THURSDAY, MARCH 27, 1884

THE CHOLERA BACILLUS

IN his capacity as chief of the German Cholera Commission Dr. Koch has issued a further—his sixth—report, and it is one which must become historic in connection with inquiries as to the etiology of that disease. Hitherto Dr. Koch has almost entirely confined himself to reporting facts as they were elicited, and whenever he has referred to any inferences which might be drawn from them, it has only been to show how many sources of error stood in the way of all attempts to arrive at trustworthy conclusions. This attitude of Dr. Koch has naturally tended to increase the confidence in which he is held as a scientific worker, and it has an important bearing on the character of the present report, in which the reserve hitherto maintained is thrown off, and Dr. Koch announces that the bacilli he has discovered are altogether peculiar to cholera, and further, that they are the actual cause of cholera.

The further investigations which have been made relate to the cultivation of the bacilli in question, to their behaviour in the bodies of patients during the various stages of the disease, and to the examination of additional bodies of persons dying both of cholera and of other diseases. The result is that what are now termed the cholera bacilli can be found in no bodies except those of cholera patients; that at certain stages of the cholera disease they are invariably found in the bodies of the patients, whether these have lived and died in Egypt or in a country so far distant from it as India; that these organisms confine themselves to the organ which is the seat of the disease, namely, the bowel; and that they behave exactly as do other pathogenic bacteria, their first appearance coinciding with the commencement of the disease, their increase being proportional to its advance, and their disappearance corresponding with its decline. Certain incidental studies have also tended to confirm the correctness of the hypothesis that these bacilli are the cause of cholera. It is well known that the linen of cholera patients, has conveyed the infection of that disease. Now Dr. Koch has repeatedly observed that such linen, when soiled by the alvine discharges and kept moist for a period of twenty-four hours, has been the seat of an extraordinary multiplication of the special organisms; and in connection with these experiments it was found that precisely the same result took place whenever cholera dejections, or the contents of the intestines of persons having died of cholera, were spread upon such substances as moist linen or blotting paper. And further, a thin layer of the same discharges, when placed on a moist soil, was found within twenty-four hours to have been converted into a thick mass of cholera bacilli. This latter discovery is one of extreme importance in connection with the observations so frequently made as to the spread of cholera in India by means of water-sources, the soil around which is so often befouled by the natives.

From one point of view the report gives special promise. Some bacilli of disease will, in certain stages, withstand almost every form of maltreatment; they may be dried, frozen, and otherwise dealt with, and yet they remain as potent as ever for mischief. But Dr. Koch's cholera bacilli die off rapidly when dried, all vestige of life apparently disappearing after three hours' desiccation. And not only so, but these bacilli will only grow in alkaline solutions, a very small quantity of a free acid standing in the way of their development. To these two circumstances we may in all probability to a large extent attribute the frequency with which those who are directly associated with the sick and their discharges escape infection; and the fact that the healthy stomach contains a sufficient amount of acid to destroy the bacilli may possibly lead to the discovery of some therapeutic or other measure of prevention which may be generally adopted. Directly gastric disturbance steps in and the gastric juices give a different reaction, we are probably face to face with conditions specially favourable to the reception of the poison, and in this respect it is noteworthy that cholera so often attacks those persons who have suffered, or are suffering, from diarrhœa and other gastric disorders.

In one respect Dr. Koch's experiments have failed. He has not succeeded in producing cholera artificially in any of the lower animals. As we have already pointed out, cholera is not the only specific disease to which man alone appears to be susceptible; and it is possible that the fact of cholera discharges and portions of diseased intestines having been given as food to the lower animals with impunity may find much of its explanation in the absence, in the stomachs of those animals, of the needed alkaline cultivation fluid.

At one point of the report our confidence in the correctness of Dr. Koch's inferences is weakened. It is where he, in maintaining his view that the bacillus he has discovered is the actual cause of cholera, refers to its resemblance in one respect to the bacillus of enteric fever. Now, leading micro-pathologists in this country have hitherto declined to regard it as proved that any such specific bacillus has been discovered. Dr. Koch's views have therefore still to stand the test of scientific criticism by his fellow workers, who will doubtless, as occasion offers, repeat his experiments.

THE SCIENCE OF THE EXAMINATION-ROOM

THOSE persons whose unhappy lot it is to have much to do with examinations must often feel that there is some fundamental common factor dropped out in the relation between examiner and examinees. A straightforward paper is set in a subject, say A, in which we will suppose there is no attempt to "catch" or perplex the student, but simply to sample, as it were, the ordinary commonplace knowledge which average industry might acquire. There returns to the examiner in due time a mass of manuscript, evidently written with pains and labour, mostly quite seriously meant, but which does not deal with the subject A, but with something which, though apparently related, is evidently quite different, and which we may call A'. After a little while he begins to wonder whether the whole thing is not a nightmare. The form is apparently rational, and yet the details are hopelessly incongruous and absurd. Or, to put the thing in another shape, it is as if one set a paper in solid geometry and

got answers from Prof. Sylvester's infinitely thin book-worm.

If the examination-system is to be maintained without being on the one hand hopelessly discredited, or on the other lapsing into a kind of ceremonial observance like academic dress or a Guy Fawkes celebration, something must seriously be done to ascertain the real relation between A and A′. It is generally presumed that the object of "plucking" a candidate is to indicate to him his imperfect knowledge. But though the student of the subject called A′ is usually plucked by the examiner in A it is not clear that what may be called the moral result is in any way satisfactory. The examiner is disgusted equally with the candidate who has likely enough done his very best, just as the infinitely thin book-worm might do his best. The candidate grinds away at his A′ with more assiduity than ever if he is modest enough to think his ignorance to be in fault; but this only makes his subsequent failures with the examiner in A more assured, because the radical incommensurability of A and A′ becomes more intensified.

There is really reason to think that underneath the rational fabric of science as understood by intelligent persons of common sense there is a vast substratum of something altogether different, but with which a large number of individuals are quite seriously occupied. A′ is only a term in fact of a very considerable series. Every now and then in the pages of this journal strong evidences crop up of the existence of this singular body of knowledge. This existence, however, is scarcely really grasped by the scientific world proper, and it might be compared to a sort of inverse of Prof. Tait's unseen universe.

The present state of things can hardly go on. It is quite certain that, whatever intrinsic interest science of the A′ type may possess, it is of no kind of practical use to ordinary human beings. If it cannot be displaced by the real thing of which it is a kind of phantom, it is a serious question whether the struggle of the examination-room had better not be for a time suspended.

In the meantime it is very important to investigate the true nature of this phantom science. A little work, of which the second edition has been lately sent to this journal for review, appears to belong to its literature, which there is reason to think is rather copious. This particular publication is part of the "Students' Aids Series," bears the motto, "*Mens sana corpore sano*," and deals with botany.[1] It is impossible to seriously criticise it; indeed, from the point of view of what has been said above it would not be easy to do so. We may content ourselves with reproducing textually from its pages the *entire account* given of a well-known and very characteristic group of Thallophytes :—

THE OLIVE SEAWEEDS.

These weeds vary in general appearance from small tufted filaments to immense stalks terminated by a branched thallus.

In the higher forms a shrubby aspect, a kind of root, and an epidermal layer are observed. Their colour is not bright green, but in general olive.

The zoospores originate in **Oosporangia**, situated at ends or joints of the frond, or in each of the cells of a filamentous body called a **Trichosporangium**; they resemble those of the Green Algæ.

The zoospores from the Trichosporangium have been mistaken for spermatozoids.

The spores reside in sacs termed **Perispores**, having a lining membrane, the **Epispore**.

The perispores or sporangia are either scattered or are arranged in **Sori** or groups on the frond's surface, or in cavities, **Scaphidia** or conceptacula, communicating by a pore with its surface.

The scaphidia may appear as club-shaped masses or receptacula at the edges of the frond.

The antheridia are ovate sacs which contain **Antherozoa** or **Phytozoa** (two ciliated spermatozoids), and appear on slender filaments in the same or other plants, and in the same or other conceptacles as the spores. If on the same plant, they are called **Monœcious**; if on different, **Dicœcious.** When in the same conceptacles with the spores, they are Hermaphrodite. To the slender filaments destitute of antheridia the name of Paraphyses is given.

We must leave to our botanical readers to notice for themselves where this instructive specimen of A′ science differs from the kind of lesson which an ordinarily constituted teacher of real botany would try to communicate to his pupils. At any rate we may ask, would any one having learnt all this by rote (for there is reason to think that such is the method insisted upon) be secure in recognising a piece of bladder wrack when shown to him, or certain of any single fact in its life-history.

A curious point about the A′ science is the copiousness and more or less unintelligibility of its terminology. There is no doubt, however, that this is very generally mastered, however repulsive such a task might seem at first sight. But the problem is still unsolved as to what is the end gained. With the same effort it is probable that the rudiments of an Oriental language might be acquired—say Arabic—and the question arises whether in every way this would not be more profitable.

LEFROY'S MAGNETIC SURVEY IN CANADA

Diary of a Magnetic Survey of a Portion of the Dominion of Canada, chiefly in the North-Western Territories, Executed in the Years 1842-44. By Lieut. Lefroy, R.A., now General Sir J. H. Lefroy, C.B., F.R.S., &c. (London: Longmans and Co., 1883.)

THIS record of magnetical work performed forty years ago by Lieut. Lefroy of the Royal Artillery—now General Sir J. Henry Lefroy—is a contribution of interest to the science of terrestrial magnetism.

The Magnetic Survey of the British Possessions in North America authorised by Her Majesty's Government in the year 1841 at the recommendation of the Royal Society, and in great part executed in 1843 and 1844 under the supervision of the late Sir Edward Sabine, had for its primary objects the determination of the regular and irregular changes of the magnetic elements, especially that of the horary variation of the declination; this variation being then known as subject to wide differences in the high magnetic latitudes of the northern hemisphere

[1] "Aids to Botany." By Armand Semple, B.A., M.B., Cantab.; L.S.A., M.R.C.P., Lond., Physician North-Eastern Hospital for Children, Hackney, Physician to the Royal Society of Musicians, late Senior Examiner in Arts at Apothecaries' Hall, late Medical Clinical Assistant and Surgical Registrar at the London Hospital, author of the "Essential Features of Diseases of Children," "Aids to Chemistry" (Inorganic and Organic), "Aids to Materia Medica" (Inorganic and Organic), "Tablets of Materia Medica," "Aids to Medicine." (Double Part.) Third Thousand. (London: Baillière, Tindall, and Cox, King William Street, Strand. Dublin: Fannin and Co., Grafton Street. Edinburgh: MacLachlan and Stewart, South Bridge. Glasgow: A. and W. Stenhouse, College Gate. New York: Putnam and Sons, 1883.)

as compared with those observed in middle latitudes, both in respect of the turning hours and in the direction of the movement at the same local time. Furthermore, investigation of observations made by Polar voyagers and Arctic travellers had shown that the northern part of these British possessions was a region of peculiar interest as comprising in its area the most powerful of the two foci of magnetic intensity in the northern hemisphere, and also the locus of vertical dip commonly recognised as the North Magnetic Pole.

To Lieut. Lefroy—furnished with transportable magnetometers—was assigned the arduous and responsible duty of traversing this region of such striking magnetical interest, to determine the absolute values of the declination, inclination, and intensity at available stations; and at one or more fixed winter residences in high latitudes to make hourly and term day observations of those regular and irregular fluctuations in the movements of the needle presumed to exist in values of more than ordinary magnitude.

Sir Henry Lefroy's present volume contains the diary of his journeys—these latter extending to 5480 geographical miles—in which is given in more or less detail the magnetical elements determined at three hundred and fourteen stations, combined with such astronomical observations as were necessary, in the then imperfect state of the maps of the region traversed, to approximately assign the geographical positions of the places of observation.

The extended series of hourly and term day magnetical and meteorological observations made at the fixed winter and spring residences [1843-44] of Fort Chipewyan on Lake Athabasca (lat. 58° 43′ N., long. 111° 19′ W.), and at Fort Simpson on Mackenzie River (lat. 61° 51′ N., long. 121° 25′ W.), with their very complete and able discussion by Capt. Lefroy, were printed by order of Her Majesty's Government in 1855. This masterly work is well known to those interested in the science of terrestrial magnetism. The Diary now for the first time published is a fitting sequel to the earlier work; and is not the less valuable from what may appear to be its tardy production. The author's preface—which conveys a graceful tribute to his old chief—in a few words clears up the seeming anomaly. He says:—

"The renewed attention directed to the distribution and periodical changes of the earth's magnetism in the North Polar region, suggests an endeavour on my part to present the observations of my magnetical survey of 1843-44 with fuller explanation, and in a form more convenient for reference than that in which they were originally published" [Sabine's 'Contributions to Terrestrial Magnetism,' No. vii. *Philosophical Transactions*, 1846, and No. xiii. *Philosophical Transactions*, 1872]; "and being still the principal authority for the received position of the focus or pole of greatest magnetic intensity, as well as for the lines of equal magnetic force, equal inclination, and equal variation over a large part of the continent of North America, it is certain that whenever they come to be repeated, the observer of the future will inquire for particulars not contained in, and not suitable for, the *Philosophical Transactions*."

Apart from the value of a full record of the observations made over so great an extent of continental America, is the consideration of the graphical treatment of the isoclinal and isodynamic lines, as embodied on maps accompanying the Diary. The author dwells on the difference in rendering the mapped results on the system followed by Sabine—as given in the *Philosophical Transactions*—and on that adopted by himself. Sabine's aim was to present, over the vast area he was dealing with, the normal values of the magnetical elements, free—so far as his judgment permitted—from the local disturbances experienced at individual stations, depending on geological conditions; and stations at which the disturbances obviously affected the assumed normal values were designedly rejected. Lefroy's treatment includes every station at which he set up his instruments, rejecting no observation because of its anomaly where there was no internal appearance of error. By the one investigator we are thus presented with a harmonious mapped system of regular lines or curves indicating equal values of the magnetic elements; by the other the equivalent lines of equal values are more or less sinuous, in some places much distorted, and losing the semblance of regularity.

In the case of the isoclinal lines as so developed, the author partly infers that their greater inflections bear some relation to the courses of the rivers; and he further draws attention to his isodynamic lines or curves, differing both in form and position from those of Sabine.

In a discussion as to the appositeness of either of the systems pursued, it must be borne in mind that, at numerous well-known points on the earth's surface, a movement made by the observer of the magnetic needle a foot or two vertically, or a few feet horizontally, either way, considerably affects the observations. This is notably the case at many oceanic islands, and a marked example is to be found on our own coasts at Canna near the island of Skye. Sir H. Lefroy's experiences in this direction are well marked at Stations LII. and CXXI., where the total force observed was 15·26 and 15·38 respectively; the normal value undoubtedly was about 14·10 and 14·15; the disturbance from a local geological cause thus increased the total force by 1/14th. It is therefore certain that, unless we have some fairly approximate knowledge of the normal value of the magnetic elements at the disturbed station, we should remain in ignorance of the extent of the disturbance.

In the present state of our knowledge of the distribution of magnetism in the several determinate values of declination, inclination, and intensity over the earth's surface—limited in the best explored regions to a very small number of points of observation compared with the great areas of land and water which they represent—it appears premature to give interpretation to local disturbances as being connected with topographical features rather than geological. On general grounds we must consider the delineation of the normal lines in any region as a primary need, whether in a theoretical or a practical direction.

Local magnetic disturbances demand a special study; this has been given effect to in a theoretical direction by Lamont in Germany ("Researches on the Direction and Intensity of Terrestrial Magnetism in Northern Germany, Belgium, Holland, and Denmark in the Year 1858," Munich, 1859), and practically is being now worked out in the United States; it is understood a special magnetic survey of the State of Missouri is nearly complete.

As magnetical observations multiply over large areas of land, it is possible that the normal lines may be found

to lose symmetry by disturbing causes which may extend over many square degrees of surface, as distinct from local irregularities. Lamont's observations in continental Europe point to this. A first essay on a large scale has been lately made by the able and diligent magnetician, C. A. Schott, to chart the distribution of the magnetic declination of the United States for the epoch January 1885. In this work distinct notice is taken of all local disturbances in the direction of the magnetic needle, the number of observing stations being 2359. This valuable essay is published as an Appendix to the Report for 1882 of the United States Coast and Geodetic Survey.

It should be observed that in Sir Henry Lefroy's maps the lines of magnetic declination are reproduced as given by Sabine ; in Mr. Schott's paper this is the only element discussed, doubtless from the more ample material at his command, and possibly from its practical value for topographical, geological, or mining purposes.

Whenever the time arrives for undertaking a magnetic survey of the British possessions in North America, Sir Henry Lefroy's Diary will be invaluable as a pioneer work. At the present time his early published magnetical and meteorological observations at Lake Athabasca and Fort Simpson are of great interest in connection with those recently made in a neighbouring region by Capt. Dawson, R.A., at the International Circumpolar Station, Fort Rae.

F. J. EVANS

EXCURSIONS OF AN EVOLUTIONIST

Excursions of an Evolutionist. By John Fiske. (London: Macmillan and Co., 1884.)

MR. FISKE is certainly one of the most successful of the writers who have undertaken the task of popularising the many new ideas which have been originated by the theory of evolution. He has not himself added anything of any importance to these ideas ; but, having accepted them with enthusiasm, he represents them to the public with so much force and clearness, as well as grace of literary style, that while reading his pages we feel how the function of a really good expositor is scarcely of less value in the world than that of an originator. The applicability of these remarks to his earlier works will, we think, be generally recognised by the readers of this journal; and, if so, they are certainly no less applicable to the series of essays which we have now to consider.

The first essay is on "Europe before the Arrival of Man," and it gives an exceedingly clear and well-condensed *résumé* of the present standing of the question as to the probable date of man's appearance in geological time. Next in logical order we have three essays on "The Arrival of Man in Europe," "Our Aryan Forefathers," and "What we learn from Old Aryan Words." Within the compass of the pages allotted to them we do not think that it would be possible to give a more instructive and entertaining history than is presented by these chapters. The fifth essay is on the question, "Was there a Primitive Mother-Tongue?" which is very conclusively answered in the negative. "Sociology and Hero-Worship" is devoted to arguing the relations that subsist between a genius and the age or society in which he lives ; this is appropriately followed by the essay on "Heroes of Industry," which is a kind of historical sketch of the philosophical principles that govern the possibilities of invention. A new point of departure is taken in the next three essays on "The Causes of Persecution," "The Origins of Protestantism," and "The True Lesson of Protestantism." Here the main argument is that the rise of Protestantism and the decline of the persecuting spirit are due to an increasing recognition of the right of private judgment, coupled with an increasing refinement of moral feeling. The theory of corporate responsibility, which is more or less essential to the integrity of the social state in the earlier stages of its development, becomes gradually superseded by the theory that the individual is alone responsible for his beliefs and actions ; hence the growing recognition of the right of private judgment. "The Meaning of Infancy" is a brief restatement of the author's views already published in his "Cosmic Philosophy." These are the views which deserve to be regarded as perhaps the most original that Mr. Fiske has enunciated. The general fact that the protracted period of infancy among the anthropoid apes (and therefore presumably among the brutal ancestry of man) must have had a large share in determining the evolution of man is a fact which could scarcely escape the observation of any attentive evolutionist ; but Mr. Fiske is the only writer, so far as we are aware, who has treated this fact with the consideration that it deserves. Of the remaining essays, "Evolution and Religion" is an after-dinner eulogium on Mr. Herbert Spencer, "A Universe of Mind-Stuff" is an exposition of Clifford's essay upon this subject, and "In Memoriam: Charles Darwin," is a well-written obituary review of Mr. Darwin's life and work.

