each other such angles of union for each temperature a curve is obtained expressing the densities of the saturated vapour in relation to pressure. It is evident from inspection of such a curve for acetic acid, shown in a plate in the Transactions of the Chemical Society, 1886, 806, that the line of zero-pressure would be cut at the density 60, corresponding with the formula $\text{C}_4\text{H}_8\text{O}_4$; a similar curve can be constructed from the Natansons' results and Ramsay and Young's determinations of the vapour-pressures of nitric peroxide, and this intersects the line of zero-pressure at a point corresponding with the vapour-density 92, equivalent to the formula N_2O_4 . The second argument is as follows: Representing the relations of temperature and pressure of a "perfect" gas for any given constant volume, $p = c \cdot t$, where c is a constant and t absolute temperature. This is the equation to a straight line; such a line is termed an *isochoric line* or *isochor*; its point of origin for a perfect gas is absolute zero of pressure and temperature. If a different volume be chosen, the slope of the line is different. Now it is clear that if a given volume of gas contains $2n$ molecules, pressure will rise with rise of temperature at twice the rate that it would if the given volume of gas contained n molecules. Constructing for nitric peroxide and for acetic acid, on the assumption that they are perfect gases, diagrams showing the relations of pressure and temperature for the formulæ NO_2 and $\text{C}_2\text{H}_4\text{O}_2$ at such volumes that 1 gramme occupies, say, 1000 c.c. in each case, the resulting straight lines will manifestly differ in slope from those corresponding to the respective formulæ N_2O_4 and $\text{C}_4\text{H}_8\text{O}_4$, the pressure in the latter case not rising so rapidly with rise of

temperature owing to the smaller number of molecules in that volume. But we know that the actual behaviour of these bodies is not that of perfect gases. The line representing the relations of pressure and temperature, should at high temperatures, when the substances exist in the molecular states NO_2 and $\text{C}_2\text{H}_4\text{O}_2$, nearly coincide with the theoretical line for these molecular states; and at low pressures and temperatures with the line denoting the molecular condition N_2O_4 and $\text{C}_4\text{H}_8\text{O}_4$. The data of actual experiment show that such is the case. The S-shaped isochoric curve trends so that it is probable that it would become tangential with that expressing the behaviour of molecules of the higher formula, showing no signs of cutting it as it must needs do were still more complex molecules capable of existence. The third line of argument is derived from the application of Raoult's method to a solution of nitric peroxide in acetic acid, and the results obtained show that the molecular weight corresponds closely with the formula N_2O_4 .—Contributions to the chemistry of lignification: the constitution of the jute fibre substance, by Messrs. C. F. Cross and E. J. Bevan. The authors describe the results of a fuller study of the lignocelluloses (cf. Chem. Soc. Trans., 1882, 90; 1883, 18).—The atomic weight of chromium, by Mr. S. G. Rawson. The atomic weight of chromium, as determined by converting a known weight of ammonium bichromate into chromic oxide, is found to be 52.061.