As we have not detected any errors on matters of fact, the only criticisms we have to make pertain to matters of opinion. In particular, it appears to us that, in his anxiety to raise the cosmic theory of evolution into a religion of cosmism (or, as he terms it, in his earlier work, "Cosmic Theism"), Mr. Fiske entirely loses the clearness of view and precision of statement which elsewhere characterise his work. Although no friend or admirer of Comte, with a strange inconsistency he follows implicitly the method of the French philosopher in blindfolding judgment with metaphor, and then, without rein or bridle, running away upon a wild enthusiasm. We have here no space to justify this general statement, but we feel sure that no sober-minded man can read the after-dinner speech or eulogy on Mr. Spencer without feeling that its extravagance runs into absurdity. We have no wish to deprive Mr. Fiske of any happiness that he may derive either from his "religion" or from his "hero-worship" ; but we cannot review his essays without observing that in neither of these respects is he likely to meet with much sympathy among "men of science," to whose opinion he habitually professes so much deference.

GEORGE J. ROMANES

OUR BOOK SHELF

The Zoological Record for 1882. Being Vol. XIX. of the Record of Zoological Literature. Edited by Edward Caldwell Rye, F.Z.S., &c. (London : Van Voorst, 1883.)

ALMOST before the shadow of 1883 had passed away, the "Record of the Zoological Literature of the Year 1882"

made its appearance, and the circumstances attending its publication are, as the editor informs us, without precedent in the nineteen years during which this important and most valuable annual has been issued. The sudden death on the Niger of Mr. W. A. Forbes, the late recorder of the literature relating to the mammals, was soon followed by the loss of the help of Mr. Howard Saunders in the arduous work concerning the recording of the literature of the birds. These severe losses have been supplied by Mr. Oldfield Thomas and Mr. R. B. Sharpe. In the records of the fishes Mr. Boulenger has had the assistance of Mr. R. Ogilvie-Grant. Mr. Ridley has handed the recording of the Protozoa over to Mr. W. Saville Kent, and the Myriapod literature has fallen to Mr. I. D. Gibson-Carmichael. It thus happens that of the recorders who, just twenty years ago, assisted Dr. Günther in the arduous undertaking of bringing out the first volume of this work, but one, Dr. E. von Martens, still responds to the editor's call, though happily all of the first recorders still survive to overlook and appreciate the labours of their successors.

The editor apologises for some slight delay in the appearance of the volume, owing to the mechanical difficulties brought about by all these changes, difficulties only to be thoroughly understood by those who have experienced them, and which we trust will not trouble the editor again. It is not without interest to note that nearly two-thirds of this volume is compiled by officers of the Natural History Department of the British Museum; indeed, if we include Dr. E. von Martens' work, and remember that he occupies the position of assistant in the Natural History Museum of Berlin, it would appear that over 600 out of 700 pages have been compiled by writers whose lives are devoted to the subjects about which they write.

The editor has again to thank the British Association for the Advancement of Science and the Government Grant Committee of the Royal Society for kindly aid in assistance of the publication. The number of new genera and sub-genera recorded in this volume is 1015 as against 1438 in the last volume, and it will be remembered that this latter number included 483 new genera made by Haeckel.

Each recorder seems to have executed his share of the work well and painstakingly. The special treatment of the literature of each group is on the lines of that followed in the later volumes of the series. We warmly congratulate the Zoological Record Association on the result of their editor's labours.

Sketches of North-Western Mongolia. Vol. IV.—*Ethnographical Materials.* By G. N. Potanin. 1025 pages, with 26 Plates (Russian). (St. Petersburg: Published by the Russian Geographical Society.)

THE first two volumes of this important work contained the results of the journeys by the author in 1876 and 1877. The third, which is in print, will contain the geographical materials collected during the journey of 1879, and the volume we have before us deals with the ethnographical part of the same journey. It begins with an enumeration of the Turkish and Mongolian peoples who inhabit the region: Tartars, Uryankhays, Kirghiz, Durbuts, Darkhats, and Buryats, with the legends current about their origin. There is no general sketch of the populations dealt with; the aim of the author seems to have been to give in this volume a collection of materials, rather than to enter the field of general conclusions. With regard to the former, the present volume is a most valuable one. We find in it interesting facts as to the family, social, and religious life of the inhabitants; a list of names of stars, plants, and animals, together with the beliefs about them, and finally, their legends and folk-lore. Of these, no less than 200 are given, containing a rich and new source of information. On almost every one of the 500 pages occupied by these legends and tales one is attracted either by their poetical beauty or by the light they throw on the mythology and popular conceptions of the inhabitants of this border region of Central Asia; while M. Potanin's name is the best warrant for the accuracy of the transcription of the legends reported. However rich this material, one hesitates to say which of the two is more valuable, the folk-lore published, or the annotations which follow them. These last cover 300 pages of small type, and we find there, philological explanations, comparisons with the legends of other Finnish tribes, most valuable materials for comparative mythology, and so on, all being the result of a thorough study of nearly the whole of the Russian literature of the subject, disseminated through periodicals of the most various descriptions. While perusing these invaluable materials one only regrets that the author has not yet been brought to summarise his wide studies and to draw therefrom some conclusions which may enter into the domain of science. In any case a careful index of all matter mentioned in the volume would much facilitate the researches. The plates represent mostly the pictured tambourines of the shamans and the *ongons* (holy pictures and idols) of the Tartars, Uryankhays, and Buryats.

P. K.

LETTERS TO THE EDITOR

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

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

Quintino Sella

IT is proposed to place a bronze wreath on the tomb of the distinguished Italian geologist and statesman, Quintino Sella. English geologists are invited to express their sympathy with their Italian fellow-workers by sending in their names with a small subscription. I have been requested to bring the matter before their notice, and to collect the subscriptions in this country. THOS. M'KENNY HUGHES

Woodwardian Museum, Cambridge, March 25

Electrostatic Measurement of E.M.F.

PERHAPS you will allow me to make known through your columns to those who have from time to time made inquiries concerning my Absolute Sine Electrometer, that, after many months' work, I have satisfactorily concluded a series of experiments with the instrument which was made for Prof. Anthony. When this instrument was finished last year, I made some observations with it which were so unsatisfactory that I did not feel justified in allowing it to be sent to America. I have now, however, removed all the difficulties connected with it, and I uniformly obtain results perfectly consistent one with another. Indeed my difficulties during the last six weeks were due to the fact of my employing cells which were not sufficiently constant, and not to any fault of the electrometer, a fact which I did not realise for some time.

I hope to publish in a few days a full report on the various points connected with the instrument and on the experimental results obtained. GEORGE M. MINCHIN

Royal Indian Engineering College, Cooper's Hill, March 24

Pons' Comet

THIS comet has been visible here some time. I first saw it at 9 p.m. on January 15, but only for two or three minutes, through the clouds. On the following evening (January 16) I saw it well. To the naked eye it looked like a star of the first magnitude seen through a haze; the tail was visible, but not at all conspicuous. In the telescope (4-inch) the head was large, but

appeared wholly nebulous, with a bright central condensation; the tail broad, but faint. I could only trace it some 2° or 3°. The brightness of the nucleus must have been considerable, as when close to the horizon I could see it through a pretty thick cloud. Subsequently the nucleus has seemed to me decidedly more disk-like, I suppose from being better seen. I may add that the sunset-glows and the unusually cloudy weather we are having have interfered greatly with satisfactory observation.

Nelson, N.Z., February 1 A. S. ATKINSON

The Access to Mountains and Moorlands Bill

I AM glad to observe that you have called the attention of scientific men to the importance of Mr. Bryce's Bill. Perhaps nothing can better show the need of such a measure than certain facts in regard to the Clova district in Forfarshire, which is classic ground to the botanist; indeed, I think I may venture to say that it is the richest ground in the British Islands. From time immemorial a right of way existed through Glen Dale, and, I can remember the time when botanists could ascend any of the hills in that district without being subjected to the tender, though somewhat embarrassing attention of gamekeepers. I have good reason to believe that the case is somewhat altered in recent years, and that, after a man has gone hundreds of miles in order to see *Oxytropis campestris* growing in its only British station, he may find himself turned back just within sight of the goal. The thing can still be done by taking advantage of a curious fact in natural history, viz. that two gamekeepers cannot remain long in loving converse with three men: by keeping this fact in mind, one out of three may still study the botany of Clova. After having gone pretty well over Scotland I am glad to say that there are many places in which there is no need for Mr. Bryce's Bill. In most cases in which it is needed it is where "new men" usurp a power which the old lords of the soil never dreamt they possessed. A. CRAIG-CHRISTIE

Edinburgh, March 24

A Sixth Sense

IN the valuable address given by Sir William Thomson at the Midland Institute, Birmingham, on October 3, and reported so fully in the columns of NATURE, it is implied that Dr. Thomas Reid of Glasgow brought out the distinction of a sixth or muscular sense. I cannot find any satisfactory evidence of this, although Reid came very near it indeed when he stated in his "Inquiry into the Human Mind," chap. v. section 1:—"By touch we perceive not one quality only, but many, and those of very different kinds;" and again:—"There is, no doubt, a sensation by which we perceive a body to be hard or soft;" and again, further on he even speaks of its being strange that this sense should "be so much unknown as never to have been made an object of thought or reflection nor to have been honoured with a name in any language."

And on the other hand, while I cannot detect any attempt whatever to refer this sensation to the muscles as its peripheral origin, while speaking of our conception of the hardness of bodies, Dr. Reid says (p. 121, ed. of 1846):—"We have no way of coming at this conception and belief, but by means of a certain sensation of touch;" and again, "I see nothing left but to conclude that, by an original principle of our constitution, a certain sensation of touch both suggests to the mind the conception of hardness and creates a belief of it." Reid, in short, like his eminent predecessor Hutcheson in the same chair, was dissatisfied with the ordinary division of the senses, and really felt disposed to split up the varied phenomena bundled up under the term "touch" into two or more divisions; but it was reserved for Dr. Thomas Brown, a good physiologist according to the light of the times, and Professor of Moral Philosophy in Edinburgh (1810–20), explicitly to complete the distinction hinted at by Reid, and to refer our conception of resistance or tension (as we find in estimating weights by the hand) to a distinct sixth or muscular sense. Thus in his twenty-second lecture he says:—"The feeling of resistance is, I conceive, to be ascribed, not to an organ of touch, but to our muscular frame, to which I have already more than once directed your attention, as forming a distinct organ of sense." In the lecture which follows that, Brown admits the frequent mingling of mere tactual sensation with that of muscular effort:—"But it is not of this mere tactual feeling we think when we term bodies hard or soft—it is of the greater or less resistance which they afford to our muscular contraction."

It is remarkable that the teaching of this eminent psychologist, the preceptor of James Mill, should so early have been forgotten in Scotland. HENRY FAULDS

Laurel Bank, Shawlands, Glasgow, March 18

MR. FAULDS, in the preceding letter, is no doubt quite correct in remarking that the distinction pointed out and insisted on (not merely hinted at) by Thomas Reid, a little more than a hundred years ago, in the Moral Philosophy Chair of the University of Glasgow, was more clearly and fully defined by his eminent successor in Edinburgh, Thomas Brown. But I cannot agree with his last sentence, implying that Thomas Brown is forgotten in Scotland. In fact, my mind was so full of Reid and Brown, from my recollections of the teachings of the Professors of Moral Philosophy and Logic in this University, that, in giving my address at Birmingham, I said Thomas Brown, meaning Thomas Reid, but feeling the names of Reid and Brown both thoroughly mixed up with all I had ever learned of this subject. WILLIAM THOMSON

The University, Glasgow, March 20

Earthworms

THE theory of the formation of vegetable mould through the action of earthworms, by Darwin, received little attention when published from people who had been accustomed to examine the soils of various countries. That the vegetable soil had been formed as he states seemed to have been accepted by his followers without hesitation. In your columns, however, of late, letters have appeared from Messrs. R. M. Christy and T. E. Wilcox, showing that earthworms do not exist in the prairies in the north-west of Canada or in the United States, in those of Kansas, the Indian Territory, or in Idaho and Washington Territory. This is simply what may be expected. Notwithstanding the keenness of observation of Darwin and his width of observation, there seem vast regions where earthworms have had little to do with the formation of the vegetable soil. In many parts of Australia, and also in the moister climate of New Zealand, the soil affords few indications that earthworms ever passed it through their bodies. In a section of soil I brought from the Mataura plain, South Island of New Zealand, nothing could be seen to indicate that worms had ever swallowed it. That vegetable soil forms a fit habitation for earthworms is undoubted. Darwin admits "that a layer, though a thin one, of fine earth, which probably long retains some moisture, is in all cases necessary for their existence." Before this thin layer existed, how could they—the worms—form vegetable soil? This thin layer must have been formed in some other way; Darwin does not say how. It is not necessary to call in the aid of earthworms to do so. The very name which has been universally applied to the thin upper covering, the exterior film enveloping the surface of the deposits underneath, viz. vegetable soil, speaks to its origin in the decay of vegetation. Take for instance the boulder-clays of this part of the Lothians in Scotland, with their tough, stony texture, their pebbles as finely striated as when the ice squeezed them into the pasty mass of crushed shales out of which they appear to have been partly formed. While these surfaces could have afforded none of the conditions required by Darwin, or indeed supply any other save inorganic food, the slow growth on their surfaces of the more simple forms of vegetable life, and their decay, would in the lapse of ages supply the thin film which Darwin requires. It surely, then, is attempting too much to ascribe to the earthworm the formation of the vegetable soil. The earthworm is not the only occupant of the material which the growth and decay of vegetation supplies as a surface covering. The earthworm is not the only drainer. The roots of many plants not only descend deeply into the subsoils, but also fetch up from depths where worms could not reach supplies of material to mix with the superficial covering; and so do the various insects which have their habitat in the soil, burrowing as they go, and casting, like the mole, the stuff behind them or upwards as they descend.

So far as I have examined soils, I am inclined to think that the earthworm is far more plentiful when animal matter in a decaying state is applied to soils near the dwellings of man, or when his deposits are laid over those of the larger animals. As against the views of Hutton and Playfair, and as stated by Darwin, that the vegetable soil or mould is always diminishing, I have to say it seems entirely the reverse; it seems to have had a be-

ginning, is increasing, and shall increase so long as vegetable and animal life covers the surface of the earth. This is not the case where vegetation ceases to cover the surface, and the sun and wind get direct access to the surface; any soil that may have been formed there soon disappears. In such situations, until vegetation has again spread itself, all the earthworms that could congregate there would only add to the decaying animal matter, as live they could not, there being no food for them in the absence of vegetation and other animal matter.

Bonnington, Midlothian JAMES MELVIN

I INCLOSE an excerpt from NATURE of January 3 (p. 213), which I saw in one of our daily newspapers. The observation there made is correct as to the absence of earthworms in the region mentioned, but the reason assigned is, I think, incorrect. It is well known to settlers on virgin soils in this country that in the first tillage of the ground they will see no earthworms. This is equally the case whether they settle upon prairie land which has been swept annually by fires, or upon wood land which has been cleared for cultivation and which has never been burned over. Even in the natural meadows called "beaver meadows," which one will chance upon in an otherwise completely forest-covered region, one will at first find no sign of the earthworm. Some sluggish stream is dammed by a colony of beavers, and the land flooded is cleared of trees by them. Alluvial deposits accumulate, and when the beavers have been killed or driven away the dam is destroyed by freshets, and the little stream regains its former dimensions, while the flooded ground, drained naturally, becomes a meadow covered with wild grasses nourished by rich depths of soil. But, until settlement and tillage by man, there is no trace of earthworms even in these most favourable localities. At first they are found about the stableyard, then in portions of ground enriched by stable manure, garden or meadow, till at length they may be found in all soils, either those cultivated or those pastured by domesticated animals.

For years I have been accustomed to go to Mukoka, in the Canadian Dominion, for shooting and fishing. This section is a wooded wilderness with numerous lakes and streams. It is still Governmental wild land, and in part unsurveyed for settlement. The frontier settlers there tell me that until a place has been inhabited for five years it is useless to search for the earthworm. HY. F. WALKER

8, East Thirtieth Street, New York City, U.S.A., March 5

The Remarkable Sunsets

THE following extract from a letter written at Auspaki, province of Vitebsk, Russia, may be of interest:—

"*February* 26 (Old Style), *March* 9

"February has been the coldest and the pleasantest month this winter, particularly the latter part of it; frost from 5° to 12° Reaumur; bright sunshine. Now we have been able to see the roseate sunsets, which for at least three months have been hidden by clouds. We are, however, so accustomed to brilliant sunsets here, that we might not have remarked them if our attention had not been directed to them. Here, generally, when the sky is clear and the frost severe, the eastern horizon is a misty blue, above which is a rosy streak melting away into the clear blue above. But these latter sunsets have differed from that in a great measure. The west has often been blood-red, and the eastern horizon has been rosy, not so much in a streak but in patches, which have sometimes been visible over head. At the beginning of the month I was in Riga, and found the river open below bridge; indeed, the navigation has not been closed the whole winter. Snow there was none in Riga, and I saw them carting the most miserable ice for the ice-cellars; I think it was little more than six inches thick. We have been favoured here; we have retained our snow, and have had, and still have, good sledge roads. We filled the ice-cellar the day before yesterday, and the ice was more than a foot in thickness. . . ." J. M. HAYWARD

Sidmouth, March 24

THOUGH we are no longer favoured with the gorgeous sunsets which marked the autumn and early winter, yet two phenomena are still frequently visible which seem referable to the same cause as those splendid displays.

The first is the unusual *white glow* in the western sky before sunset which was an almost constant precursor of the brilliant and long-continued colouring of the past months. It was very marked on November 8, the occasion of the first remarkable sunset, and it is still to be seen on almost any fine evening before the sun sets, though it is no longer followed by the more striking phenomena.

The second is a decidedly unusual *pink tinge* occasionally visible for some ten to twenty degrees round the sun when shining in a somewhat hazy sky, the colour being brought out with great distinctness if light cumulus cloud happens to be passing across it. I first observed it about 1 p.m. on Sunday, March 2, and it was very marked last Thursday (20th) between 10 and 11 a.m., and again on Friday (21st) between 1 and 2 p.m., as well as on one or two other days which I have not specially noted.

May not both be due to the gradual subsidence to a lower level in our atmosphere of the particles which at a higher elevation caused the wonderful colouring of the past months?

Hampstead, March 24 B. W. S.

P.S.—Since first writing the above, I see in NATURE that it was from March 1 to 3 that the fall of dust was noticed at Kilcreggan. Writing from the neighbourhood of London, it may be as well to say that the appearance is wholly different from any effect of London smoke (with which I have been familiar for nearly fifty years) both in colour and in being produced at a higher level than that of ordinary clouds.

"Curious Habit of a Brazilian Moth"

IN NATURE for May 17, 1883 (p. 55), appeared a letter entitled as above, by Mr. E. Dukinfield Jones, in which the author stated that he had observed a kind of moth in Brazil engaged in sucking up water in large quantity through its proboscis. I may say that this strange habit is not confined to *Panthera apardalaria*, as I have observed the same thing in two species of butterfly (*Papilio orizabus*, B., and *Appias saba*, F.), and imagine that the phenomenon is by no means rare. These two butterflies are very common by the sides of streams and damp places on the Ankay plain in Madagascar.

One morning while sitting by the side of one of these streams I noticed the Papilio, which is an insect measuring about four inches from tip to tip of its wings, resting on the wet bank; and wishing to procure it as a specimen, I approached it as gently as possible, the creature being apparently so absorbed in what it was about as to be totally unconscious of my proximity to it. Noticing strange and unaccountable movements—sundry jerks and probings with its proboscis—I quietly sat down near it to watch it more closely. I observed that every second or two a drop of pure liquid was squirted (not exuded merely) from the tip of its abdomen. I picked up a leaf that was lying near, and inserted the edge of it between the insect's body and the ground so as to catch the liquid. Unfortunately I had no watch with me at the time, nor means of measuring liquids; but I reckoned that about thirty drops were emitted per minute. I held the leaf for about five minutes—as nearly so as I could reckon—and at the end of that time there was caught in it about a saltspoon full of what seemed to be pure water, without either taste or colour. After watching the butterfly for a time, I seized it by the wings between my thumb and fingers with the greatest ease, so utterly lost did it appear to be to what was going on near it.

In another spot I saw as many as sixteen of these large butterflies within the space of a square foot, all engaged in the same strange action. Some of them emitted the liquid more frequently and in greater quantity than others; and one of them squirted the liquid so as to drop fully a quarter or a third of an inch beyond the point on the ground perpendicular with the end of its body. It was at this spot that I saw the second of the butterflies alluded to also engaged in the same curious proceeding.

Antananarivo, Madagascar, January 3 R. BARON

Representation of Students

THE students in residence at Girton College are indirectly represented by the members elected by the "certificated students," but cannot themselves, whilst they are in the condition of undergraduates, elect a representative on the governing body.

The College Hall of Residence has advanced one step further in the same direction by offering direct representation to students *in residence*, and it is this new departure which was mentioned in NATURE (vol. xxix. p. 388).

Ever since the establishment of Girton College, students in residence have valued their prospective right to have a voice in the management more dearly than would generally be credited, and have held that Girton stood first among colleges for women partly because it conferred this dignity upon its students.

But the dignity conferred by the actual enjoyment of a privilege exceeds that conferred by a prospective right to the same privilege.

ANOTHER CERTIFICATED STUDENT OF GIRTON COLLEGE

"Suicide" of Black Snakes

IN NATURE, March 13, p. 452, Mr. Edward Hardman, Government Geologist of Perth, West Australia, mentions an instance of the suicide, by its own venom, of a black snake. The snake had been wounded, and, the wounded part having been attacked by black ants, "it instantly turned short round and hit itself twice on the neck with seeming determination; in less than one minute it was dead." Mr. Hardman believed the death to be due to its own venom.

He records further instances, *which, though he had not witnessed himself*, had been *related* to him by those who had witnessed the facts.

I believe it to be a generally accepted opinion among thanatophidiologists that, from what is known of the virulent properties of snake-poison, though fatal to man and other living beings, it is innoxious in its effects to serpents of like nature. Sir Joseph Fayrer, a great authority upon this question, has said: "Strange to say—and this to me is one of its greatest mysteries—a snake cannot poison itself or one of its own species, scarcely its own congeners, and only slightly any other genus of venomous snake, but it kills innocent snakes quickly" (address on "The Nature of Snake-Poison," delivered at a meeting of the Medical Society of London, January 28).

The glands which secrete such venom draw their secretion from the blood; that blood, therefore, must have within itself, as part of itself, the elements which constitute its virulence, and cannot therefore be injuriously affected by a further introduction of these elements. Their presence in the blood gives to this vital fluid a power whereby an immunity is obtained, somewhat similar to that which vaccination and syphilisation give to human beings, and which the vaccination of the cultivated virus of anthrax, of rinderpest, of foot and-mouth disease, gives to animals.

It may, however, happen that the climate of Australia has a special action producing effects different from those observed in India, and, if so, requiring close investigation and study.

The question becomes an interesting one, and, if philosophically prosecuted, may elicit facts which would give to this instance of venom envenoming itself a significance and an established position in the history of natural science.

JAMES DONNET

Unconscious Bias in Walking

THIRTY or more tests in walking, with closed eyes, on a nearly level lawn lightly covered with newly-fallen snow, gave the following results:—My natural gait, in which I step a half to three-quarters of an inch further with my right foot than with my left, always produced a sharp curve to the right. Whenever the step made by either foot was about three inches greater than that made by the other my course was substantially straight. A curve to the left always resulted when either foot stepped more than three inches further than the other. Unnatural toeing out of either foot did not change the result. My right arm is three-quarters of an inch longer than my left, but my legs are of equal length. Both limbs on my right side are stronger and more skilful than those on the left. When but a single action is required, it is my right arm or my right leg that prefers to perform it. When two actions are necessary, the right side chooses that requiring the greater skill, leaving to the left the plainer work, regardless of the power demanded by it. Thus, in mounting a horse, or leaping across a ditch in the ordinary manner, I spring from the left foot; yet if I am to land on the foot from which I start, I can hop higher and farther with my right leg. I can also lift a greater weight with it; and can lower myself to, and raise myself from, a kneeling position with the right leg alone—a feat impossible for me to perform with the left. In my case, at least, the division of labour is decided by skill, and not by strength. These facts, considered in connection with the further observation that in walking the foot which for the time being supports the person does not rock into a pushing position until the other foot has completed its forward motion and is ready to drop to the ground, incline me to the opinion that walking is a reaching rather than a pushing process. Perhaps photography may help to decide this point.

J. E. SMITH

New York, March 10

Recent Weather in North America

THE ice-storm, as we call it, which we have lately experienced, seems to call for a permanent record. It began at about 4 p.m. on the 7th inst., and until 12 noon of the following day there was a constant drizzle or rain, the thermometer being a few degrees below the freezing-point. The amount of the rainfall at the surface of the ground was 1·10 inches. As the rain fell upon the trees it soon formed a coating of ice upon every exposed branch and twig, and this grew thicker and heavier until saplings were bent to the ground and large branches were broken from many trees over a wide area of country. The wind blowing gently from the north, the coating of ice was much thicker on that side of each twig or branch. Fences were decorated with long icicles hanging at a decided angle towards the south. Telegraph wires were so heavily loaded that many fell, and some of them, besides the coating of ice, had a most curious decoration in the shape of little icicles hanging about two inches apart, some of them appearing horizontal, and some (it is said) actually pointing upwards. The storm is reported as having extended over an area of some 20,000 square miles. It was not immediately followed by a thaw, which might have relieved the trees of their load; a gentle precipitation, partly of snow and partly of sleet, took place at intervals from 5 p.m. on the 8th till early in the morning of the 10th, the temperature remaining below freezing. The view on the 10th, when the clouds broke away and the sun shone on the trees, was beautiful beyond description, but the most remarkable effect was that produced by the moonlight on the evening of that day.

In order to gain something like an accurate idea of the amount of ice which had frozen on the trees, I made measurements of a number of twigs taken from the extremities of branches, in order to compare their diameter in their natural state with that they had when covered with ice. Some of the figures may be of interest. One twig ·11 of an inch in diameter was enlarged to ·73; another of the same size to ·84; one of ·12 inch diameter measured ·84 with its ice-covering, and another of ·12 inch measured 1·03; one of ·18 diameter had become 1·21, and one of ·21 had become 1·07. The largest ratio of increase which I found on a tree was in the case of a twig ·09 of an inch in diameter, which had attained to ·97, having gained nearly nine times its original diameter. But some upright stalks of weeds standing about eighteen inches above the ground gave still larger proportional measurements. One 5/100 of an inch in diameter now measured ·87, and another of 4/100 of an inch measured ·85, having increased its diameter by more than twenty times.

I made another estimate of the quantity of ice on the trees by breaking the ends of some branches from an apple-tree and weighing them with and without the ice that coated them. It appeared that wood which weighed ten ounces was carrying ice which weighed sixty-nine ounces.

Perhaps it should be noted that the ice did not freeze on the twigs or stalks so that the cross-sections would be exactly circular, and that the measurements made were those of the largest diameters in the several instances.

Prof. Brocklesby writes to the papers of a similar storm many years ago, when a piece of branch weighing four ounces carried four pounds of ice.

SAMUEL HART

Trinity College, Hartford, Conn., March 11

EDUCATION IN THE UNITED STATES[1]

A SUCCESSFUL effort made to meet a strong desire that this Report should be brought out sooner enables us to call attention to it in less than twelve months after the last, but, as in material food so in the case of the many reports embodied here, thorough digestion has been essential.

[1] "United States Report of the Commissioner of Education for the Year 1881." (Washington: Government Printing Office, 1883.)

An additional interest, moreover, is lent to this Report by the working up of the information supplied by a Compendium of the Census of 1880. Here are given very full particulars of the changes in distribution of population during the last ten years, and of the amount of education still required by its various classes.

As to the former we may mention in passing that the Report calculates that more than half the English-speaking people of the earth live now in the United States, which in size and population has become the fourth nation of the world. Rather more than one-eighth, six and a half out of fifty millions, of its inhabitants are immigrants; and a singularly similar proportion exists between the coloured and the white population. Emigration is a stream westwards, not only across the Atlantic but across the continent of America. While 1,211,000 of the population of the State of New York were immigrants to it, 882,000 had emigrated from it. Nearly 10,000,000 out of 43,000,000 of natives had moved from the States of their birth to other States. It would seem to an Englishman in his own land that this "unsettled" state of the country must loosen all the feeling of attachment to the soil suggested by the word "home"; but it must, as the Report describes, tend immensely to consolidate the widespread territories; and it certainly suggests the fairness of the great work of education being made a national and not a State function.

Of the emigrants from Europe there were twice as many from Ireland as from Great Britain, but the Irish were equalled in number by the Germans alone, and the total Teutonic immigration in proportion to that of Irish was as 40 to 18. "The preponderance, therefore, of Celtic methods and ideas among our immigrant population is at an end, at least for the present. The German, Scandinavian, and British elements will exert an ever-increasing Teutonic influence, and will form a strong, steady, and sensible influence to counterbalance the volatile and brilliant qualities of the Irish blood. Not the least among the attractions which have drawn to America the Swedes, Danes, and Norwegians whose steady industry and stalwart vigour is felt with immense effect along the northern border States and Territories, are the schools, to which they give their hearty support. In these schools they find less of class education in America even than in Germany, where the children are separated, the high from the low, the rich from the poor, at the entrance into the school-room; instead of the social intercourse, the common interest, the mutual enjoyment which may be the result of the American public school." Nor is all the advantage to the immigrant only. "The influence of the Germans has been exercised in behalf of better methods of primary instruction, thorough training, and high standards in the intermediate and higher grades, the introduction of the German language into the schools, and science training, especially as related to the development of our internal resources." Much do we want more of a similar element in England! Much information is condensed in sixteen diagrams or outline maps showing at a glance various results of the census.

A list is given of 251 "cities," towns, that is, containing over 7500 inhabitants. Belonging to these are—

17	per cent.	of	the population;
26	,,	,,	daily attendance;
33	,,	,,	annual school income;
49	,,	,,	school property.

Nothing can speak more strongly than the above figures of the advantage to education afforded by the concentration of population such as is the case in England. Even in a country where the rural population forms five-sixths of the whole, and is felt to be of vastly greater importance than it is in England, only one-half of the school property and two-thirds of the income is devoted to them; whereas, to secure equal advantage to the scholars, these proportions ought to be more than reversed. As it is, a rural school and an ungraded school are almost synonymous, and more exact reports from each State of their efficiency and means are strongly urged, and their want of trained teachers regretted. But even in the cities the population keeps ahead of the provision of "sittings," till New York already requires over 50,000, and Brooklyn and Chicago over 30,000, more than their present supply. The latter has been driven to the certainly unhealthy practice of "double divisions," teaching, that is, one set of children after another within twenty-four hours. Very far, therefore, are these large cities from carrying out the suggestion here quoted from the London School Board, of providing schools beforehand for increasing population.

The excess of female over male teachers has become a national characteristic, and our Report accounts for it not only by the superior attractions of pioneer life for the men, for it is the case even in States where men largely preponderate; but also by the industry and intelligence which have become the inherited tendencies of the women of the Northern States. In the colleges, accordingly, we note that just over ten thousand women are being co-educated with men, and "the experience of these institutions shows that co-education is entirely practicable, and is recommended by their officers upon considerations of economy, its agreement with the conditions of family life, and its practical results." The equal capacity of women with men for higher education, our Report asserts, has been conceded both in Europe and the United States; and it quotes elsewhere the large increase of female pupil-teachers in England compared with the corresponding increase in males. Extra care has been given to the reports on this subject, both on account of the attention directed from other countries upon the United States and also because it may well form a standard of social progress. But the "meagre wages" of which the Report speaks are illustrated by the fact that even in Pennsylvania, where excellent provision is made for the examination and appointment of teachers, the average salaries for men were about 40*l.* for the six months' teaching required in the year, and 33*l.* for women, while in Alabama the average was only 20*l.* A large increase in the number of female students at the normal colleges shows, however, that these wages are not to be spurned, if they do not attract the highest talent desirable. All Bills introduced into Congress agree in providing that a large part of the national aid proposed shall be applied to the increase of teachers' salaries. It would seem, however, that the difficulty of the thinness and dispersion of the population causing schools to be small, and therefore education per head costly as well as inefficient, is rather increased by an unwise feeling of independence which objects to be joined with neighbouring districts, even where distance allows it. To gratify this same feeling, also, the State Government, after laying down wise and complete rules, has left in some cases to the school authorities and to the people themselves in each city or town, the whole practical control of the work. It is like passing an Act of Parliament without making it the duty of any body of men to see that it is enforced. A State supervision is a step towards centralisation, which is, no doubt wisely, recommended strongly by our Report.

The desirability that curriculums should be laid down by the central authority is quoted as the experience of the world, and of Belgium particularly, where, whenever the schools have followed definite programmes, progress has been marked, while in schools in which the whole matter has been left to the teachers routine has prevented it.

The long recesses, caused in a new country by the scarcity of labour during harvest times, so shorten the educational year that while on the one hand it is felt that not enough is provided for in the curriculum of most schools, on the other hand, time is too short to allow the

effective teaching of what is already there. The Report remarks that it is impossible to examine the various courses without being struck with the general neglect of elementary science; adding that "the rural schools would seem to be favourably situated for the study of nature in some of her varied aspects. The well-known effect of such study upon the mind, its value as a resource to the individual, and its relation to the tendency of modern thought, are so many reasons for its introduction into these courses."

The higher classes, we are told, are working harder at the schools, but the key to the reports from so many States in which population as well as cost and efficiency are said to have increased while attendance has not, evidently is that a class is rapidly increasing in America now who make no demand for education and do not appreciate it. The chief of the four recommendations with which the Report ends is the appropriation of more national land for the purposes of education in impoverished portions of the country. Yet the special reports of New York and Connecticut show that ignorance is not caused by want only: for the reduced attendance is accounted for by commercial prosperity and demand for labour, during which a hard-struggling population is tempted to forsake school in order to earn money.

Maryland reports great illiteracy among both blacks and whites, and shows a decrease in everything except expenditure. North Carolina is much more satisfactory, partly through the help of religious bodies, who are making great efforts for the benefit of the negro, whose education remains the difficult question of the United States. More than half as many more black children are uneducated in the whole Union than white children. From the Report it is evident that many of the Northern States feel that they are already heavily taxed for the support of their own schools. Yet their wealth is immense compared with that of the Southern States; the Report quotes personal property and real estate as two and a half times greater per head in the three States of New York, New Jersey, and Pennsylvania than it is in the south. Again, it is a small class in the north that does not appreciate education, but in the south not only is the negro himself careless about it, but there is often to be found among the whites a bitter hatred of the educated black. It is absurd to leave a difficult and costly matter like his education in the hands of his late masters, and expect them to both do it and pay for it; and the only practical method is, as our Report recommends, for the nation to establish and maintain good schools in the face even of hostility. In some places where the Peabody Fund is pushing the work on, the negro is better cared for than the white child, but its administrators cannot undertake the education of a whole people.

The endeavour to make elementary science a feature of the higher grade schools has revealed the same difficulty as has been pointed out at home, viz. the lack of teachers prepared to give the instruction. "The lifeless routine of memorised recitations is worse than useless in science. It paralyses the faculties by which the facts of science are apprehended, and renders true progress impossible. This is a matter demanding attention in normal schools." In a few cities special means have been provided for meeting the emergency. In Boston, courses of lectures were given successfully by the professors of the Institute of Technology upon different branches of natural science, designed to meet the want of teachers; and a similar course before the Teachers' School of Science, on physics, zoology, botany, and geology, were well illustrated by experiments and specimens, and attended by 400 teachers, the entire expense being borne by two ladies. The Lawrence Scientific School, Harvard University, teaches all the principal sciences experimentally, students being assisted also by scholarships. Many women in the normal colleges are now giving special attention to them. A branch specially recommended to be taught there is the laws of health. Of all agencies these normal schools can do most to promote the systematic training of the body. A gymnasium, the study of physiology, hygiene, and sanitation are urged as invaluable to teachers, and it is to them that we must look in some measure for the diffusion of knowledge with reference to the laws of health. A quotation from Dr. Schrodt is made, almost equal to saying that every boy when he leaves school "ought to be either a fool or a physician"! The laws of health should be made as familiar to the minds of children as the rudiments of language and numbers. We are glad to note in Prof. Hitchcock's report on college hygiene that he recommends simultaneous care of the digestive organs with relaxation of mental effort, rather than violent exercise, for students. A larger number of the training schools report laboratories, museums, &c., and the Bureau urges the usefulness of an educational museum from which it would circulate illustrations of the most improved appliances.