Linnean Society, March 7.—Mr. Carruthers, F.R.S., President, in the chair.—Mr. J. E. Harting exhibited specimens of a South American Bat (*Noctilio leporinus*) alleged to be of piscivorous habits, and which, through the kindness of Sir William Robinson, the Governor of Trinidad, had been forwarded from that island by Prof. McCarthy, together with a Report on the subject. From this Report, it appeared that the stomach of one specimen, opened within half-an-hour after it had been shot on the evening of December 29, "contained much fish in a finely-divided and partially-digested state." In three others procured at 6 a.m. the following morning, the stomachs were empty. On the morning of December 31, at 3 a.m., numbers of these bats were observed returning to their caves: two were shot, and "both contained considerable quantities of fish." Prof. McCarthy added that in the stomachs of other specimens examined by him fish scales were undoubtedly present. Of the specimens forwarded in spirits to this country, two had been skinned and the stomachs and intestines examined by Mr. Harting. The sac-like stomach was much less muscular than might be expected in a fish-eating mammal; but in one of them (the other being empty) fragments of a finely-striated and iridescent substance resembling fish-scales were found. A discussion followed, in which Prof. Howes and Mr. W. P. Sladen took part, the conclusion being that, although there was no *a priori* improbability in the alleged piscivorous habits of this bat, it could hardly be accepted as a fact until the fragments, supposed to be of fish, were really proved to be so by careful microscopical and chemical examination.—A paper was then read by the Rev. Prof. Henslow on the vascular systems of floral organs, and their importance in the interpretation of the morphology of flowers. The author drew attention to the importance of this class of observations, as supplementing development and teratology; for, by referring all organs back to their "axial traces," their real origins could generally be discovered. Taking the words metaphorically as "floral units," he explained how they can, as it were, give rise to axes as well as to all kinds of floral appendages. Quoting Van Tieghem's definitions of axial and foliar characters, the former was shown to be subject to exceptions. After describing the arrangements of the cords in peduncles and pedicels, in which endogens often have the cords as regularly placed as in exogens, the author explained the different ways by which pedicels and umbels are formed in each class respectively. The "chorism" and union of cords were illustrated and the effects produced. Considerable light was thrown upon the cohesion and adhesion of organs, and the interpretation of the "receptacular tube" and "inferior ovary" was shown to depend upon the undifferentiated state of the organs when in congenital union. The true nature of axile and free central placentas was revealed, so that in the case of the former, with scarcely any exception, the axis takes no part in the structure, all "carpophores," "stylopods," &c., being simply the coherent and hypertrophied margins of carpels. Similarly, the free central placenta of *Primula* received its interpretation as consisting of the coherent and ovuliferous bases

of fine carrels which have the upper parts of their margins coherent in a parietal manner. Illustrative diagrams were exhibited of nearly seventy genera typical of about thirty orders. The paper was favourably criticized by Dr. D. H. Scott, Mr. A. W. Bennett, and Prof. Marshall Ward.

PARIS.

Academy of Sciences, March 11.—M. Des Cloizeaux, President, in the chair.—Fresh experiments with hydrogen peroxide and chromic acid, by M. Berthelot. In previous communications (*Comptes rendus*, vol. cviii. pp. 24 and 157) it was shown that the reactions between chromic acid and hydrogen peroxide also took place with bichromate of potassium, and that this salt has the property of gradually decomposing an unlimited quantity of hydrogen peroxide, remaining itself unchanged. This continuous reaction was attributed to the formation of an intermediate compound incessantly destroyed and renewed throughout the process of decomposition, and the experiments now described tend to confirm this phenomenon.—On the cephaloid organs in the tendons of birds, by M. Ranvier. The organs to which M. Ranvier has given the name of "cephaloid" are here fully described, and their presence determined in the domestic fowl, pigeon, and duck, but not in the lapwing. Where found they invariably present pretty much the same disposition and structure.—Actinometric observations made in 1888 at the Observatory of Montpellier by MM. Houdaille and Mazade, and reported by M. A. Crova. These observations confirm the general laws established by the records of previous years (1883-87), showing that, while the epochs of maximum and minimum intensities vary with the meteorological conditions, the great maximum always occurs in spring, and the secondary in autumn.—On the solar spots, by M. Spoerer. These remarks are made in connection with the author's recent memoir on the periodicity of the solar spots since 1618 (Hallé, 1889), in which the law anticipated by Carrington is definitely demonstrated and formulated. But although the norma for the distribution of spots in heliocentric latitude is established for many past periods, great aberrations are shown to have prevailed during the period between 1672 and 1713. After the reading of the paper, M. Faye pointed out that according to his own theory the spots depended, like the pores, not on irregular eruptions of a volcanic nature, but on the alimentation of the photosphere, an essentially stable process, or at least subject only to infinitesimally slight variations. In the general complexity of the phenomenon, the pores with the faculæ and cloudy protuberances appear to be the more stable elements, and the spots and metallic protuberances more of an accessory character.—On the value of the revolution of the right ascension screw in a meridian instrument, as determined by the observation of the equatorial or circumpolar stars, by M. G. Rayet. This inquiry shows that the determination of the value in question by observing the transit of a circumpolar is not more exact than that resulting from the observation of equatorial stars, and that when practised in the ordinary way, apart from the phenomena of refraction, it leads to systematic errors, that cannot be neglected in researches needing great accuracy.—On the automatic gauging of an artificial feeder, by M. H. Parenty. The method invented by the author, and described by him in the *Comptes rendus*, vol. civ. p. 1427, has been applied with complete success for estimating continuously and automatically the irregular discharge of the Courpalet feeder of the Orleans Canal, all efforts to calculate which had hitherto been baffled by the varying size of the cuttings, its winding course, and almost imperceptible fall.—On transformations and equilibrium in thermodynamics, by M. Gouy. The method already described in the *Comptes rendus* for February 18, 1889, leads to the use in thermodynamics of a new function, which is here described, and which appears to present the advantage of being directly connected with the consideration of cycles.—Relation between magnetic rotatory power and the transmission of luminous waves by ponderable matter, by M. A. Potier. Here an explanation is sought in the views of Fresnel of magnetic rotatory power in reference to Rowland's electromagnetic theory of light.—Employment of sulphite of sodium for developing the picture in photography, by M. Paul Poiré. Numerous experiments carried out by the author with a solution of sulphite of sodium and pyrogallic acid as a developing bath show that the best results are obtained when the sulphite is in the proportion of 25 per cent. with 1.5 grammes of pyrogallic acid added. The development is slower but more intense and