Passing to more specialised education, hardly any schools have increased in every way more than commercial and business colleges; there were one-fourth more establishments and scholars than in the previous year.

Kindergarten schools had more than 60 per cent. more scholars. They may well be supported if they carry out all that their programme lays down, which includes, and indeed places foremost all that ought to be the work of home, and uses the word education in its very widest sense. The training described in the normal kindergarten schools surely must wonderfully assist all the students in their future duties as mothers; and an orphan in the care of one of these schools, many of which are carried on as charities, is hardly to be pitied!

Two fewer colleges, but more property and greater teaching power, with 3000 more students, shows that the multitude of these institutions in the United States is being checked by natural selection, while greater efficiency is found among the surviving fittest. Much interchange of the inhabitants of the various States to the Universities of others takes place. There is happily hardly any local feeling in favour of attending a college in the student's native State, and there could hardly be a more unifying action upon a population like that of the United States than this of students meeting from all points to disperse again and take influential positions in all quarters.

At Harvard College the President remarks that the scientific turn of mind is comparatively rare among the young men who enter the college, a large majority of the students preferring languages, metaphysics, history, and political economy to mathematics, physics, zoology, and botany—perhaps the result of the training in the secondary schools. But studies made to a great extent elective have not led to the choice of those requiring least effort. Many more selected scientific subjects in their senior than in their junior years. At Columbia College geology was elected by every member of the class, and astronomy by all but one. About three-fifths selected chemistry, two-fifths philosophy, and one-fifth political economy. Studies are thus selected in harmony with tastes and proclivities, and pursued with interest and satisfaction. "The mental discipline incident to the study of chemistry especially entitles the science to take a place among advanced courses of study, a truth recognised by many collegiate institutions, both by giving the science increased attention in fixed courses, and also by placing it on an equality with classical and mathematical studies when the elective system has been adopted."

Well worthy of the attention of all friends of technical education in England are the numerous efforts to carry out the same desirable ends in the United States. A school of applied science has been organised at Cleveland, Ohio, for this purpose. "The course of study will

be four years in length. One half the time will be spent in a careful study of mathematics, chemistry, physics, modern languages, and the methods of scientific research, the other half in professional studies in some department of applied science, as mechanics, in which are unfolded the laws of natural forces underlying processes and existing in materials. Mathematics has given the rules of calculation; drawing, a skill of eye and hand; and shop-practice, familiarity with actual labour accurately performed." Fourteen similar institutions during the last ten or twelve years have been started, but in all of them, as may be expected in a new country like America, the great demand is for knowledge in the arts of working wood and iron; the former is taught from felling the tree to cabinet-making, and since little of such work can be done without the aid of the companion art of working metals up into tools and machinery, they are, in varying proportions, taught together in nearly all. Several schools report that the time—in some cases two afternoons a week—assigned for shop-work did not diminish the intellectual tasks required. Rather less ambitious in its aims, but excellently practical, is the Worcester County Free Institute, founded by some gentlemen of wealth for the training of boys for the duties of an active life, "broader and brighter than the popular method of learning a trade, and more simple and direct than the so-called liberal education." The education there is based on mathematics, living languages, physical sciences, and drawing, but the distinguishing feature is the method and amount of practice in a machine-shop. A manual training school also at Boston and a school for miners and mechanics of a little lower grade still at Drifton, Pa., are schools in each of which an increasing proportion of time is devoted to technical subjects, in the latter entirely free.

On the whole, nevertheless, with seven and a half million dollars bequeathed for educational purposes during 1881, our Report regretfully remarks this year that the "claims of science do not seem to be sufficiently regarded by the benefactors of learning." While these various schools of science have increased in number slightly, and teachers and pupils by about one-tenth, schools of theology, though similarly increased in number, have lost one-tenth of their pupils.

Like the higher colleges, the schools of law have fallen off in number, but they contain more pupils. The influence of their work as affecting all future legislation in the States, and therefore the importance of their pupils being grounded in the science of legislation and not learning it in offices only by the rule of thumb, is wisely urged. Here it is history which is chiefly required to underlie "technical" training. Still more must every one feel the necessity for a high moral as well as mental standard in a profession that has in these days gathered such despotic powers to itself.

Many weighty remarks, similar to those we referred to last year, on the insufficiency of the medical course of study, are to be found in this Report. The necessity of elevating the standard of medical education is universally admitted, and a general improvement to some extent is noted. It is evidently entirely in the hands of the Universities, for themselves report that, where the standard has been raised, students have by no means fallen off, but the reverse; and medical men know well that where diplomas differ in standard, the highest are well worth working for. The importance of the degree to this profession is also shown by more being taken in medicine than in anything else, and more in medicine and science together than in letters, law, and all other subjects.

On no point does England show to such disadvantage by the side of the United States as in the matter of free libraries. It is the more inexplicable because the marvellously, not to say unfairly, cheap literature there, together with the scattered habitations, would each tend to every man's house being his library; while in England the exactly reverse conditions of costly books and closely packed population must make free libraries a most convenient arrangement. Yet in the United States seventy-one additional libraries with 178,000 volumes were started in 1881, making up nearly 4000 libraries with 13,000,000 volumes. "The true aim in the administration of these libraries should be to make the books in them accessible and useful to the greatest number of readers. The time has passed when the preservation of a library was the chief end of its economy. Methods of arranging, classifying, numbering, and charging books affect materially the usefulness of any collection." It well deserves consideration what an influence for good or for evil 4000 librarians guiding the tastes of their readers to one or other class of literature may have. A further step also is being taken in many places. Librarians and the trustees of libraries generally are trying to cooperate with teachers and parents both in selecting and supplying literature for the young; the librarian and the schoolmaster together choosing a number of volumes from the main library to be circulated at the discretion of the latter among his scholars.

An interesting matter for discussion is the principle again laid down by this Report in its remarks upon the defective classes, that those deficient in natural powers, as the deaf, the blind, have as good a right to their education as those with a sound mind in a sound body; that it is a duty and not a charity to educate them effectually. The necessity of a "technical" education also, in their case, *i.e.* teaching them a trade as well as "letters" is clearly urged. This is carried also with success in some cases as far as a college education, and the late President Garfield complimented the authorities of the Deaf-mute College at Washington upon their presenting so many more capable men to the State. This is, in bare fact, true of the college's work; but, like the view taken of much benevolent work, it seems to forget that the same amount of power bestowed upon better material would have done much more for the State, and that this better material is never scarce. It is taking much safer ground to base it upon benevolence which, like the "quality of mercy," will bring a blessing also to the giver.

There are fourteen institutions for the benefit of feeble-minded youth. Our Report pleads for them that money spent on their education will be more productive than that spent on lunatics. The census of 1880 reports 76,895 idiots and 91,997 insane. Inquiry into the cause of such large numbers in a country where overcrowding ought not to be necessary, and the fact that 14 per cent of them had a weak-minded parent and 20 per cent. a weak-minded relative, raises a doubt as to the good in the long run of relaxing the natural check to the survival of the unfit. That 33 per cent. of the parents are addicted to drink is, alas, a too natural explanation to us in England. There can be no doubt that it would be not only wise State economy, but it would bring very valuable scientific evidence upon the most home-reaching of subjects "to attach to all appropriations for charitable purposes an enabling clause that institutions disbursing this charity should contribute to the commonwealth, in as precise a form as possible, statistics of the origin of the evils they affect to relieve."

Reform schools on the excellent plan of the celebrated Michigan one at Coldwater are increasing in number, and one for females also has been opened in this State at Adrian; and while the argument from benevolence is even stronger for their inmates than for the weak-minded, the economical objection is far weaker, as the morality of colonies like Botany Bay shows that moral infirmities, when not carefully cultivated in gaols and prisons, are not so deeply set. Again, while natural checks have a tendency to eradicate *weak* mental powers, they act much more slowly, if at all, in crowded cities against diseased

morality. It is therefore the more necessary to expend money and labour upon the victims of the latter, as is the special aim of the New Jersey State Reform School. The high aim of the Female Industrial School in this State is "to make it such a home that any parent having a wayward daughter may with confidence have her committed for reformation with the assurance that her surroundings will be of an elevating character." The risk of putting a premium upon vice is easily guarded against where private feeling is not allowed to rule.

The system of public instruction in Ontario (Canada) is so highly approved and has been so successful that a detailed account of its principles and organisation is given here; and the lucid, concise *résumé* of the work of other countries supplied in this United States Report would be valuable to many a reader in Europe who has not the time or the taste to go through the more lengthy documents published in his own country. W. O.

PATHOLOGICAL ANTHROPOLOGY

A NEW and important departure in anthropological studies is taken by Prof. Klebs of Zurich in a paper "On the transformations of the human race as a result mainly of pathological influences," read at the recent meeting of the Swiss Scientific Association at Freiburg, and of which we give the leading points. Hitherto pathology can scarcely be said to have been seriously considered at all in the speculations of anthropologists on the evolution of the fundamental human types. Monogenists especially, deriving all from one primeval stock, have sought an explanation of present varieties mainly in *outward* causes, such as diet, social habits, climate—in a word, the environment. Now the learned Zurich professor attempts to refer existing varieties rather to *inward* causes, without of course pretending to deny that these may themselves ultimately to a large extent depend on external conditions.

Prof. Klebs starts with the assumption that the form of the human body cannot be endowed with greater elements of persistence than other varieties of animal species, which may be modified either naturally or artificially, as, for instance, by stock-breeders. Thus, by the laws of heredity, individual characteristics may be blended together, and give rise to new forms within the several specific groups. The intermingling of races amongst civilised peoples tends in this way, not to universal uniformity, but rather to an endless multiplication of forms. But, besides heredity, these results may be brought about by other influences which make themselves felt, especially during the period of growth, and in a less degree in later years. Such are the deformities associated with certain pursuits, the typical and special characters of certain social circles, the aristocratic, agricultural, and other types, familiar examples of which are offered by the lettered, labouring, and criminal classes.

It may be concluded from this decided tendency to variation that the bodily forms, like all other phenomena of the organised world, are subject to continual modification, that they are essentially plastic, sensitive to, and perpetuating the traces of all external influences. Thus the Danish anatomist, Schmidt, finds that the numerous crania recovered from the prehistoric graves in Jutland and the neighbouring islands present the most varied anthropological types, ranging from that of the Neanderthal skull to those of foreign races, which can scarcely be supposed to have had any direct contact with the Danish aborigines.

But amongst the causes producing structural change, none, according to Prof. Klebs, are more effective than pathological affections. It is now well ascertained that the most prevalent ailments, and especially those of an infectious character, are of a parasitic nature, so that their diffusion takes the character of a struggle for existence between two organisms. Henceforth it becomes possible to study the action of these phenomena on racial and specific transformation.

But modern anthropology has approached this question only from one point. It recognises that within a given population, limited to a definite territory, typical features may be produced, such as those observed by Virchow amongst the Frisians and by Ranke amongst the Bavarians. Yet the former refuses to attribute to rachitis the flat shape of the East Frisian skull, although analogous deviations from the normal German skull are elsewhere also produced by rachitis. A whole series, however, of pathological phenomena have been determined which place in the clearest light the connection between structural change and internal affections.

Cretinism at once suggests itself, the domain and nature of which are best defined by describing it as a malady spread over the Central European highlands, and probably connected with the action of certain upland waters on the production of goître. It has been found that in Bavaria, Switzerland, and Austria these waters contain certain minute infusoria, which, when introduced into the waters of disaffected localities, produce like effects on the inhabitants.

The bodily structure of cretins, resulting from a premature arrest of the growth of bone, recalls in the most vivid manner the descriptions of dwarfs handed down by popular traditions. Hence it seems not improbable that this degeneracy may at a given point have resulted in the formation of a definite, although possibly not permanently fixed, type. A slight general influence of cretinism may still be detected in many places, as in Salzburg, and especially in Pinzgau and Pongau, where the natives present a striking contrast to those of their kindred, who have been driven by priestly intolerance to quit their homes and settle in the North German lowlands.

The opposite deformity, that is, excessive growth of structure, is also met in upland regions, where its presence recalls the legends of giants who usually dwelt in the same districts as the dwarfs. In fact the greatest irregularity in the length of the body occurs in the highlands, although mountaineers are, on the whole, of shorter stature than lowlanders. Thus the natives of Hasle, in the Bernese Oberland, and those of Elm, in the Canton of Glaris, are above the average height. This has suggested the theory of foreign immigration, a theory, however, supported only by a few local geographical terms of somewhat doubtful origin. In reality this deformity may also depend on pathological causes. At Elm a case has occurred of gigantic growth setting in at the late age of thirty-six and continuing till the death of the subject in his forty-second year. Although we may be still ignorant of the first and true cause of this disorder, the existence of analogous cases in the same locality, the unusual size of the inhabitants, and the established fact of gigantic growth in highland regions, all seem to point at some subtle relation between such pathological phenomena and the nature of the soil. They should perhaps be regarded as due to the action of organisms in the system, as has been shown to be the case with cretinism.

Another series of pathological symptoms is associated with the development of the pigments, which have hitherto been considered as a salient characteristic of races. A distinct relation has already been established between pigmentation under certain pathological conditions, such as the so-called "bronze-skin," and a morbid state of the supra-renal capsules. Since then special attention has been directed to these organs, which would appear to be the chief centre of pigmentary development. It is now found that in the dark races, as among swarthy individuals of the fair races, the medullar portion of the supra-renal capsules is always pigmented. From this remarkable coincidence it may be concluded that to the functional activity or sluggishness of these vascular

glands are due the changes so frequently occurring in the colour of the hair and of the other cutaneous organs. Here also the pathologic action passes step by step from its most aggravated forms to its lightest phases, merging at last in simple physiological functions. The dark races, notably the Negroes, have had their origin in malarious regions, whose influence generates in serious cases a deposit of pigment or melanosis, occasionally manifested under the form of black tumours. The observations made by Prof. Klebs and others in the Pontine Marshes and Roman Campagna, show that the malaria is caused by a certain bacillus developed in the soil of those districts. Hence it may in this case be admitted that pathological actions of a comparatively mild form may exercise a modifying influence on the structural development of man. They should perhaps even be regarded as the true causes of the evolution of human types.

However crude and even unsatisfactory these views, they will doubtless serve a useful purpose by directing attention to a hitherto neglected field of research. They at all events reopen the whole question of the origin of human varieties, a question which cannot be considered as closed until monogenists and polygenists have reconciled their differences. The author's theory seems so far to support the monogenist school, inasmuch as it tends to account for present diversity by natural causes, without the necessity of having recourse to several independent centres of human evolution. The weak point of the theory seems to be that these natural causes are themselves confessedly of an exceptional character. It requires us to believe that the human varieties were evolved under morbid, that is, abnormal, conditions. Before that conclusion can be accepted, it will be necessary to show that the normal conditions of climate, diet, and so forth, were inadequate for the purpose. Unless this is done, the normal will probably continue to be regarded as, *cæteris paribus*, more efficacious than the abnormal causes.

A. H. KEANE

THE GERMAN EXPEDITION TO SOUTH GEORGIA

THE following is an abstract of the report of the German Meteorological Expedition which was despatched under the international scheme to South Georgia Island, in lat. 54° S. and long. 37° W.

The Expedition, which was chosen by a Commission appointed by the German Government, consisted of the following members:—Dr. C. Schrader, chief, observer of the Hamburg Observatory; Dr. P. Vogel, sub-chief, mathematical instructor in Munich; Dr. C. von der Steinen, physician and zoologist, physician at the Charité Hospital in Berlin; Dr. H. Will, botanist, of the Forest Academy; Dr. O. Claus, mathematician; Herren E. Mosthoff, engineer, and A. Zschau, assistant; and a few sailors.

The object of the Expedition was to effect meteorological and magnetic observations, and to study the physical condition and the flora and fauna of the island, as well, as far as permissible, to observe the transit of Venus on December 6, 1882.

The Expedition arrived at Monte Video on July 4, 1882, by one of the Hamburg liners, and left that place on the 23rd on board the German man-of-war *Moltke*, after having adjusted their instruments and obtained a few domestic animals.

After twenty days' sailing the island was sighted; on August 20 the ship reached Royal Bay on the east coast. On the shore preparations were at once begun for removing the metre-deep snow, and erecting the dwelling house, 11 × 8 metres, two smaller houses for the magnetic observations, an astronomical observatory, and a small tower. A house was also built for the cattle.

All the scientific members, with the exception of those on the watch for reading the meteorological and magnetic instruments, met daily in the work-room from 9 a.m. to 12 noon, and from 2 to 6 p.m., to execute the scientific labours.

The instruments were read every hour, while the watches of the twenty-four hours were divided so that two members were on duty, the one from 3 to 9 a.m., and from 3 to 9 p.m., and the other from 9 a.m. to 3 p.m., and again from 9 p.m. to 3 a.m., and in this manner each member had two days' watch in the week. On the 1st and 15th of every month magnetic observations were effected every fifth minute, and for one hour on these days every twentieth second. But the labour was not found to be at all too heavy.

The lowest temperature registered was −14° C., and the highest on one single occasion 18° C., but the thermometer varied generally in all seasons between −5° and +7° C., so that the difference between winter and summer consisted chiefly in the length of the days. Once during the winter—in August—the phenomenon occurred of the thermometer during, with a heavy westerly gale, to 14° C. The westerly and partly south-westerly winds were, during the winter, the warmest, which was ascribed to the circumstance that these passed over mountains some 2000 metres in height protecting the station on one side, which made them "Föhn-like."

The barometer readings varied between 715 and 770 mm. The lowest readings were never attended by violent storms; these occurred always quite unexpectedly when the glass stood at "fair." The force of the storms, which generally lasted twelve to twenty-four hours, and reaching the island seven to eight times a month, was calculated by a splendid Racknagel anemometer. The tide was carefully measured by ebb and flood gauges.

Falls of rain or snow were very rare during the year, and the plateau surrounding Royal Bay was already, in August, free from snow, and became first in April, when the ground was frozen, covered with snow. It snowed, however, several times in the middle of the summer, as, for instance, at Christmas.

The most frequent winds were those from west and south-west; the northerly ones always brought fog. In the summer the weather was nearly always thick and hazy, which greatly impeded excursions. Such were, nevertheless, undertaken several times, and the highest peaks of the arms—about 700 m.—of the chain of mountains running through the island were ascended. The central mountains range from 2000 m. to 3000 m. The climbing of the slate rocks was very difficult and fatiguing, and in spite of every effort the greatest distance covered was only about a German geographical mile, and the task of exploring the island was impossible of accomplishment, as the glaciers could not be passed by the small force at disposal. The mountains fell often abruptly into the sea, and the highest tops were about 15 km. from the station. The peaks of the above-mentioned arms were free from snow in the summer, and then covered with various kinds of moss.

The only rock found was clay-slate, in some places interspersed with varieties of quartz. Even the blocks carried down by the glaciers from the central part of the island—which was not reached—were of the same nature. No metals were found, but the slate rock contained a little iron; the quantity was, however, so small that it hardly affected the needle.

No land mammalia were found on the island, and of maritime mammals only the sea-elephant (*Phoca proboscidea*) and the sea-leopard, the latter in very small numbers. They did not breed in the bay. Of birds there were several. Two kinds of penguins (König and Esel) visited the island in great numbers, making their nests there, which always faced the sun. The eggs were very delicious. During the pairing-season large quantities of *Procellaria gigantea* came to the island, whose eggs were

also very good. *Procellaria capensis*—the Cape Pigeon—was a summer visitor only, but was found in great numbers, hatching in little holes under the turf. This bird was so persecuted by a kind of gull that it only left its nest after dark. Another specimen of Procellaria also visited the island in the summer. It was named "Equinoxalis." There was only one kind of duck, and this became very scarce through shooting. The number of cormorants was very small, while the albatross (Diomedea) remained during the summer only, when it made its nest hanging from the rocks. They had magnificent brown feathers. Of the white albatross only two specimens were seen, but the white Dominican gull was common. Some few of the *Chionis alba*—the Antarctic Pigeon—which were eaten, remained during the whole year, as well as a singing-bird of the size of a lark.

The insects found were few, viz. only a species of land-beetle without wings, about one centimetre long, resembling the common German *Lauf-käfer*, and a water-beetle of the same size. A kind of red spider was caught under big stones. Of lower maritime invertebrates a good collection was made, which has, however, not yet been classified. The greatest part of this was, however, obtained when the tide was out and no boat was necessary, and the dredging was unsatisfactory.

In the summer two species of fish were caught in calm weather, varying from 5 to 20 cm. in length. But none were caught during the winter. The Expedition collected only about forty species of land and water plants, among the former of which were several varieties of the Tussack grass, two kinds of moss, two kinds of fern, and a little shrub with leaves and red blossoms. The grass was ravenously consumed by the cattle and the goats, but the sheep preferred this little shrub. Dr. Will is under the impression that he has discovered some new varieties.

The transit of Venus was seen in perfect weather, although a severe storm raged at the time. The ingress and egress were clearly observed, as well as the progress over the sun's disk, but no photographs were taken, as the Expedition was not furnished with suitable apparatus.

The island possessed, in spite of its desolateness, a beautiful Alpine nature, the tranquillity of which was only broken by the constant thunder of avalanches. The dwelling-house was comfortable, although it would have been more so if each member had had a separate room instead of its being shared with another. The provisions furnished to the Expedition left, however, much to be desired. The tinned Australian meat was tasteless, and the vegetables bad. The milk (in tins) only lasted six months, while the salt meat and fish, although good, were not sufficient. No fresh potatoes were furnished, the claret was bad, and the beer was soon consumed. The cook did wonders, however, in the way of culinary achievements. There was no case of scurvy, neither any serious case of illness. Some experiments were made during the summer to cultivate beans, peas, and potatoes, but they failed, as the shoots were destroyed by cold as soon as above the ground.

The Expedition left the island on September 5, 1883, in the German corvette *Marie*, but all the houses were left intact.

Four of the members of the Expedition returned home, but Dr. Vogel spent a couple of months in travelling in the Argentine Republic, while Messrs. Will and Claus are negotiating with the Argentine Government about taking the command of an expedition for exploring the course of the River Pilcomayo, in which the celebrated explorer Creveaux lost his life. Should their negotiations fail, these gentlemen intend to undertake a journey to the Brazilian province of Matto Grosso, and thence make an exploration of Central Bolivia (Santa Cruz de la Sierra), and eventually follow the watercourses of Mamore and Madeira into the Amazon River, and then the latter to its mouth.

ALLEN THOMSON

BORN in Edinburgh, April 2, 1809, Allen Thomson had nearly completed his seventy-fifth year when he died on the evening of Friday last, March 21. He was the son of John Thomson, a distinguished physician, who was the first occupant of the Chairs of Military Surgery and of Pathology in the University of Edinburgh, and it is remarkable that both chairs were founded on his own recommendation. Allen Thomson graduated as M.D. at the University of Edinburgh in 1830, and in 1831 he became a Fellow of the Royal College of Surgeons of Edinburgh. Soon after graduation he became an extra-mural Lecturer on Anatomy along with William Sharpey. The atmosphere of the Edinburgh school at this time was highly charged. A number of men, afterwards famous, were either students or extra-mural teachers. It is sufficient to mention the names of John Reid, John Goodsir, Martin Barry, Edward Forbes, William B. Carpenter, and John Hughes Bennett. All of these became distinguished in biological science, and amongst them in these days there was the clash of intellect and the rivalry of a noble ambition. None of these remain except Dr. Carpenter, who must feel that the death of his friend Allen Thomson is the severance of another link connecting him with what was undoubtedly a brilliant epoch in the history of the Edinburgh medical school.

Dr. Thomson filled the Chair of Anatomy in Marischal College, Aberdeen, from 1839 to 1841, when he was appointed to the Chair of Physiology in Edinburgh. He held this office for six years, when he was transplanted to the Anatomical Chair in the University of Glasgow, which he occupied till 1877. Since then he has resided in London. Of his scientific honours it is unnecessary to say more than that they came without stint; but probably the crowning honour of this kind was when he filled the Presidential Chair of the British Association at the Plymouth meeting in 1877.

Allen Thomson had a double career to a greater extent than most scientific men. He was not merely, by his own researches and by his well-known exhaustless stores of knowledge, one of the leading living authorities in the department of embryology, but he was an eminent public man, interested and influential in many matters of social and scientific politics. In Glasgow for many years he rendered the city and the University invaluable service. By his energy and tact he contributed more than probably any other man to the great work of building the new University on Gilmore Hill.

But with all his public work he was a busy man in his own department. His early work brought him reputation as an embryologist, and he kept it up by many important papers in the same department of science. In addition he wrote on physiological optics, especially on the mechanism of accommodation, and on the sensibility of the skin. His writings were not characterised so much by brilliant originality as by facility of interpretation of the writings of others, and by a running commentary of his own, showing that he had repeated the observations he was narrating with the effect of adding a few facts here and cutting out what he believed to be erroneous there. His method of thought and literary style were both severe. He was always sceptical until convinced, and he strove to get from himself and from others accuracy in detail. Hence he was inclined to be severe on new discoveries or theories, and whilst ready to listen was rather apt to quench the enthusiasm of a tyro by a douche of cold praise. But still his mind was open and receptive, and in not a few instances he changed his opinions under pressure of argument, which cannot be always asserted even of scientific men. Dr. Thomson always had a greater interest in embryological science than in any other department of biology, and none hailed with more delight the rise of the modern British school, nor

deplored more deeply the loss of its leader, F. M. Balfour. As an embryologist his fame will depend chiefly on the clear interpretation he gave to some of the descriptions of the German school, and to the application he made of these to human embryology. An adept with his pencil as with his pen, he gave expression to his views in diagrams that probably for many a day will help the bewildered reader. Thus, though his name will not be associated with any one great discovery, Dr. Thomson will be recognised as a potent force in biological science during this century. His own work, his judicious criticisms, his personal influence, his encouragement to workers, all had an important part in moulding the present state of scientific thought on biological questions.

As to the man himself, those who knew him can testify to the kindly courtesy, to the simplicity of address, to the indescribable charm of his manner, to the warmth of his friendship. He was wise in counsel and adroit in reconciling differences amongst men. To this he owed much of his social power. His finely-moulded and venerable face will be much missed, but not more so than his wise advice at the council board or to the young man who has chosen a scientific career. JOHN G. MCKENDRICK

QUINTINO SELLA

BY the death of Signor Quintino Sella, to which we briefly referred last week, Italian science loses one of her strongest supporters and most earnest students. Although some of the best years of his life were devoted to statesmanship, his early writings on mineralogy were of sufficient solidity to establish for their author a very high reputation. These mineralogical memoirs, contributed chiefly to the Royal Academy of Sciences of Turin, were distinguished by a profound knowledge of crystallography. When the Geological Survey of Italy was about to be established, Signor Sella was commissioned to visit most of the European countries where Surveys were in operation, and in 1861 he presented to Signor Cordova, then Minister of Agriculture, Industry, and Commerce, a valuable report, "Sul Modo di fare la Carta Geologica del Regno d'Italia." In collecting materials for that report he spent some time in this country, and took the warmest interest in the work of the Geological Survey. Ten years later he prepared an elaborate report on the mineral wealth of Sardinia. When the International Geological Congress was held at Bologna in 1881, Signor Seila, as one of the most representative scientific men in Italy, was selected to act as the president; and those who had the advantage of attending that meeting carried away with them the most pleasant recollections of his courtesy. Signor Sella died at Biella in Piedmont on the 14th inst.

We direct attention to the letter from Prof. Hughes in connection with a memorial to the Italian *savant*.

NOTES

AT the final meeting, on Saturday last, of the General Committee of the International Fisheries Exhibition, the balance of the funds was disposed of. The surplus amounts to over 15,000*l*., and of this 10,000*l*. were allotted to alleviate the distress of widows and orphans of sea fishermen, while 3000*l*. were voted as an endowment to a society which is to be called "The Royal Fisheries Society," whose functions will be somewhat similar to those of the Royal Agricultural Society; the remaining 2000*l*. are kept in reserve.

PROFESSORS MARTENS, Mendeléeff, and Minaieff are to attend the jubilee of Edinburgh University, as delegates from the University of St. Petersburg, and Prof. Rokhmaninoff as delegate from the University of Kieff.

THE great gold medal of the Paris Geographical Society has been awarded to the Deep-Sea Expeditions of the *Talisman* and *Travailleur*; a gold medal to M. Arthur Thouar, for his journey across the desert of the Northern Chaco in search of the remains of the Crevaux Expedition; a gold medal to M. Désiré Charnay, for his Central American explorations, and especially his researches in Yucatan.

A MEETING of the Governors of the City and Guilds of London Institute for the Advancement of Technical Education was held last week for the purpose of receiving the Annual Report of the Council. The chair was occupied by the Lord Chancellor. The Chairman, in moving the adoption of the Report, said that the Institution had arrived at a critical point of time, at a point of time at which he might remind them of the progress which things had made, but one, nevertheless, at which it became necessary that they should recognise the importance of proceeding energetically. With respect to the Central Institution, the buildings were nearly completed, and it was expected that the public opening of those buildings might take place in June of this year. It was proposed that four professors should be appointed to the Central Institution—viz. Professors of Chemistry, of Engineering, of Mechanics and Mathematics, and of Physics, the whole being superintended by a Board of Studies. There would be laboratories properly fitted up, and workshops and drawing offices, all with a view to supplying instruction which would combine the elements of those fundamental studies which underlay practical art. It was hoped that, as time went on, the number of exhibitions and scholarships, which would enable poor and meritorious students to obtain the benefits of the Institution, might increase. It was estimated that 9000*l*. a year would be available for the maintenance of the Institution, and that the fees of the students would amount to 2000*l*. That would give 11,000*l*. as an expected present income. When the grant amounted to 10,000*l*., and the students numbered from 150 to 200, paying in fees 5000*l*., the income would be 15,000*l*., and it was estimated that that amount would be required for maintaining the Institute in full working order. Passing from the Central Institution to Finsbury College, the Chairman said that the progress of that branch had been very satisfactory. During the past year it had instructed 799 persons, of whom 100 had been day students and the rest students attending the evening classes. The day students had to pass a preliminary examination in elementary mechanics, and there were six free scholars. The South London School had an attendance of 300 students. The candidates presented for examination this year were 2397, being an increase over the former year of 425, and the passes were 1498, showing an increase over the former year of 276. They came from 104 centres, showing an increase of seven centres; and they were examined, as in the former year, in thirty-seven subjects. What was still more remarkable was the rapid extension of the desire to have the benefit of these examinations, for there were now preparing for them 5862 students, being an increase over those who were under similar preparation in the former year of no less than 1814. He recognised with gratitude the liberality with which they had been supported by the City Guilds and other bodies, and he could not but think that those who had helped them so far would help them still further. Since the report had been written, the Skinners' Company had increased their subscription for the year 1884 from 500*l*. to 1000*l*., and their donation to the building fund from 2000*l*. to 3000*l*.

A CORRESPONDENT sends us the following:—"The new scheme for examinations for admission to Sandhurst which has been agreed upon (it appears) by the War Office and the Civil Service Commissioners must, if unmodified, work serious mischief to scientific education in public schools in which any pro-

portion of the pupils are looking forward to the army as a profession. This will be seen from the following scale of marks, which has been communicated to the Committee of the Head Masters' Conference :—

		Marks
Obligatory Subjects (*Three* out of the four to be taken up by every candidate)	Mathematics	3000
	Latin	3000
	French	3000
	German	3000
Optional Subjects (*One* only to be taken up)	Higher Mathematics	2000
	Greek	2000
	Chemistry	1500
	Electricity and Magnetism ...	1500
	Geology and Physical Geography	1500
	English History	1500

A glance at this table is sufficient to show that the authorities are holding out a *distinct bribe* to candidates to eschew the experimental sciences altogether ; and whatever their intention may be, the result will be the reduction of scientific knowledge among future officers of Her Majesty's army to the lowest possible minimum. This is surely a retrograde step in these late decades of the nineteenth century. Nor must it be forgotten that the application of the same scheme to examinations for admission to Woolwich is contemplated. Not only will every candidate be induced, if he can do so, to take up simply the four subjects in the first category, but, more than this, the scientific subjects (exclusive of mere mathematics) will only hereafter be taken up by those candidates whose performances in the more highly rewarded subjects are hopeless—the scientific subjects, in other words, will become simply a *refuge for mediocrity and incompetency*. Men who are spending the best years of their lives in combating the traditional prejudices which exist in this country in favour of the older studies will not only feel that they have to complain of the tardy and grudging recognition which is given to the 'new learning'—they will feel now, and justly so, that they have been betrayed by those from whom, on every ground, they ought to be able to look for more encouragement."

THE Worshipful Company of Clothworkers, who have already given 3500*l.* to the Bradford Technical School, have also promised an annual subscription of 500*l.* towards the working expenses of the school.

DR. DOBERCK writes from Hong Kong Observatory, February 17 :—" The building of the Hong Kong Observatory was begun in June 1883, but only the foundations had been laid at the end of July, when I arrived. The main building, the architectural details of which do credit to the Surveyor-General's department, was so far finished by January 1 that I could take up my residence there, and tridiurnal eye-observations were commenced. Before the middle of the month the magnetic hut was ready, and I lost no time in making a complete set of magnetic observations. I expect that it will be possible to start the self-recording apparatus by March 1. I get telegraphic weather information from the Treaty Ports, Nagasaki, Vladivostock, and Manilla, and publish weather reports, which, as you will see from one of the three newspapers which publish them (sent herewith) also indicate winds to be expected from the gradients."

THE Belgian Royal Academy proposes for public competition the subjoined subjects in the mathematical and physical sciences: —1. To resume and coordinate the researches hitherto made on the integration of linear equations of the second order with two variables, and to complete this theory, or at least advance it by further original research. 2. To establish by fresh experiments the theory of the reaction of bodies in the so-called nascent state. 3. Fresh spectroscopic researches with a view to ascertain especially whether the sun contains or not the essential constituent principles of organic compounds. 4. A complete exposition of the theory of deviations from the vertical, and verifying whether it applies to existing observations. 5. Fresh researches on the nutritive deposits in cereals, and especially on the transformations experienced by them during germination. 6. Fresh researches on the development of the Trematodes, from the histogenetic and organogenetic standpoint. 7. A study of the influence of compressed oxygen on the vital phenomena. Medals of the intrinsic value of 32*l.* and 24*l.* are offered respectively for the best papers on the first three and last four subjects. The papers must be legibly written in French, Flemish, or Latin, and forwarded prepaid to M. Liagre, Permanent Secretary, Palais des Académies, Brussels. They are to be signed by a motto, which is to be repeated in a sealed note containing the authors' names and addresses.

IN the *American Journal of Science and Arts*, vol. xxiii. 2nd series, p. 276, a letter from Rev. George Jones, U.S.N., to Prof. Silliman, written at Quito, Ecuador, December 13, 1856, describes a fall of ashes from Cotopaxi, which was thirty miles distant, in which a purple sky was noted. The paragraph in which the mention is made runs as follows :—" Yesterday morning we noticed that at the south the sky had an unusual appearance, being of a purple colour for about 90° along the horizon, and so up to about 45° in height, the edge of this being mixed up with patches of white. About 12 o'clock ashes began to fall, first in small quantities ; but by 8 o'clock the fall had got to be so considerable as to powder the clothes quickly, on our going out ; and people coming into a house would look as we do at home when coming in from a snowstorm."

THE exploring expedition, under the direction of M. Regel, the naturalist, has again left for Bokhara on its way to Chardshui, Kelif Kabadian, and Baldshuat, whence it will proceed *viâ* the Pamir plateau as far as the Kashgar frontier. M. Schwartz, the astronomer, accompanies the expedition.

PROF. OSBORNE REYNOLDS will give a discourse at the Royal Institution to-morrow (Friday, March 28) on the Two Manners of Motion of Water shown by Experiments ; and Prof. T. G. Bonney, the President of the Geological Society, will give a discourse on Friday (April 4) on the Building of the Alps.

ON Monday, at 9 p.m., a violent shock of earthquake, accompanied by a loud subterranean rumbling, was felt at Fünfkirchen, in Southern Hungary. It was also felt in Essegg and all over Slavonia. It is reported from Vierno that a shock of earthquake was felt there as well as at Karakul and in the Issyk-Kul district on the 13th inst.

AT one of the last meetings of the Russian Chemical Society, Prof. Mendeléeff made the following interesting communication with regard to solutions :—It would be easy to prove, with the data of Gerlach, Marignac, Cremers, and Schiff, that the volume of a given amount of a salt in its solutions (for instance, of a molecule) varies with the variations of temperature and the degree of concentration of the solutions. It increases as both increase ; and it might be concluded therefrom that the force on which solution depends varies with the degree of concentration. Still, another conclusion can be arrived at, if Grassy's measurements of the decrease of volumes of NaCl and $CaCl_2$ be taken into account. Interpolation shows that these solutions are reduced in volume, by pressure, as the amount of the dissolved salt varies ; and the reduction of volume which accompanies the solution enables us to calculate the corresponding pressure. It appears that to each molecule of NaCl dissolved in 100 parts of water corresponds a nearly permanent pressure of about 120 atmospheres, whatever be the degree of concentration. For $CaCl_2$ the pressure also remains constant, but is nearly three times the above. Thus, if the tendency towards solution be measured by pressure, it results, for the two salts above mentioned, that the first amounts of salt dissolved exercise the same pressure as

the last which bring the solution near to saturation. Prof. Mendeléeff points out that researches pursued in the direction just mentioned could throw some light on the internal forces which are active in solutions and other chemical compounds.