clearer than when the sulphite contains carbonate, and the bath may be used repeatedly and preserved for months in corked bottles.—On the monochloroacetic ethers α and γ ; synthesis of citric acid, by MM. A. Haller and A. Held. It has already been shown that W. James's cyanacetoacetic ether is identical with that obtained by the authors by treating sodium acetoacetic ether with cyanogen chloride. This view is here confirmed by a fresh synthesis of this cyanide, prepared by making acetyl chloride react on sodium cyanacetic ether.—Papers are contributed by MM. Ph. Barbier and J. Hilt, on australene; by M. A. Müntz, on the fertilizing properties of the Nile waters; by M. Aimé Girard, on the cultivation of the potato; by M. I. Straus, on preventive vaccination against glanders; by M. S. Arloing, on the zymotic effects of the soluble substances contained in the cultures of *Bacillus heminecrobiophilus*; and by M. A. Bottarel, on the poisoning apparatus found in certain fishes.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Carl von Linné's Ungdomsskrifter, vol. ii. (Stockholm, Norstedt).—Mechanics and Experimental Science: Heat and Light: Dr. E. Aveling (Chapman and Hall).—Mechanics and Experimental Science: Magnetism and Electricity: Dr. E. Aveling (Chapman and Hall).—Industrial Education: Sir P. Magnus (K. Paul).—Chambers's Encyclopædia; new edition, vol. iii. (Chambers).—Practical Plane and Solid Geometry; revised and enlarged edition: J. S. Rawle (Simpkin).—Practical Iron Founding (Whittaker). The Orbit of the Planet Sappho (80): R. Bryant (Waterlow).—A Text-book of Pathology, vol. i.: D. J. Hamilton (Macmillan).—The Elastic Researches of Barré de Saint-Venant: edited by K. Pearson (Cambridge University Press).—Agricultural Canada: Prof. Fream.—Report of the Rugby School Natural History Society, 1888 (Rugby).—Philosophy and Specialities: G. Mallory (Washington).—Nineteenth Annual Report of the Wellington College Natural Science Society, 1888.—Journal of the Chemical Society, March (Gurney and Jackson).—Anales del Museo Nacional de Buenos Aires, Entrega Decimaquinta (Buenos Aires).—Proceedings of the Royal Society of Edinburgh, vol. xvi. pp. 1-64.—Annalen der Physik und Chemie, 1889, No. 4 (Leipzig, Barth).

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