It appears from the annual report of the Russian Chemical and Physical Society that the chemical section has now 162 members; its income, including several grants, reached 5734 roubles (about 570*l.*), and its capital 13,932 roubles, of which 7894 roubles were devoted to premiums. The physical section has 103 members; its income reached 1851 roubles, and its capital 16,000 roubles.

At the annual general meeting of the Hackney Microscopical and Natural History Society held on March 19 at the Morley Hall, Hackney, a valuable microscope was presented to the honorary secretary by the members. The president, Dr. M. C. Cooke, in presenting the testimonial, made some highly eulogistic remarks upon the energy and unremitting attention given by the honorary secretary during the seven years of the existence of the Society, to which he ascribed its present flourishing condition. A silver plate bearing the following inscription was attached to the instrument:—"Presented to Collis Willmott, Esq., by members of the Hackney Microscopical and Natural History Society in appreciation of his services as Hon. Secretary, 19th March, 1884."

We have received from the Direction of Schools at Tiflis its annual report, and we are glad to recognise that education in the Caucasus—which is perhaps more independent of the Ministry of Public Instruction than other parts of Russia—is spreading more rapidly than might have been supposed. On January 1, 1883, there were no less than 1168 schools under the supervision of the Ministry, with an aggregate of 80,838 scholars, of whom 15,036 are girls. If the 60 Jewish and 1920 Mussulman schools at synagogues and mosques be added—however low the degree of education given to their 18,647 scholars—as also 31 schools of various descriptions, military, theological, and lower medical, the aggregate number of scholars would reach 102,728. There is thus (excepting the Jewish and Mussulman schools) one school for each 4880 inhabitants, surely still a very low figure; but it is a little higher in the more densely peopled Northern Caucasus (1 to 3060 in Kubau). Of the 1168 schools above mentioned there were 1055 primary schools, with 52,251 scholars, one-fifth of whom are girls; 33 higher primary schools, with 5213 scholars; 5 schools for teachers, with 500 scholars; 8 technical schools, or *Realschulen*, with 2312, and 10 lyceums, or half-lyceums, with 3555 scholars. We see with pleasure that there were also 6 lyceums and 6 half-lyceums for girls, with the high figure of 3127 scholars. The distribution of education among different nationalities is very interesting. Of the above-mentioned 80,838 scholars, 46 per cent. per cent. were Russians, 25 per cent. Armenians, 17 Georgians, and 5·2 Tartars and Circassians. With regard to the population, the proportion of Armenians receiving instruction is 1 to 41, while it is only 1 to 44 with the Russians, 1 to 75 with the Georgians, 1 to 350 with the Circassians, 1 to 851 with the Tartars, 1 to 33 with Jews, and 1 to 7 with the Western Europeans settled in the Caucasus. Even in lyceums the Armenians (1 to 858) come first after the Jews (1 to 210) and before the Russians (1 to 866), while only 1 to 11,237 Circassians, 1 to 9352 Tartars, and 1 to 1246 Georgians, enter the lyceums. The Russians like the technical schools better, and the daughters of the functionaries take the lead in the lyceums for girls. Altogether the tendency towards education is well felt in Northern Caucasus, and it is agreeable to see that in secondary schools—male and female—11 to 12 per cent of the scholars are children of peasants and Cossacks. The number of these schools is even too small, and in 1882 no less than 441 boys were refused admission to lyceums on account of want of room. One may be sure that this tendency would be still greater were it not for the want of sympathy displayed throughout Russia with the so-called classical lyceums, where a mechanical study of Latin takes the place of sound instruction in natural sciences. We must notice also a beautiful educational map of the Caucasus which accompanies the Report for 1880. Owing to a system of coloured signs of different shapes, one sees at a glance the number of schools of different description, male and female, spread throughout the Caucasus, as well as who pays for them—the State, the municipalities, the village communes, or private persons; while a number of coloured plates on the borders of the map show the tendency towards instruction in different provinces, the nationalities of the scholars, and so on.

We are informed that Mr. Robert Hunt's (the Keeper of Mining Records) large and comprehensive work on the history, discovery, practical development, and future prospects of metalliferous mines in the United Kingdom, under the title of "British Mining," will be published early next month by Messrs. Crosby Lockwood and Co.

AN IMPROVED THERMO-ELECTRIC PILE FOR MEASURING SMALL ELECTROMOTIVE FORCES[1]

THIS paper contains a description, illustrated by sketches, of a new and convenient form of thermo-electric apparatus for measuring small electromotive forces by the method of opposition, and of the method of constructing and using the apparatus.

The apparatus consists essentially of a series of about 300 pairs of horizontal, slender, parallel wires of iron and German silver, the former alone being covered with cotton. The wires are about 8 inches long, fixed side by side in close mutual contact, though insulated from each other, as a continuous flat layer about 16 inches long, in a wooden frame, and soldered end to end in single continuous series. About 1½ inch in length of the opposite ends of the wires are bent downwards to a vertical position, so as to enable them to dip into two liquids of different temperatures contained in two long, narrow troughs. The liquids employed are non-conductors; this was found to be necessary. The one for the hot junctions is melted paraffin kept at a temperature of 120° C., and the one for the cold ones is non-volatile petroleum, known by the name of "thin machinery oil." The ends of the wires are immersed about one-fourth of an inch in the liquids.

The maximum power of the instrument is of course limited by the amount of difference of temperature of the two liquids, and of the two series of ends of wires immersed in them. Any lower degree of electromotive force is obtained by attaching a copper wire to one end of the series, and sliding the free end of the other terminal wire across the middle part of the upper surface of the wires, from that end of the series towards the other; the German silver wires being bare permit metallic contact.

An apparatus as above described, consisting of 295 pairs of wires, had a resistance of 95·6 ohms at 16° C., and by a difference of 100° C. of temperature of the two baths, gave a current having an electromotive force of ·7729 volt, or with a difference of 130° C., 1·005 volt. Each element therefore equalled ·0000262 volt for each C. degree difference of temperature.

After having been verified with a standard voltaic cell, such an apparatus (or any fraction of it) may itself be employed as a standard. It is capable of producing and measuring as small a degree of electromotive force as a 34861st part of a volt. When the potential of the currents to be measured exceeded one volt, either an additional pile or a standard voltaic cell was employed with it.

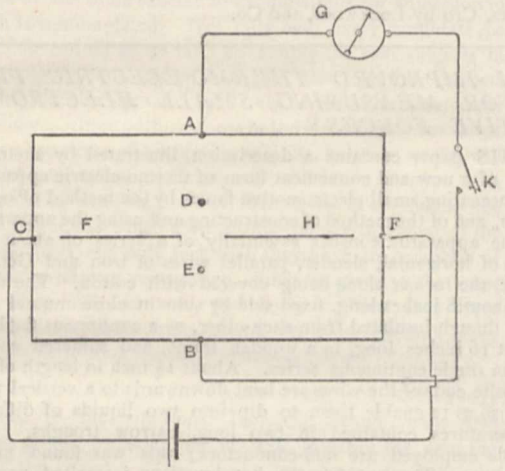
Several apparatus of this kind have been constructed, and a large number of determinations of electromotive force have been made with them. Fifteen determinations per hour have frequently been made; the rate of working, however, depends upon the steadiness of the current to be measured.

[1] Abstract of a paper read before the Birmingham Philosophical Society February 14, by Dr. G. Gore, F.R.S.

THE REVERSAL OF HALL'S PHENOMENON

IN a recent communication to the Physical Society I mentioned among other things that I had succeeded in reversing the direction of the Hall effect in iron. It was, however, found to be so exceedingly difficult to keep the two points where the galvanometer connections were made at the same potential, even for a few seconds, that the extent of the deflections due to the Hall effect could only be roughly guessed at, and the experiment was hardly a satisfactory one. I believe this inconvenience arose from the fact that the iron, being a strongly magnetic metal, was slightly displaced whenever the polarity of the electromagnet was reversed, thus shifting the points of contact with the galvanometer wires. I have since repeated the experiment with gold, which turns out to be perfectly easy to work with, and altogether more suitable for the purpose. The following is an account of four experiments:—

Experiment 1.—A piece of nearly pure gold foil 5 cm. long and 3·5 cm. broad was cemented to a plate of glass and the whole placed between the flat pole pieces of an electromagnet. The middle points, A, B (see figure) of the longer sides of the foil were connected to a galvanometer, G, and the middle points, C, F, of the shorter sides to a battery. A current was passed through the metal from left to right, and the electromagnet



excited so that a south pole was beneath the glass and a north pole above it. The galvanometer was immediately deflected, indicating a current flowing in the direction B G A. If either the polarity of the magnet or the direction of the current through the foil was reversed, the transverse current was also reversed and flowed in the direction A G B. This is the ordinary "Hall effect," and the direction of the transverse currents agrees with that mentioned by Mr. Hall for gold. The extent of the deflections varied from about 50 to 70 scale divisions on each side of zero. Similar but smaller deflections occurred when the galvanometer was connected with points nearer to the middle of the plate.

Experiment 2.—Two longitudinal slits, F, H, about ¼ mm. wide, were then cut along the middle of the foil, leaving a connection 4 mm. wide between the two halves of the sheet, and the former experiment was repeated. The following are the details; and to understand them it must be remembered that the galvanometer is affected by two causes besides the transverse current: (1) by the direct action of the electromagnet upon the galvanometer needle, though 13 feet away from it; (2) by a small permanent current due to the fact that, however carefully adjusted, A and B are never (or hardly ever) at exactly the same potential.

The image of the galvanometer wire was brought as nearly as possible to zero of the scale before beginning the experiment, and the connections were made so that a current in the direction A G B caused a deflection to the left (−), and a current in the direction B G A caused a deflection to the right (+).

Upper pole of magnet north:—

Galvanometer key, K, raised, deflection + 25 divs.[1]
,, ,, depressed, ,, +102 divs.[2]

[1] Due solely to the action of the magnet upon the galvanometer needle.
[2] Due partly to the action of the magnet on the galvanometer needle, partly to the permanent current above referred to, and partly to the transverse current resulting from magnetisation.

Upper pole of magnet south:—

Galvanometer key raised, deflection − 24 divs.
,, ,, depressed, ,, − 42 divs.

Net deflections due to current (subtracting effect of the magnet on the galvanometer needle):—

Upper pole north (102 − 25 =) +77 divs.
,, south (−42 + 24 =) −18 divs.

Sum of opposite deflections due to transverse current, (77 + 18 =) 95, or deflection on each side of zero = 47·5 divs.

The slits therefore had the effect of reducing the amount of the Hall deflections; the direction was unaffected.

Experiment 3.—The galvanometer contacts were now moved from the edges to the points D, E, about 5 mm. from the middle line, and the experiment was repeated with the following result:—

Upper pole of magnet north:—

Key raised, deflection + 18 divs.
,, depressed, ,, +165 divs.

Upper pole south:—

Key raised, deflection − 35 divs.
,, depressed, ,, +180 divs.

Net deflections due to current:—

Upper pole north (165 − 18 =) +147 divs.
,, south (180 + 35 =) +215 divs.

Sum of deflections due to transverse current (215 − 147 =) 68.
Deflection on each side of zero = 34 divs.

Thus when the galvanometer contacts were near the middle of the plate the deflections were almost as great as when the galvanometer was connected to the edges. *But they were in the opposite direction*, showing that the Hall effect was reversed.

Experiment 4.—A repetition of the last.

Upper pole north:—

Key raised, deflection + 28 divs.
,, depressed, ,, +170 divs.

Upper pole south:—

Key raised, deflection − 24 divs.
,, depressed, ,, +170 divs.

Net deflections due to current:—

Upper pole north (170 − 28 =) 132 divs.
,, south (170 + 24 =) 194 divs.

Sum of deflections due to transverse current, (194 − 132 =) 62.
Deflection on each side of zero = 31 divs.

These results, curious as they are, were of course not unexpected, the experiment having been in fact devised for the purpose of testing in an absolutely conclusive manner the sufficiency of the explanation of Hall's phenomenon by strains and Peltier effects which I have recently proposed (see NATURE, p. 467).

Supposing the magnet and the battery to be so arranged that before the slits were made the points A and D were in stretched districts, and B and E in compressed districts of the metallic sheet, then the effect of cutting the slits will be practically to divide the plate into two independent plates, each of which undergoes strains similar to those originally existing in the whole. A and B therefore will still be in regions which are respectively stretched and compressed, while on the other hand the region in which D is will now be compressed, and that in which E is will be stretched. Thus as regards the points D and E the result of making the slits is to reverse the strain, and in consequence the Peltier effects and the galvanometer deflections. If Mr. Hall's own theory were correct, the existence of the slits should make no appreciable difference of any kind. That they should have the effect of *reversing* the action of the magnet upon the current is altogether inconceivable. SHELFORD BIDWELL

DR. FEUSSNER'S NEW POLARISING PRISM

IN a recent number of the *Zeitschrift für Instrumentenkunde* (iv. 42–50, February 1884), Dr. K. Feussner of Karlsruhe has given a detailed description of a polarising prism lately devised by him, which presents several points of novelty, and for which certain advantages are claimed. The paper also contains an account, although not an exhaustive one, of the various polarising prisms which have from time to time been constructed by means of different combinations of Iceland spar. The literature of this subject is scattered and somewhat difficult of access,

and moreover only a small part of it has hitherto been translated into English; and it would appear therefore that a brief abstract of the paper may not be without service to those amongst the readers of NATURE who may be unacquainted with the original memoirs, or who may not have the necessary references at hand.

Following the order adopted by Dr. Feussner, the subject may be divided into two parts:—

I.—Older Forms of Polarising Prisms

In comparing the various forms of polarising prisms, the main points which need attention are:—the angular extent of the field of view, the direction of the emergent polarised ray, whether it is shifted to one side of or remains symmetrical to the long axis of the prism; the proportion which the length of the prism bears to its breadth; and lastly, the position of the terminal faces, whether perpendicular or inclined to the long axis. These requirements are fulfilled in different degrees by the following methods of construction.

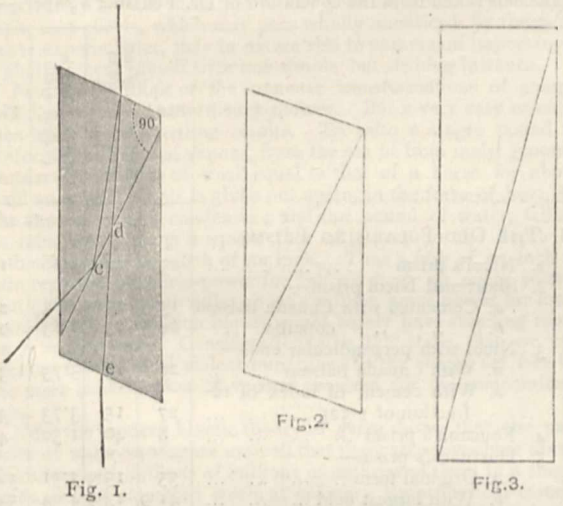


Fig. 1.

Fig.2.

Fig.3.

1. *The Nicol Prism* (*Edin. New Phil. Journal*, 1828, vi. 83).—This (Fig. 1), as is well known, is constructed from a rhombohedron of Iceland spar, the length of which must be fully three times as great as the width. The end faces are cut off in such a manner that the angle of 72° which they originally form with the lateral edge of the rhombohedron, is reduced to 68°. The prism is then cut in two in a plane perpendicular to the new end surfaces, the section being carried obliquely from one obtuse corner of the prism to the other, in the direction of its length. The surfaces of this section, after having been carefully polished, are cemented together again by means of Canada balsam. A ray of light, on entering the prism, is separated by the double refraction of the calc-spar into an ordinary and an extraordinary ray: the former undergoes total reflection at the layer of balsam at an incidence which allows the extraordinary ray to be transmitted; the latter, therefore, passes through unchanged. This principle of obtaining a single polarised ray by means of total reflection of the other is common to all the forms of prism now to be described.

Dr. Feussner gives a mathematical analysis of the paths taken by the two polarised rays within the Nicol prism, and finds that the emergent extraordinary ray can include an angular field of 29°, but that this extreme value holds good only for rays incident upon that portion of the end surface which is near to the obtuse corner, and that from thence it gradually decreases until the field includes an angle of only about half the previous amount. He finds, moreover, that, although of course the ray emerges parallel to its direction of incidence, yet that the zone of polarised light is shifted to one side of the central line. Also that the great length of the Nicol—3·28 times its breadth—is not only an inconvenience, but, owing to the large pieces of spar thus required for its construction, prisms of any but small size become very expensive. To this it may be added that there is a considerable loss of light by reflection from the first surface, owing to its inclined position in regard to the long axis of the prism.

It is with the view of obviating these defects that the modifications represented in Figs. 2 to 6 have been devised.

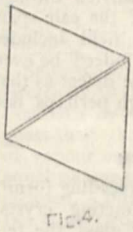


Fig.4.

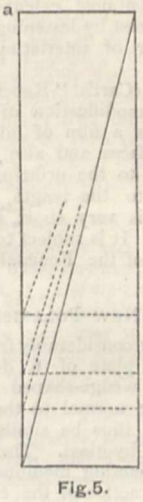


Fig.5.

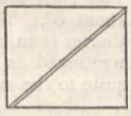


Fig.6.

2. *The Shortened Nicol Prism.*—This arrangement of the Nicol prism is constructed by Dr. Steeg and Reuter of Homburg v. d. H. For the sake of facility of manufacture, the end surfaces are cleavage planes, and the oblique cut, instead of being perpendicular, makes with these an angle of about 84°. By this alteration the prism becomes shorter, and is now only 2·83 times its breadth; but if Canada balsam is still used as the cement, the field will occupy a very unsymmetrical position in regard to the long axis. If balsam of copaiba is made use of, the index of refraction of which is 1·50, a symmetrical field of about 24° will be obtained. A prism of this kind has also been designed by Prof. B. Hasert of Eisenach (*Pogg. Ann.* cxiii. 189), but its performance appears to be inferior to the above.

3. *The Nicol Prism with Perpendicular Ends.*—The terminal surfaces in this prism are perpendicular to the long axis, and the sectional cut makes with them an angle of about 75°. The length of the prism is 3·75 times its breadth, and if the cement has an index of refraction of 1·525, the field is symmetrically disposed, and includes an angle of 27°. Prisms of this kind have been manufactured by Dr. Steeg, by Mr. C. D. Ahrens, and others.

4. *The Foucault Prism* (*Comptes Rendus*, 1857, xlv. 238).—This construction differs from all those hitherto mentioned, in that a film of air is employed between the two cut surfaces as the totally reflecting medium instead of a layer of cement. The two halves of the prism are kept in position, without touching each other, by means of the mounting. The length of the prism is in this way much reduced, and amounts to only 1·528 times its breadth. The end surfaces are cleavage planes, and the sectional cut makes with them an angle of 59°. The field, however, includes not more than about 8°, so that this prism can be used only in the case of nearly parallel rays; and in addition to this the pictures which may be seen through it are to some extent veiled and indistinct, owing to repeated internal reflection.

5. *The Hartnack Prism* (*Ann. de Ch. et de Physique*, ser. iv. vii. 181).—This form of prism was devised in 1866 by MM. Hartnack and Prazmowski; the original memoir is a valuable one; a translation of it, with some additions, has lately been published (*Journ. of the R. Microscopical Soc.*, June, 1883, 428). It is considered by Dr. Feussner to be the most perfect prism capable of being prepared from calc-spar. The ends of the prism are perpendicular to its length; the section carried through it is in a plane perpendicular to the principal axis of the crystal. The cementing medium is linseed oil, the index of refraction of which is 1·485. This form of prism is certainly not so well known in this country as it deserves to be: a very excellent one supplied to the present writer by Dr. Steeg is of rectangular form throughout, the terminal surfaces are 19 × 15 mm., and the length 41 mm. The lateral shifting of the field is scarcely perceptible, the prism is perfectly colourless and transparent, and its performance is far superior to that of the ordinary Nicol. The field of view afforded by this construction depends upon

the cementing substance used, and also upon the inclination of the sectional cut in regard to the ends of the prism; it may vary from 20° to 41°. If the utmost extent of field is not required, the prism may be shortened by lessening the angle of the section, at the expense however of interfering with the symmetrical disposition of the field.

6. *The Glan Prism* (Carl's "Repertorium," xvi. 570, and xvii. 195).—This is a modification of the Foucault, and in a similar manner includes a film of air between the sectional surfaces. The end surfaces and also the cut carried through the prism are parallel to the principal axis of the calc-spar. The ends are normal to the length, and the field includes about 8°. This prism is very short, and may indeed be even shorter than it is broad. It is subject to the same defect as that mentioned in the case of the Foucault, although perhaps not quite to the same extent.

II.—The New Polarising Prism

This prism differs very considerably from the preceding forms, and consists of a thin plate of a doubly refracting crystal cemented between two wedge-shaped pieces of glass, the terminal faces of which are normal to the length. The external form of the prism may thus be similar to the Hartnack, the calc-spar being replaced by glass. The indices of refraction of the glass and of the cementing medium should correspond with the greater index of refraction of the crystal, and the directions of greatest and least elasticity in the latter must stand in a plane perpendicular to the direction of the section. One of the advantages claimed for the new prism is that it dispenses with the large and valuable pieces of spar hitherto found necessary; a further advantage being that other crystalline substances may be used in this prism instead of calc-spar. The latter advantage, however, occurs only when the difference between the indices of refraction for the ordinary and extraordinary rays in the particular crystal made use of is greater than in calc-spar. When this is the case, the field becomes enlarged, and the length of the prism is reduced.

The substance which Dr. Feussner has employed as being most suitable for the separating crystal plate is nitrate of soda (*natronsalpeter*), in which the above-mentioned values are $\omega = 1{\cdot}587$ and $\epsilon = 1{\cdot}336$. It crystallises in similar form to calcite, and in both cases thin plates obtained by cleavage may be used.

As the cementing substance for the nitrate of soda, a mixture of gum dammar with monobromonaphthalene was used, which afforded an index of refraction of 1·58. In the case of thin plates of calcite, a solid cementing substance of sufficiently high refractive power was not available, and a fluid medium was therefore employed. For this purpose the whole prism was inclosed in a short glass tube with air-tight ends, which was filled with monobromonaphthalene. In an experimental prism a mixture of balsam of tolu was made use of, giving a cement with an index

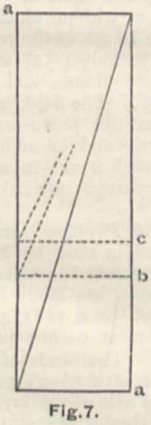


Fig.7.

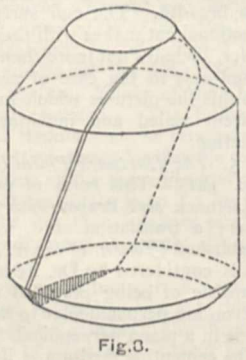


Fig.8.

of refraction of 1·62, but the low refractive power resulted in a very considerable reduction of the field. The extent and disposition of the field may be varied by altering the inclination at which the crystal lamina is inserted (Fig. 7), and thereby reducing the length of the prism, as in the case of the Hartnack.

In order to obviate the effects of reflection from the internal side surfaces of the prism, the wedge-shaped blocks of glass of which it is built up may be made much broader than would otherwise be necessary; the edges of this extra width are cut obliquely, and suitably blackened.

The accompanying diagram (Fig. 8) represents a prism of cylindrical external form constructed in this manner, the lower surface being that of the incident light. In this the field amounts to 30°, and the breadth is about double the length.

Dr. Feussner remarks that a prism similar in some respects to his new arrangement was devised in 1869 by M. Jamin (*Comptes Rendus*, lxviii. 221), who used a thin plate of calc-spar inclosed in a cell filled with bisulphide of carbon; and also by Dr. Zenker, who replaced the liquid in M. Jamin's construction by wedges of flint glass.

Amongst others, the carefully considered modifications of the Nicol prism which have recently been devised by Prof. S. P. Thompson (*Phil. Mag.*, November, 1881, 349; and *Journ. R. Micros. Soc.*, August, 1883, 575), and by Mr. R. T. Glazebrook (*Phil. Mag.*, May, 1883, 352), do not appear to have been known to Dr. Feussner.

The following tabular view of different forms of polarising prisms is taken from the conclusion of Dr. Feussner's paper:—

	Field	Inclination of section in regard to long axis	Ratio of length to clear width	Fig.
	°	°		
I. The Old Polarising Prisms				
1. Nicol's prism	29	22	3·28	1
2. Shortened Nicol prism—				
a. Cemented with Canada balsam	13	25	2·83	2
b. ,, ,, copaiba ,,	24	25	2·83	2
3. Nicol with perpendicular ends—				
a. With Canada balsam	20	15	3·73	3
b. With cement of index of refraction of 1·525	27	15	3·73	3
4. Foucault's prism	8	40	1·528	4
5. Hartnack's prism—				
a. Original form...	35	15·9	3·51	5 *ab*
b. With largest field	41·9	13·9	4·04	5 *aa*
c. With field of 30°	30	17·4	3·19	5 *ac*
d. With field of 20°	20	20·3	2·70	5 *ad*
6. Glan's prism	7·9	50·3	0·831	6
II. The New Polarising Prism				
1. With calc-spar: largest field ...	44	13·2	4·26	5 *aa*
2. ,, field of 30° ...	30	17·4	3·19	5 *ac*
3. ,, field of 20° ...	20	20·3	2·70	5 *ad*
4. With nitrate of soda: largest field	54	16·7	3·53	7 *aa*
5. ,, ,, field of 30°.	30	24	2·25	7 *ab* and 8
6. ,, ,, field of 20°.	20	27	1·96	7 *ac*

As an analysing prism of about 6 mm. clear width, and 13·5 mm. long, the new prism is stated by its inventor to be of the most essential service, and it would certainly appear that the arrangement is rather better adapted for small prisms than for those of considerable size. Any means by which a beam of polarised light of large diameter—say 3 to 3½ inches—could be obtained with all the convenience of a Nicol would be a real advance, for spar of sufficient size and purity for such a purpose has become so scarce and therefore so valuable that large prisms are difficult to procure at all. So far as an analyser is concerned, the experience of the writer of this notice would lead to the opinion that improvements are to be looked for rather in the way of the discovery of an artificial crystal which absorbs one of the polarised rays than by further modifications depending upon total reflection. The researches of Dr. Herapath on iodosulphate of quinine (*Phil. Mag.*, March, 1852, 161, and November, 1853, 346) are in this direction; but crystals of the so-called herapathite require great manipulative skill for their production. If these could be readily obtained of sufficient size, they would be invaluable as analysers.

This opinion is supported by the existence of an inconvenience which attends every form of analysing prism. It is frequently, and especially in projecting apparatus, required to be placed at

the focus of a system of lenses, so that the rays may cross in the interior of the prism. This is an unfavourable position for a prismatic analyser, and in the case of a powerful beam of light, such as that from the electric arc, the crossing of the rays within the prism is not unattended with danger to the cementing substance, and to the surfaces in contact with it.

PHILIP R. SLEEMAN

ON VARIOUS SUGGESTIONS AS TO THE SOURCE OF ATMOSPHERIC ELECTRICITY[1]

WE have seen that, taking for granted the electrification of clouds, all the ordinary phenomena of a thunderstorm (except *globe* lightning) admit of easy and direct explanation by the known laws of statical electricity. Thus far we are on comparatively sure ground.

But the case is very different when we attempt to look a little farther into the matter, and to seek the source of atmospheric electricity. One cause of the difficulty is easily seen. It is the scale on which meteorological phenomena usually occur; so enormously greater than that of any possible laboratory arrangement that effects, which may pass wholly unnoticed by the most acute experimenter, may in nature rise to paramount importance. I shall content myself with one simple but striking instance.

Few people think of the immense transformations of energy which accompany an ordinary shower. But a very easy calculation leads us to startling results. To raise a single pound of water, in the form of vapour, from the sea or from moist ground, requires an amount of work equal to that of a horse for about half an hour! This is given out again, in the form of heat, by the vapour when it condenses; and the pound of water, falling as rain, would cover a square foot of ground to the depth of rather less than one-fifth of an inch. Thus a fifth of an inch of rain represents a horse-power for half an hour on every square foot; or, on a square mile, about a million horse-power for fourteen hours! A million horses would barely have standing room on a square mile. Considerations like this show that we can account for the most violent hurricanes by the energy set free by the mere condensation of vapour required for the concomitant rain.

Now the modern kinetic theory of gases shows that the particles of water-vapour are so small that there are somewhere about three hundred millions of millions of millions of them in a single cubic inch of saturated steam at ordinary atmospheric pressure. This corresponds to 1/1600 or so of a cubic inch of water, *i.e.* to about an average raindrop. But if each of the vapour particles had been by any cause electrified to one and the same potential, and all could be made to unite, the potential of the raindrop formed from them would be fifty million million times greater.

Thus it appears that if there be any cause which would give each particle of vapour an electric potential, even if that potential were far smaller than any that can be indicated by our most delicate electrometers, the aggregation of these particles into raindrops would easily explain the charge of the most formidable thundercloud. Many years ago it occurred to me that the mere *contact* of the particles of vapour with those of air, as they interdiffuse according to the kinetic theory of gases, would suffice to produce the excessively small potential requisite. Thus the source of atmospheric electricity would be the same as that of Volta's electrification of dry metals by contact. My experiments were all made on a small scale, with ordinary laboratory apparatus. Their general object was, by various processes, to precipitate vapour from damp air, and to study either (1) the electrification produced in the body on which the vapour was precipitated; or (2) to find on which of two parallel, polished plates, oppositely electrified and artificially cooled, the more rapid deposition of moisture would take place. After many trials, some resultless, others of a more promising character, I saw that experiments on a comparatively large scale would be absolutely necessary in order that a definite answer might be obtained. I communicated my views to the Royal Society of Edinburgh in 1875, in order that some one with the requisite facilities might be induced to take up the inquiry, but I am not aware that this has been done.

I may briefly mention some of the more prominent attempts which have been made to solve this curious and important problem. Some of them are ludicrous enough, but their diversity well illustrates the nature and amount of the difficulty.

[1] By Prof. Tait. Read at the meeting of the Scottish Meteorological Society on March 17, and communicated by the Society.

The oldest notion seems to have been that the source of atmospheric electricity is aërial friction. Unfortunately for this theory, it is *not* usually in windy weather that the greatest development of electricity takes place.

In the earlier years of this century Pouillet claimed to have established by experiment that in all cases of combustion or oxidation, in the growth of plants, and in evaporation of *salt* water, electricity was invariably developed. But more recent experiments have thrown doubt on the first two conclusions, and have shown that the third is true only when the salt water is boiling, and that the electricity then produced is due to friction, not to evaporation. Thus Faraday traced the action of Armstrong's hydro-electric machine to friction of the steam against the orifice by which it escaped.

Saussure and others attributed the production of atmospheric electricity to the condensation of vapour, the reverse of one of Pouillet's hypotheses. This, however, is a much less plausible guess than that of Pouillet; for we could understand a particle of vapour carrying positive electricity with it, and leaving an equal charge of negative electricity in the water from which it escaped. But to account for the separation of the two electricities when two particles of vapour unite is a much less promising task.

Peltier (followed by Lamont) assumed that the earth itself has a permanent charge of negative electricity whose distribution varies from time to time, and from place to place. Air, according to this hypothesis, can neither hold nor conduct electricity, but a cloud can do both; and the cloud is electrified by conduction if it touch the earth, by induction if it do not. But here the difficulty is only thrown back one step. How are we to account for the earth's permanent charge?

Sir W. Thomson starts from the experimental fact that the layer of air near the ground is often found to be strongly electrified, and accounts for atmospheric electricity by the carrying up of this layer by convection currents. But this process also only shifts the difficulty.

A wild theory has in recent times been proposed by Becquerel. Corpuscles of some kind, electrified by the outbursts of glowing hydrogen, travel from the sun to the upper strata of the earth's atmosphere.

Mühry traces the source of electricity to a direct effect of solar radiation falling on the earth's surface.

Lüddens has recently attributed it to the friction of aqueous vapour against dry air. Some still more recent assumptions attribute it to capillary surface-tension of water, to the production of hail, &c.

Blake, Kalischer, &c., have lately endeavoured to show by experiment that it is not due to evaporation, or to condensation of water. Their experiments, however, have all been made on too small a scale to insure certain results. What I have just said about the extraordinary number of vapour particles in a single raindrop, shows that the whole charge in a few cubic feet of moist air may altogether escape detection.

And so the matter will probably stand, until means are found of making these delicate experiments in the only way in which success is likely to be obtained, viz. on a scale far larger than is at the command of any ordinary private purse. It is a question of real importance, not only for pure science but for the people, and ought to be thoroughly sifted by means which only a wealthy nation can provide.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The General Board of Studies propose to appoint, early in Easter Term, a number of Readers and University Lecturers, including the following: a Reader in Comparative Philology, stipend 300*l.* per annum; a Reader in Botany, stipend 100*l.*; University Lecturers in Sanskrit, in Comparative Philology, in Mathematics (one in each group of the Tripos, Part 3), in Applied Mechanics, in Botany, in Animal Morphology, in Advanced Physiology (three), in Geology, in History (five), and in Moral Science; all at 50*l.*, except in Animal Morphology and in Geology, to which 100*l.* is assigned. The University Lecturers will for the most part be chosen from such College Lecturers as open their lectures to the University generally; but the Board is not necessarily restricted to such; nor to persons who may apply. Candidates are to send in their names and testimonials (if any) to the Vice-Chancellor not later than April 25. It is understood that two lectures a week during

term time shall be the minimum during two terms for each lecturer receiving 50*l.* per annum. As far as possible the University Lecturers are to give special personal attention to their pupils, so as to obviate as much as possible the necessity of private tuition in the subject of the lectures; and the students' fees are to be understood as payment for this personal supervision.

The Special Board for Biology and Geology have published a report showing urgent need for a Senior Demonstrator in Elementary Biology and Animal Morphology at 200*l.* a year; the classes have grown enormously, consequent on recent changes in the M.B. examinations. They recommend that the Lecturers, by whose aid Mr. Sedgwick carries on the work of the late Prof. Balfour, shall be appointed University Lecturers, Dr. Hans Gadow in the Advanced Morphology of Vertebrates, and Mr. W. F. R. Weldon in that of Invertebrates. Moreover, they consider an Assistant Demonstrator as well as other occasional demonstrators are required.

Prof. Hughes has written a letter on the subject of the proposed Sedgwick Museum, suggesting that educational utility rather than architectural display should be the principal aim in the building, and pleading strongly against possible curtailment of the site available for the new museum to satisfy demands of other departments. The area now proposed, 240 feet by 50 feet, with room behind for future extension by annexes, &c., is not too large. If sufficient space can be secured for future extension, it is best to place the museum entirely on one floor; but if this is not certain, it would be desirable to have two long rooms one above another, each 20 feet high.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science* for January, 1884, contains:—Notes on Echinoderm morphology, No. vii.: on the apical system of the Ophiurids, by P. Herbert Carpenter, M.A. (plate 1).—On the homologies of the primary larval plates in the test of Brachiate Echinoderms, by W. Percy Sladen (plate 1).—On the origin of metameric segmentation and some other morphological questions, by Adam Sedgwick, M.A. (plates 2 and 3).—On certain abnormalities in the common frog (*Rana temporaria*): (1) the occurrence of an ovotestis; (2) abnormalities of the vertebral column, by A. Gibbs Bourne, B.Sc. (plate 4).—Researches on the intracellular digestion of Invertebrates, by Dr. E. Metschnikoff (translated from *Arbeiten Zool. Instit. Wien*, 1883.—On the ancestral history of the inflammatory process, by Dr. E. Metschnikoff.—The structures connected with the ovarian ovum of Marsupialia and Monotremata, by Edward B. Poulton, M.A. (plate 5).—On the skeletotrophic tissues and coxal glands of Limulus, Scorpio, and Mygale, by Prof. E. Ray Lankester, M.A. (plates 6 to 11).

THE *Journal of Physiology*, vol. iv., No. 6, February, 1884, contains:—On the electrical phenomena of the excitatory process in the heart of the frog and of the tortoise as investigated photographically, by Dr. J. Burdon-Sanderson and F. J. M. Page (plates 13 to 20).—Experiments on the ears of fishes with reference to the function of equilibrium, by Dr. Henry Sewall.—On the influence of certain drugs on the period of diminished excitability, by Dr. S. Ringer and Dr. H. Sainsbury (plate 21).—On the action of digitalis, by Dr. J. Blake.—On the coagulation of the blood, by L. C. Wooldridge, D.Sc.—An investigation regarding the action of rubidium and cæsium salts compared with the action of potassium salts on the ventricle of the frog's heart, by Dr. S. Ringer (plate 22).—Some notes on the fibrin ferment, by S. Lea, M.A., and J. R. Green, B.Sc.

THE *Journal of the Royal Microscopical Society*, February, 1884, contains:—On the constituents of sewage in the mud of the Thames, by Lionel S. Beale, F.R.S. (plates 1 to 4).—On the modes of vision with objectives of wide aperture, by Prof. E. Abbe (figures); and the usual summary of current researches relating to zoology and botany.

Morphologisches Jahrbuch, Bd. ix., Heft 11, contains:—On the comparative anatomy of the excretory sexual organs of insects, by J. A. Palmen.—Contributions to the comparative anatomy of fishes, No. i.; on the cranium of *Amia calva*, L., by Dr. M. Sagemehl (plate 10).—A contribution to a knowledge of the pseudobranchiæ in osseous fishes, by Dr. F. Maurer (plates 11 and 12).—On the morphology of the mammalian teat, by Hermann Klaatsch (plates 13 to 17).

Archives Italiennes de Biologie, tome iv., fasc. 11, December 15, 1883, contains:—New researches on the alterations in organs in diabetes, by Dr. P. Ferraro.—New researches on the normal and pathological anatomy of the human placenta and of that of mammals, being the substance of three letters to Prof. Albert Kölliker, by Dr. G. B. Ercolani.—On the ciliary muscle in reptiles, by Dr. Ferruccio Mercanti.—On the reproduction of epithelium of the anterior crystalline capsule in adult animals under normal and pathological conditions, by Dr. F. Falchi.—On some dangers from fly's excrement, by Dr. B. Grassi.—On the course and termination of the optic nerve in the retina of a crocodile (*Champsa lucius*), by Dr. A. Tafani (with a plate).—On the development of the vertebral column in osseous fishes, by Dr. B. Grassi.—Notice of the death and writings of Dr. P. Burresi, and of the death of Prof. G. B. Ercolani of Bologna.

Rivista Scientifico-Industriale, Florence, January 15.—A description, with illustration, of the seismoscopic clock invented by Brassart Brothers, by E. Brassart.—On the harmonic sounds produced by a fluid discharged through a tube, by Tito Martini.—Variations in the electric resistance of solid and pure metallic wires under varying temperatures; Part i., Historic survey of the works hitherto issued on the influence of temperature on the conductibility and electric resistance of solid and pure metals, by Prof. Angelo Emo.—Account of the semi-incandescent electric lamp invented by Tihon.—A practical application of Newton's rings in motion, by Prof. Augusto Righi.—On the periodical migrations of the *Myosus glis*, Gml., by S. Mina-Palumbo.—On the nest of the *Geophilus flavus*, by Prof. F. Fanzago.—On the mollusks at present inhabiting the province of Porto-Maurizio, Maritime Alps, by G. R. Sulliotti.

Rendiconti del Reale Istituto Lombardo, February 7.—Obituary notice of Prof. Emilio Cornalia (concluded), by Prof. Leopoldo Maggi.—A short description of the crystals of barium found at Vernasca, by Dr. F. Sansoni.—On the importance of certain symptoms in the diagnosis of sciatica and other affections of the hip, by Dr. G. Fiorani.—Whether women should be permitted to follow the legal profession, by Prof. E. Vidari.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 13.—"Notes on the Microscopic Structure of some Rocks from the Andes of Ecuador, collected by Edward Whymper. No. II. Antisana." By Prof. T. G. Bonney, D.Sc., F.R.S.

The specimens examined consisted of one series gathered by Mr. Whymper and another obtained by him from a collector. The latter came from the south-west or west side of the mountain, at elevations probably not exceeding 13,000 feet. Among them are pitchstones and augite-andesites, in which a little hypersthene possibly occurs. Mr. Whymper's own collection contains specimens of the great lava stream on the west side of Antisana, taken at about 12,340 feet above the sea. It is an augite andesite. The remainder represents the rocks forming the upper part of the mountain, collected from a moraine about 16,000 feet above the sea, supplied by occasional crags, which crop out through the snow and are mostly inaccessible. These are a series of augite-andesites, in some of which hypersthene is certainly present.

Linnean Society, March 20.—H. T. Stainton, F.R.S., vice-president, in the chair.—The Rev. Canon Jas. Baker, Mr. W. Brockbank, Mr. Robert Mason, and Mr. Ed. A. Heath were elected Fellows of the Society.—Mr. J. G. Baker showed and made remarks on a supposed hybrid between the Oxlip (*Primula elatior*) and the Cowslip (*P. veris*).—In illustration of his paper, a contribution to the knowledge of the genus *Anaphe*, Walker, Lord Walsingham exhibited a large and remarkable nest containing a packed mass of cocoons, also specimens of the insects and of the larvæ of a species of Congregating Moth of this genus from Natal; and he likewise showed a live example of a dipterous parasite which had emerged from the moth's eggs when hatched. He further stated that the nest and contents had been forwarded to him by Col. Bowker of Durban, and the larvæ were found alive on its receipt in England in August last. Many of the larvæ remained in the nest, but others in companies of twenty to forty occasionally marched out, moving in closely serried rank, much after the manner of the larvæ of the Procession Moth (*Cnethocampa*). From December to February about 250 moths emerged, but, from the difficulty of obtaining their natural food, all died, though a pair bred and the eggs hatched.

The mature insect closely resembles the *Anaphe panda*, Boisd., though under the latter name, it would seem, there are several well-marked local races. The genus is found in West Africa as well as Natal; and it appears that in the several species the colour, size, shape, and material of the common nest, as well as the individual silky cocoons, markedly differ. The habits of these moths when still more fully known in their native haunts will yet form a most interesting chapter to the traveller. Of *Anaphe* four species have hitherto been described, viz. *A. venata* from Old Calabar, *A. ambigua* from Angola, and *A. reticulata* and *A. panda* from Natal. To these Lord Walsingham adds *A. carteri* from the Gold Coast, and *A. infracta* from the Cameroons.—A paper, on the hairs occurring on the stamens of plants, by Mr. Greenwood Pim, was read. As to the morphology of these he sums up the groups thus: (1) simple unicellular, subulate, smooth, *Malva*, *Campanula*; (2) unicellular, subulate, rugose or papillar, *Cuphea*, *Nerium*, *Eutoca*; (3) unicellular, flattened, spathulate, rugose or striate, *Verbascum*, *Celsia*, *Antirrhinum*; (4) pluricellular, simple, smooth, *Salvia*, *Adhatoda*; (5) pluricellular, simple, rugose or striate, *Anagallis*, *Thunbergia*; (6) pluricellular and branched, *Browallia* and some forms of *Salvia*; (7) pluricellular with glandular tip, *Oxalis*, *Gesnera*; (8) multicellular, *Convolvulus*, *Ipomœa*.—A communication was read, "Closure of the Cyclostomatous Bryozoa," by Arthur W. Waters. While admitting that the group possesses few characters available for purposes of scientific determination, he nevertheless points out that the ovicells have a greater importance than that hitherto accorded them; also that the connecting pores are comparable with the rosette plates of the Chilostomata, and that stress must be laid on the size of the zooecial tube, and more particularly to the position and variation of its closure. The author states that in the Cyclostomata (simplest Bryozoa) he has found a calcareous partition closing the tubular zooecium, thus protecting the colony; whereas in the Chilostomata there is a horny operculum, which, unlike the other, is not a sign of death, but, being movable, protects the living polypide, and through it the colony.—A paper was read on the life-history of *Æcidium bellidis*, by Mr. C. B. Plowright, in which he gives the results of a series of experiments, noting the infection and appearance of the Uredo. He differs in opinion from most authorities, who regard the *Æcidium* of the daisy as a variety of *Æ. compositarum*, while he demonstrates it to be a true heterœcismal Uredine.—The last communication read was by Mr. F. Kitton, on some Diatomaceæ from the Island of Socotra, in which a number of new species are described and figured.

Geological Society, March 5.—Prof. T. G. Bonney, F.R.S., president, in the chair.—F. N. Maude, John Potts, and Corbet Woodall were elected Fellows, and Dr. Charles Barrois, of Lille, a Foreign Correspondent of the Society.—The following communications were read:—On the structure and formation of coal, by E. Wethered, F.G.S., F.C.S. The conclusions on the evidence elicited from the author's investigations were (1) that some coals were practically made up of spores, others were not, these variations often occurring in the beds of the same seam; (2) the so-called bituminous coals were largely made up of the substance which the author termed hydrocarbon, to which wood-tissue undoubtedly contributed. An appendix to the paper, written by Prof. Harker, Professor of Botany and Geology at the Royal Agricultural College, Cirencester, dealt with the determination of the spores seen in Mr. Wethered's microscopic sections. The writer concluded that the forms in the coal were from a group of plants having affinities with the modern genus *Isoëtes*, and from this Isoëtoid character he suggests the generic title of *Isoëtoides* pending further investigation.—On strain in connection with crystallisation and the development of perlitic structure, by Frank Rutley, F.G.S.—Sketches of South-African geology; No. 1, a sketch of the high-level coal-field of South Africa, by W. H. Penning, F.G.S. In this paper the author gave a sketch of the high-level coal-field of the Transvaal and the neighbouring region. This coal-field was described as extending 400 miles from north to south, with an average breadth of 140 miles, so that its area is about 56,000 square miles. The tract consists of an elevated plateau forming the "High Veldts" of the Transvaal and the plains of the Orange Free State. It slopes away to the north-west, and is scarped to the south and east by the heights known as the Stormberg and Drakensberg Mountains; nearly all the principal rivers of South Africa take their rise in this tract of land. The coal-bearing beds forming the plateau rest unconformably in the north upon deposits probably of Upper Palæozoic age, described as the Megaliesberg beds. In the south-west the Lower Karoo beds underlie the coal-beds, also unconformably. The beds of the high grounds consist above of sandstones, called the "High Veldt beds" by the author, and below of shales, for which the name of "Kimberley beds" is proposed, after the chief town of Griqualand West, in which district they form nearly the whole surface. These two series are conformable, and generally lie horizontally. In the shales coal occurs only in minute patches; the seams of coal are interstratified with the sandstones, into which the shales pass up gradually, and which sometimes include thick-bedded grits and conglomerates. Both shales and sandstones contain interstratifications and numerous dykes of trap, which have rarely produced much alteration in the sedimentary beds, from which the author concludes that the eruptions were sub-aqueous and contemporaneous, or nearly so. Owing to the persistent horizontality of the rocks, the mountains and valleys are merely carved out of the plateau, so that the thickness of the deposits is easily measured. The author gave 2300 feet as the minimum thickness of each series. By a comparative section it was shown that the coal-bearing sandstones ("High Veldt beds") are the "Upper Karoo" of Stow, and the "Stormberg beds" of Dunn. The "Kimberley beds" are the Upper Karoo beds of Dunn. In the latter part of his paper the author noticed briefly the different localities where coal has been found, namely, Newcastle, Lange's Nek, the Lebelelasberg Mountains, near New Scotland, several places on the High Veldt, Wemburg, Brandfoote, Cornet Spruit, Burgersdorf, and Indwe, twenty miles east of Dordrecht. The most northerly point of the Transvaal where coal has been found is on the Letsebo River. West of the Drakensberg coal occurs at a lower level.

Entomological Society, March 5.—Special General Meeting.—Mr. J. W. Dunning, president, in the chair.—Prof. J. O. Westwood, hon. life president, proposed, and Mr. H. T. Stainton seconded, a proposition "That it is desirable to obtain for the Society a Royal Charter of Incorporation." After a short discussion, the resolution was carried *nem. con.*

Ordinary Meeting.—Prof. Westwood, hon. life president, in the chair.—Two new members were elected.—Mr. E. A. Fitch exhibited a large geodephagous larva said to have been coughed up at Maldon by a young man who was suffering from bronchitis.—Mr. J. W. Dunning protested against the irregular manner in which the names of persons had lately been used in entomological nomenclature; and Mr. H. J. Elwes expressed his disapproval of the use of Hindoo mythological, and other names not of Latin or Greek derivation, in the same manner.—Mr. E. Saunders read the concluding part of his synopsis of the British *Hymenoptera Aculeata*, part iii. *Apidæ*; and also, further notes on the terminal segments of aculeate *Hymenoptera*.

EDINBURGH

Mathematical Society, March 14.—A. J. G. Barclay, vice-president, in the chair.—Mr. W. J. Macdonald gave an account of Pascal's "Essais pour les Coniques."—Mr. R. E. Allardice read a paper on the geometry of the spherical surface; and Prof. Chrystal gave an additional proof of one of his theorems.—Mr. Thomas Muir, F.R.S.E., contributed a note on the condensation of a special continuant.

Royal Physical Society, March 19.—Mr. B. W. Peach, F.R.S.E., F.G.S., president, in the chair.—The following communications were read:—Notes on a second collection of birds and eggs from Central Uruguay (with exhibition of specimens), by Mr. J. J. Dalgleish.—On a revised list of British *Ophiuroidea*, by W. E. Hoyle, M.A., F.R.S.E., of the *Challenger* Expedition Office.—On the Breadalbane Mines, by Messrs. J. S. Grant Wilson and H. M. Cadell, B.Sc., of H.M. Geological Survey of Scotland (communicated by permission of the Director-General of the Geological Survey). These mines are situated in the basin of the Tay, and the highest—those of Tyndrum—were first noticed. The galena veins were partly in a fissure traversing the quartzites in close proximity to a large fault which the authors had observed for the first time at Tyndrum. Another vein existed in the fault fissure itself or in the mica schists which were brought down by it against the quartzites. A difference in inclination brought the two fissures together, and at a certain depth they found a conjoint vein. Below the line of junction the ore almost disappeared, as had been proved by the old workings, and very little ore was visible in the portion of the conjoint vein exposed on the surface. The veins were of quartz with spathic iron and barytes,

and were never more than four feet in thickness. The ore was distributed in broad rudely parallel diagonal bands, and the veins resembled in this as in other particulars those of the Upper Harz belonging to von Groddeck's "Type Clausthal." Lead ore was discovered at Tyndrum in 1741, and was mined with varying activity till 1862, when the mines were abandoned, as they had quite ceased to pay expenses. Chrome iron ore was known to occur in considerable quantity in a mass of serpentine at Coirie Charnaig in Glen Lochaig, but had never been extensively worked. An interesting occurrence of grey and yellow copper ore was found at Tomnadashan on the southern shore of Loch Tay. The ore was disseminated through a mass of crystalline rock resembling diorite, which had been injected into the schists, hardening and contorting them at its edges. The basic rock was in turn traversed by multitudes of veins of pink granitite, which at some places united and formed a stock-like mass with large pink orthoclase crystals. The ore was found most abundantly at the junction of the two rocks. Molybden glance occurred in the acid rock, but no traces of blende or galena had been discovered at Tomnadashan. At Corrai Bui near Ardeonaig rich argentiferous galena veins traversed the schists on the top of a hill which was capped by a series of calcareous beds. The galena contained from 85 to 600 ounces of silver per ton of ore, but the veins thinned out on passing down into the non-calcareous beds below, and became quite barren at a depth of 100 feet. There were many other very thin veins of pyrites, blende, galena, &c., in the Breadalbane district, but none were thick enough to be worked with profit.—Prof. Cossar Ewart, F.R.S.E., exhibited, with remarks, the following specimens:—(1) the Tadpole fish (*Raniceps trifurens*); (2) the Great Fork-beard (*Phycis blenniodes*); (3) the Power Cod (*Gadus minutus*); (4) an Albino specimen of the Haddock (*Gadus æglefinus*).—Prof. Ewart also exhibited and described a new hatching-box he had devised for adhesive eggs to take the place of the American "Clark" hatching-box. The advantage of Prof. Ewart's box is that the glasses are arranged in a horizontal position, so that the embryos, when hatched, pass at once into comparatively still water, instead of having to run over and under a varying number of vertical glass plates.—Prof. Ewart also described an easy method of stocking spawning beds capable of being readily used by the fishermen themselves. All that was required was an ordinary wooden tub and a shallow galvanised iron tray about twenty inches in diameter, with the bottom consisting of two portions each hinged to a central bar so as to open downwards. The object in view is to deposit stones on the spawning bed coated with fertilised ova. To do this the tray is placed in the tub, which is then filled with sea-water. Into the tray a number of flat stones are arranged; the water is then fertilised and the stones coated with eggs. This done, the tray is lowered to the bottom by means of four cords—two attached to the rim of the tray, and one to each half of the bottom. When the tray has reached the sea-floor, the cords attached to the false bottom are set free, and the tray raised by the cords attached to its edge, the result being that the egg-coated stones are left at the bottom. By this method the fishermen, without any trouble or expense, could add 200 or 300 eggs for every herring they removed from the sea, and thus do their best to restore the balance of nature which their operations had disturbed.

PARIS

Academy of Sciences, March 17.—M. Rolland in the chair.—On the new map of Tunis to the scale of 1 : 200,000, now being prepared in the French War Office, and the first six sheets of which have just appeared, by M. F. Perrier. The map, which will be completed early next year, will comprise twenty sheets altogether, uniform with that of Algeria, of which it forms a natural continuation.—Relative rapidity of combustion of explosive gaseous mixtures, by MM. Berthelot and Vieille.—On the solution of a very extended class of equations in quaternions, by M. Sylvester.—Notice of the labours of the late M. Sella, Corresponding Member of the Section of Mineralogy, by M. Daubrée.—Notice of the second volume of the Emperor of Brazil's "Records of the Rio de Janeiro Observatory," by M. Faye.—Remarks on a note by Sir Richard Owen on the discovery of a mammal (Tritylodon) in the South African Trias, by M. Albert Gaudry.—Application of the incandescent lamp for the lighting of astronomical instruments, by M. G. Towne.—Remarks on the shadows cast by the faculæ on the penumbra of the solar spots (one illustration), by M. E. L. Trouvelot.—On some arithmetical applications of the theory of elliptical functions, by M. Stieltjes.—On a new generalisation of the Abelian functions, by M. E. Picard.—On the thrust of a mass of sand with horizontal upper surface against a vertical or inclined wall, by M. J. Boussinesq.—Theory and practical formulas of magneto-electric machines with alternate currents, by M. Félix Lucas.—Note on Hall's electro-magnetic phenomenon, by M. A. Leduc.—On the laws regulating the decomposition of salts in water, by M. H. Le Chatelier.—Note on the action of chloruretted aldehydes on benzine in the presence of chloride of aluminium, by M. Alph. Combes.—On the addition of chloride of iodine to monobromuretted ethylene, by M. Louis Henry.—Note on the dialysis of the acid of the gastric juice, by M. Ch. Richet.—Distribution of the motor roots in the animal muscular system, by MM. Forgue and Lannegrâce.—Memoir on the relations between plants and the nitrogen consumed by them, by M. W. O. Atwater.—Note on the cultivation of the sedimentary matter brought up from great depths by the dredgings of the *Travailleur* and *Talisman* during the expeditions of 1882-83, by M. A. Certes. The object of these experiments is to show that the absence of plants or animals in decomposition at the bottom of the sea is probably due to the presence of microbes analogous to those which, under our eyes, are daily working at the transformation of organic into inorganic matter.—On the renal organs of the embryos of Helix, by M. P. de Meuron.—On spermatogenesis and the phenomena of fecundation in *Ascaris megalocephala*, by M. P. Hallez.—On the Simœdosaurian, a reptile belonging to the Cernay formation of the Rheims district, by M. Victor Lemoine.—On the morphological value of the cortical libero-lignose masses in the stems of the Calycantheæ, by M. Oct. Lignier.

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